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Do not mistake the future

An avalanche of new products (mostly all-ceramic), some of which are out of touch with everyday lab practice and the economic situation, have recently flooded the market.
Meanwhile, Shofu have launched a new porcelain for PFM techniques. It is aesthetic, easy to use and compatible with almost all alloys. It's enough to give technicians - and patients - their smile back.

Shofu have maintained their responsible approach, avoiding over the top marketing and providing high quality products, which reflect the real needs of technicians. This is one way to say '*Yes*' to technological advancements (Shofu has had zirconium, alumina and pressed ceramics porcelains for years), and '*No*' to technological one-upmanship, which is a far call from the real ceramics market.

This is also a great opportunity for technicians to take stock of the real needs of their practitioners and the future of their labs.
In short, to avoid 'mistaking the future'.

So let us take a look at this beautiful product, which revisits certain basic principles of dental porcelain.

Vintage MP: compatible with all alloys!

To a certain extent, Vintage MP porcelain reinvents the approach to PFM, by considerably refining the quality of the opaquers and reworking translucence and light refraction in the dentine.

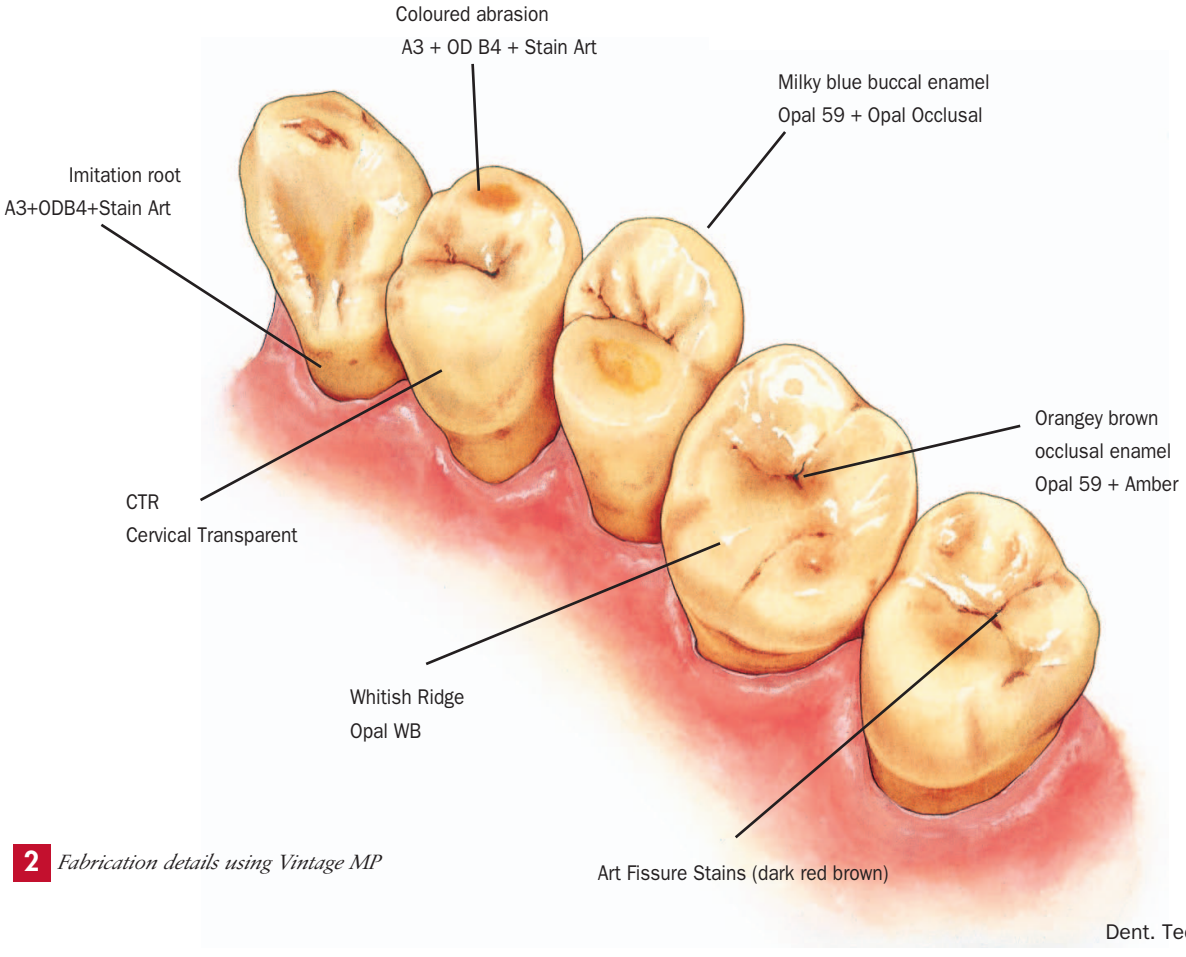
The use of a first layer of BA (Base) Paste, with exceptional masking properties and a warm tone close to a matt gold, resolves oxydation problems in depth, gives perfect shade stability and an incomparable mechanical bonding strength to the opaques (paste and powder).
Vitrified and coloured pigments and a reinforced anti-greening effect ensure the excellent masking properties of these opaquers, and guarantee the final result.

The dentine is the result of a new manufacturing procedure and an innovative porcelain composition; it has a wide CTE (13.6-15.2 x 10-6 K-1, compatible with all precious, semi-precious and non-precious alloys).
It has the same refraction index as natural dentine, stopping light penetration to a large extent in this area, and making the contour of the subjacent metal framework virtually invisible.
A real compromise between all-ceramic and PFM - interesting, don't you think?
But let us continue...

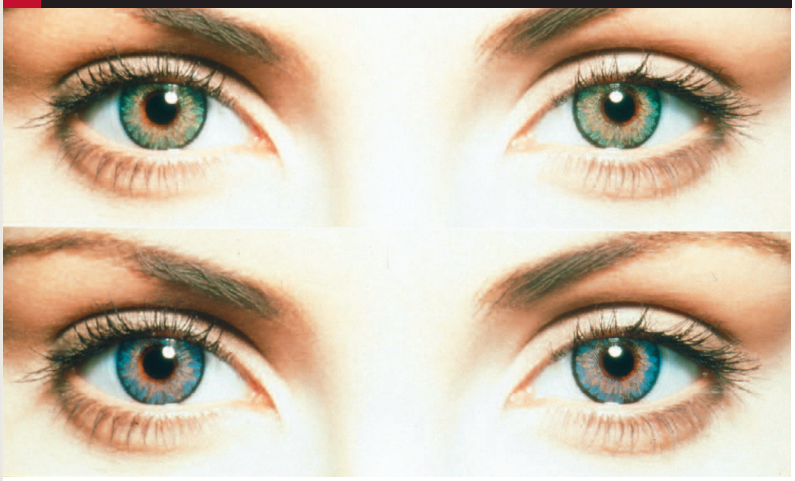
> « It has the same refraction index as natural dentine... making the metal framework virtually invisible »

1 *Vintage MP Ceramic kit*

> « Vitrified and coloured pigments ensure the excellent masking properties of these opaquers »



2 *Fabrication details using Vintage MP*



3 *Beauty...*

4 *... in a painting...*

5 *...in the sky...*

6 *... and sometimes in the hands of a ceramist: 15 and 16 are zirconium restorations*

Seeking beauty

For most people, life is a chain of constraints and boredom, made bearable by moments of beauty (fig. 3).

Beauty seems to be a reflection of something we know little about - a butterfly, a summer sky, a beautiful smile, a glance...
These are promises of happiness that give life its warmth and charm.

Beauty walks across the earth, is fixed for an instant in a painting by Jean Monnet (fig. 4), soars up across the sky (fig. 5), and can even come into the hands of a dental technician, who is juggling with light and colour to bring off a restoration (fig. 6).

For me, this is a dental technician's first source of satisfaction; dealing with beauty is an everyday occurence in our line of work.

Not only must we understand and recreate it, but we also offer it to other people. To rehabilitate a smile succesfully is to make someone else happy.

The interplay of shape, matter and light is our profession, and can even help others to overcome longstanding complexes and problems.

We call our beauty *aesthetics*.
If you think about it, few trades require such craft and workmanship, offering the satisfaction of every action backed by tradition, experience and patience, in order to create the finished result.

In this article I would like to look at how, despite time and profitability constraints, or even because of them, we can maintain our work satisfaction due to a mixture of knowledge, comprehension and beauty.

7 *Photo of a cross-section of a natural tooth*

Back to the source

Our craft is to reproduce the tooth, and nothing but the natural tooth, not to recreate inadapted morphologies or off-by-heart schemas for porcelain build-up.
There is nothing to invent, the beauty of the model is enough in itself, all we have to do is simply observe and reproduce.
Teeth have a binary structure; dentine (ivory) and enamel. All the rest is a play of light and colour. If we look at the cross-section of a natural tooth (figs. 7 and 8), starting at the core and moving to the outer edges, what do we learn?

- The shapes in the dentine are sharp, angular, prominent, smooth... but never rounded, regardless of the patient's age and the wear on the tooth.
- The shade of the dentine is generally recorded at the cervical third of the tooth (fig. 8, note 1). But we can also see that there is another shade of dentine that comes from the pulpal chamber, and which colours the incisal edge (fig. 8, note 2). This signifies that a single shade reference - say A3 - given by the dentist, is incomplete.
- Dentine has a lamellar structure like enamel, though it is much more dense and refracts very little light.
- Between the dentine and the enamel there is a luminous halo (fig. 8, note 3). Almost like a void of matter that liberates and diffuses an intense light, capable of rendering the enamel iridescent from the inside, as we can see.

Anterior teeth have a devilishly thin incisal edge in dentine, which you have to be able to reproduce, or risk losing a lot of the vitality of your restoration.
Despite the presence of lobes and mamelons, the labial surface is smooth and flat, which indicates that the cut backs for these should be slight and almost imperceptible; the play of light will do the rest.

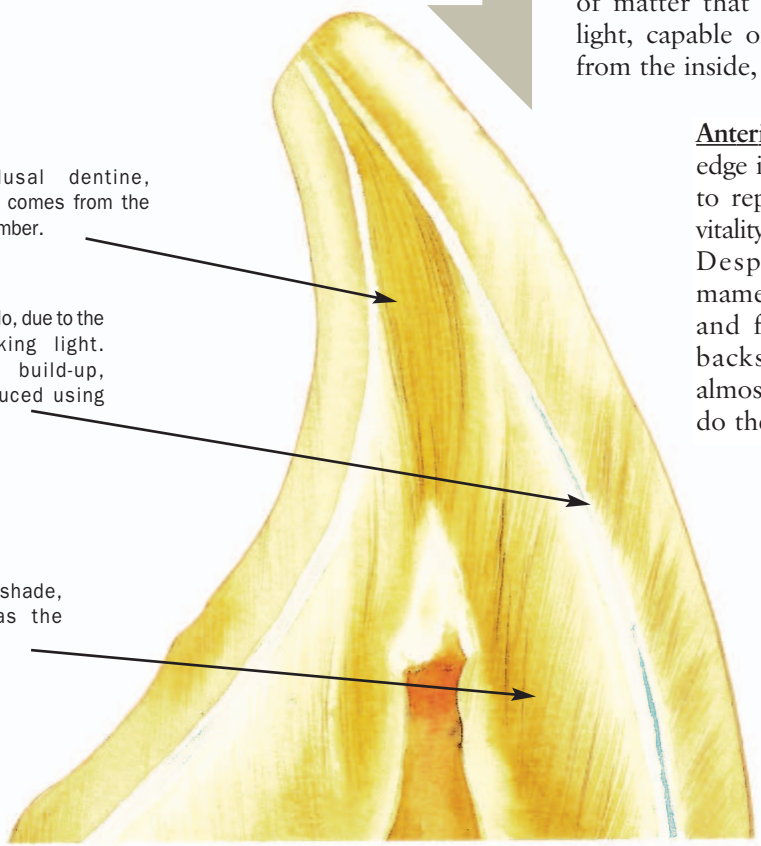
> « We call our beauty *aesthetics*. Few trades offer such an opportunity. »

> « *reproduce the tooth, and nothing but the natural tooth* »

(2) Occlusal dentine, the shade comes from the pulpal chamber.

(3) Luminous halo, due to the dentine blocking light. In ceramic build-up, this is reproduced using transparents.

(1) Labial dentine shade, generally taken as the reference shade.



8 *Cross-section of a natural tooth - watercolour*

9 *Photo of a cross-sectioned posterior*

- The tooth is made up of dentine and enamel; this 'void of matter' is just external light that has penetrated the enamel to refract against the dentine (which is more dense and opaque). This is an effect in natural teeth, but does not naturally occur in porcelain, as the level and angles of refraction are different.

  To create this effect, ceramists had the idea of using transparents, sandwiched between the dentine and the enamel.

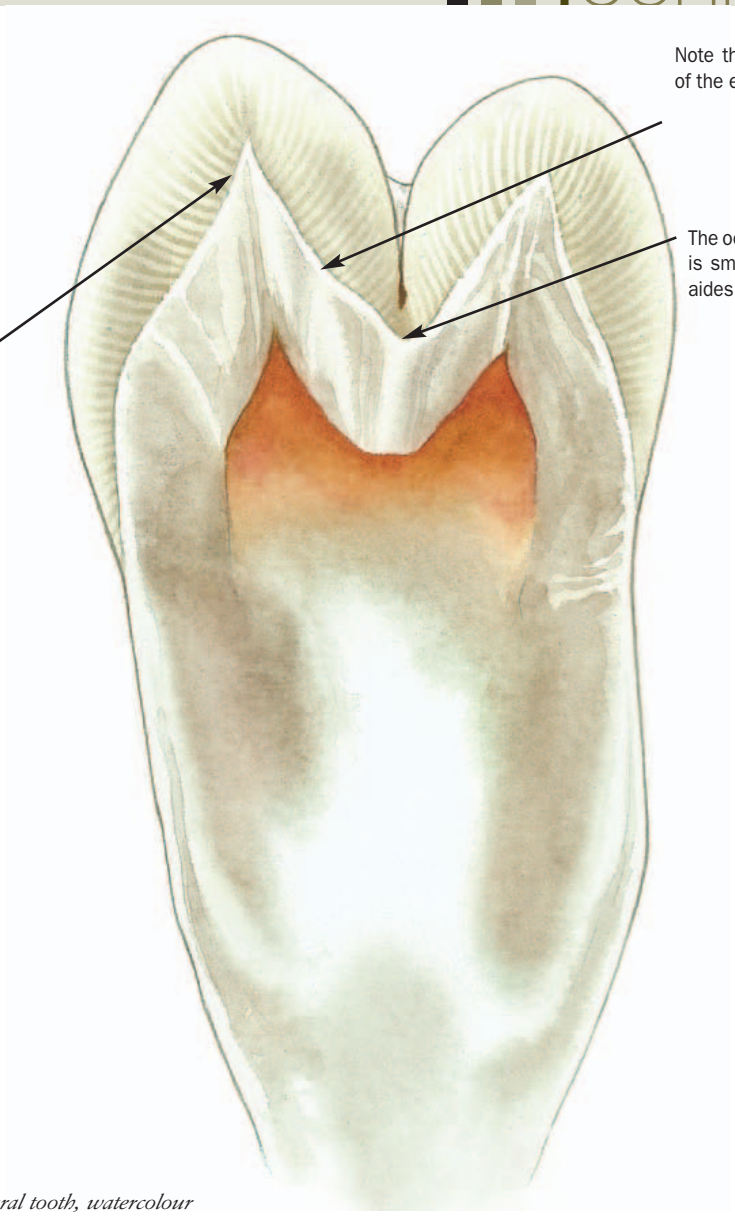
- If we observe the cross-section of a natural tooth, we can see that it does not react in the same way at the root of the tooth as it does at the edge (fig. 9, note 1). At the cervical, the entering light remains mostly on the surface, whilst closer to the incisal edge, the retransmitted light intensifies.

It is essential to take the time to understand this process:

- To determine the role of each layer during shade taking, and therefore select the appropriate porcerlain powder.
- To undersand the 'story' of a tooth (its history and background).
- To create a good contrast between dentine and enamel - a guarantee of the vitality of your porcelain.

<u>Posteriors</u>: this photo of a cross-section of a natural tooth (fig. 9), reproduced in watercolour (fig. 10), clearly reveals:

- A considerable bulk of dentine at the neck of the tooth, which leaves little space for the enamel, and explains why there is often a notable difference in shade between the inferior and superior parts of the tooth.
- The tips of the dentine are small and pointed (fig. 10, note 1).
- Above all, note the clear, smooth, angular occlusal anatomy, there are no fissures or other technician's fabrications (to sculpt and mark fissures in the dentine is a morphological error).



10 *Cross-section of a natural tooth, watercolour*

1) Determining the role of each layer:

Dentine gives shade and the level of saturation. Shofu got it right when they developed Shade Eyes, a spectro-colourmetre, which, rather than taking the shade at various places on the tooth, concentrates on determining the unique shade of the dentine with all its components:

- The colour (group A, B, C, D)
- The level of colour saturation (A1, A2, A3, A3.5, A4 etc.)
- The value - that is to say, brightness, or the capacity that an object has to absorb or refract light.
- Red shift - or how to control the influence of the gingiva, fluorescence and opalescence, which are determined by age, wear on teeth and enamel thickness, and which influence the 'pearl effect' - the systematic greying of teeth, caused by light thrown back from the buccal cavity.

Remember that dentine is the key to a succesful build-up.

Transparent serves to highlight and reveal the shape of the dentine, but also to make light refracted from the dentine circulate in the interior of the tooth. If the shape of the dentine is scrupulously respected, a layer of transparent allows for the reproduction of the exact organisation of a natural tooth. Transparent allows for the slight modification of the tone of a shade.

Example: To obtain a more yellow A3 shade, colouring the dentine could create a very localised stain, whilst colouring the enamel will give you an excess of yellow on the surface. Instead, it can be a good idea to use a yellow translucid, which will gently diffuse a yellow tone throughout the tooth due to the internal circulation of light.

« Enamel either reveals or masks the shade given by the dentine and the transparent. »

Enamel serves to reveal or to mask the shade given by the dentine and the transparent.
A young tooth, where the enamel is still thick, white and milky, will mask more (as enamel grows transparent over time).
In this case, it is clear that the shape and shade of the dentine are not very distinct, as they are suffocated by a considerable layer of enamel.
On the other hand, in an old tooth, enamel has grown transparent, it has thinned and the surface aspect is polished - all factors for revealing the shape and shade of the dentine.

You may ask why I have taken the time to go over the position and function of each layer in natural teeth?
Because - contrary to what we were taught, i.e. that a build up is the super-positioning of porcelain powders - a porcelain build up is essentially about respecting the internal structure of a natural tooth - in other words reproducing the unique 'story' of a given tooth.

An added difficulty is that this story is unique at a given time, but natural teeth continue to evolve. The pulpal chamber is mortified over time and the dentine takes its place in a centripedal movement, giving saturated shades at the core of the tooth. In addition, external effects mark the tooth; for example tobacco, cracks and loose teeth all affect the shade and the overall aspect of a tooth.
The enamel also changes by thinning, external polishing and increased translucence. So many variants of a story, so many possible varieties of an A3 shade...

A succesful porcelain is one where the choice and placement of the powders allows light to give the same effects as in a natural tooth.
This association of shape-matter-light is the key to success.

« A build-up is essentially about respecting the internal structure of a natural tooth; reproducing the unique story of a given tooth. »

2) Understanding a story

I use the term 'to understand a story', because for me it reflects the reality of our work as ceramists. What does this unique tooth have to tell me, what do the dentine, the transparent and the enamel have to say for themselves, and how can I reproduce this with cut backs and my choice of powders?
What worries me most is not a shade error, but rather delivering a 'stupid tooth' to the dentist - and therefore the patient.

A stupid tooth is, for example, a ceramic with a translucent incisal edge, whilst the original tooth is old, and all occlusal translucence has worn away due to abrasion.

It is basically a ceramic that is built up using the same old schema, the same cut backs, etc, regardless of the age, texture and shade of the original tooth.

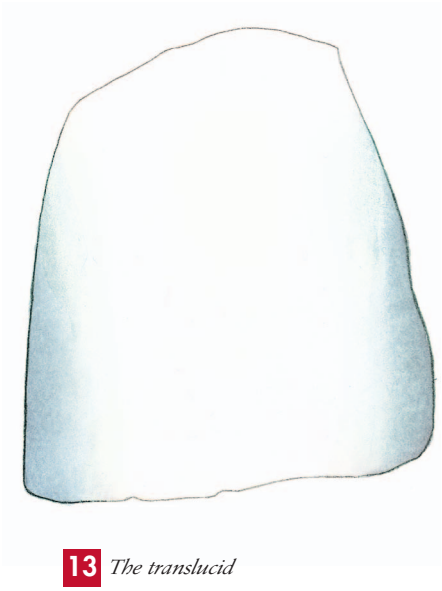
A story…

11 *Very old centrals, finished case. Guess which one...*

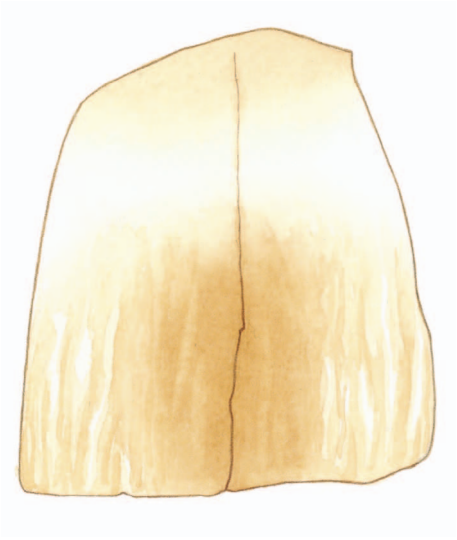
Here is a very old central (figs. 11 to 15) with advanced wear, intense internal and external colouring, and which has a bluish grey translucid covered by a whitish enamel that is polished (lustred even), and which reveals the internal morphology and shade.

In order to identically reproduce this tooth, I needed to determine the role of each layer as closely as possible.

12 *The lobes*



13 *The translucid*



14 *The incisals*

Dentine build up

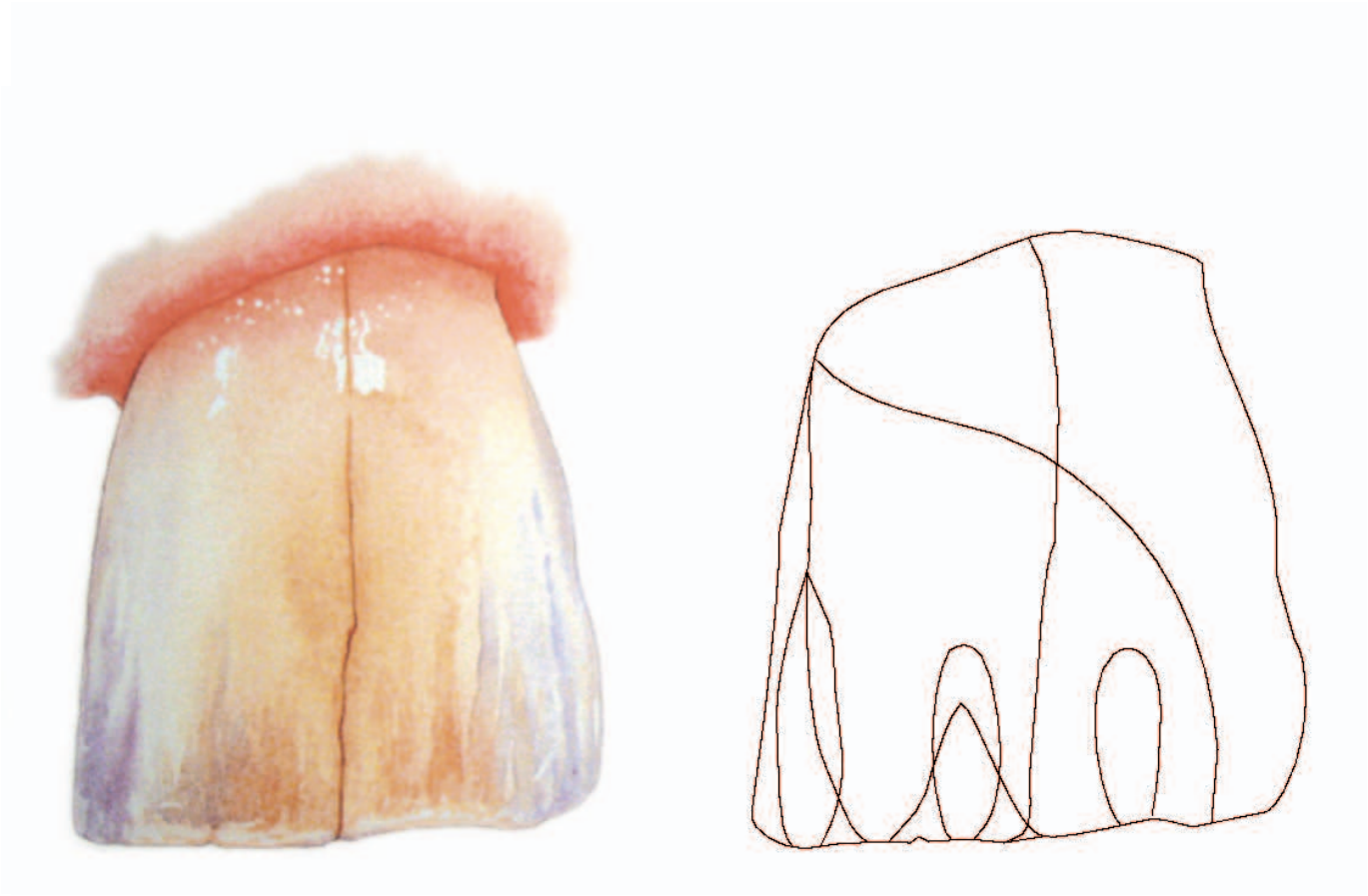
In this specific case, the dentine can be divided into three parts:

- The cervical third, which, due to its proximity with the gingiva, generates pink reflections, which will be absorbed by the gingiva itself once the enamel build up is done.

- The median third which gives the real tooth shade. This is the zone that dentists and technicians use as a reference when shade taking. Shofu has reworked its dentine texture, which tended to be too dense, all pervading and heavy for very saturated teeth (A4, C4).

  The new generation of MP Dentine, which is lighter and more transparent, offers perfect shade stability even after several firings.

- The occlusal third is directly influenced by the internal shade of the pulpal chamber, as well as being influenced by external colourations due to wear on the incisal edge.
  For the build up, I deliberately condense this part mechanically, in order to prepare a dentine that gives very clean cut backs and to make the dentine mass more reactive to light refraction.



15 *Watercolour of the finished tooth*

Transparent and enamel build up

- The dentine is covered by an addition of blue transparent (BT) on the mesial and distal, as well as a fine layer of non-opalescent transparent (TGlass, which is likely to leave the grey light generated in the mouth by the 'pearl effect').
- To materialise the start of the crown in relation to the root, and to give depth to the dentine shade, I place a layer of cervical transparent from the required shade group (CTA, CTB, etc.).
  Note that this material has an extremely fine granularity, and was designed by Shofu to encourage the adherence of the gingiva to the porcelain.
- The central part of the tooth is covered with a thin layer of desaturated enamel, obtained by mixing 50% Opal 60 with transparent TGlass. I oversize this slightly.
- The proximal zones of bluish translucence and the transition lines are covered by a milkier enamel (OC/Opal WE). The central occlusal part, where the wear on the dentine generates internal coloration, will be highlighted by the additon of a coloured enamel such as Opal Amber (AM).

As you can see, analysing the role of each layer during shade taking facilitates the preparation and choice of appropriate powders, and therefore the build up.

The surface aspect of the porcelain still needs to be determined; the plaster model can help with this. Obviously digital photos are an ideal source of information (when they are good quality, which is not always the case).

For this aged tooth - and this is certainly not a general thing - I use a fine pumice to polish the ceramic to the desired level of abrasion, and then alter the shine with an in-house mix of white chalk powder and ordinary polishing paste such as Dialux.

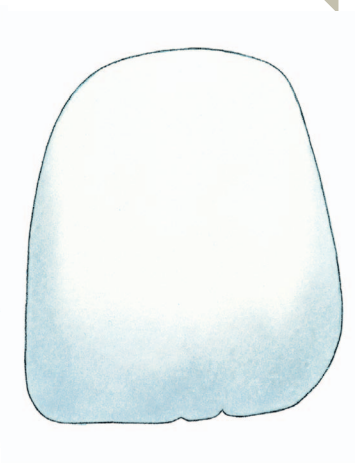
16 *A young tooth with a transparent incisal edge; finished case*

Another Story…

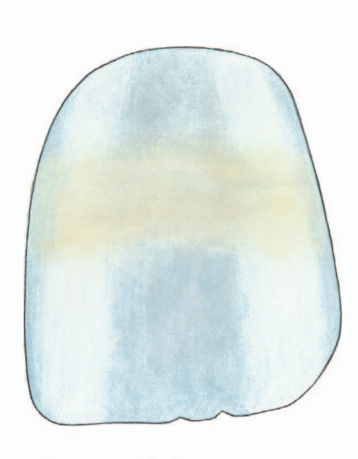
Situation in the mouth:

- Fig. 16: a photo of the finished case, this was a young tooth with a transparent incisal edge.
- Fig. 17: a watercolour showing the precise work on shape and the intense brightness of the lobes.
- Fig. 18: an opalescent translucence that reveals the forms of the dentine, and encourages light circulation in the tooth.
- Fig. 19: Watercolour of Opal Occlusal or WE which regulates translucence.
- Fig. 20: Watercolour of the finished tooth. As you can see, the succesful reproduction of a shade depends on the correct positioning and correct choice of powders.

17 *The lobes*



18 *The translucid*

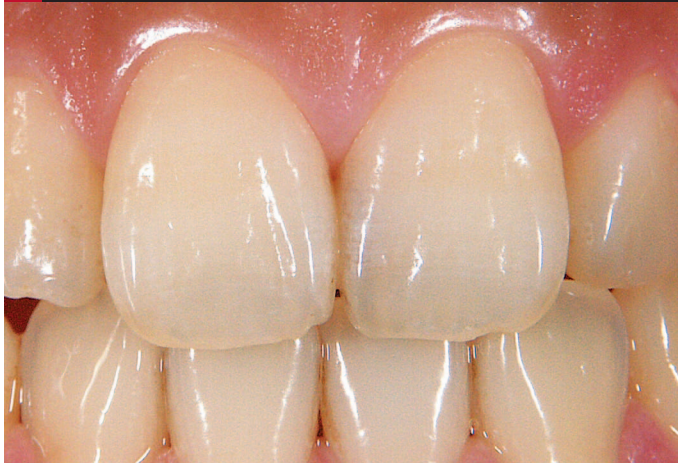


19 *The incisals*

20 *Finished tooth*

So many other stories…

21 *11 & 21 PFM MP*



22 *11 & 21 all-ceramic Shofu ZR*

3) Create a real contrast

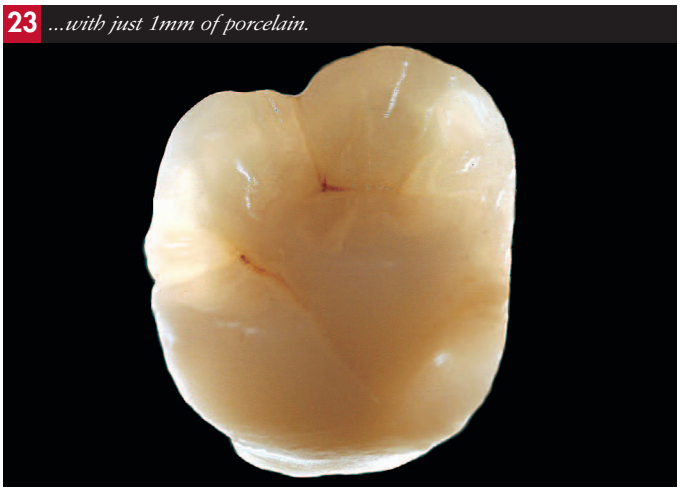
In this article I have tried to demonstrate the fundamental role played by dentine, and in particular the importance of cut backs. Why?

In order to reproduce a tooth's story and to create natural light diffusion in the tooth, as we have seen. But above all, by refining my work on dentine, I create a remarkable contrast between a smooth, compact dentine, and the enamel; this blocks the light at the dentine rather than at the opaquer.

For PFMs, this masks the shadow, opacity and design of the metal framework, changing everything.
Light circulates normally, the opaquer, which must be matt, simply plays the role of a deep colour source, whilst the dentine and enamel do the rest.
Shofu have got it right this time. They have reworked their opaquers, giving them added stability and exact shades, and above all exceptional masking capacities, even at mininmal thickness (0.1mm), as well as raising the refraction coefficient of the dentine.

Example :
Figs. 23 and 24 show a PFM fabricated using Vintage MP, which gives the impression of a fairly thick build up; in reality I had 1mm at the most in which to do my build up.


23 *Note the translucense...*


23 *...with just 1mm of porcelain.*

« Vintage MP porcelain imitates the structure of a natural tooth... it fits with the times! »

Conclusion

So what is new about Vintage MP Porcelain? Without doubt its beauty, its simplicity and its technical innovation, but above all its imitation of natural tooth structure. It is a porcelain to fit with the times!

Of course, zirconia is present on the market, and perhaps it will become commonplace in the future, but for now, it represents only a small part of production in developed countries. Lab profitability is still largely dependant on PFM production.

What an excellent compromise, to be able to mask the subjacent metal opacity and reproduce light diffusion in the tooth with MP Dentine.

We are submerged by technology, and yet everything indicates that we should go back to a certain simplicity, humility - this is a time for labs to combine quality, modernity and profitability. Perhaps what is really new for labs is the economic situation, which forces us to work faster on more elaborate cases.

Competition is fierce, and we have to adapt the way we work. We might as well do it using efficient products and with fresh enthusiasm.

This is an excellent opportunity to revisit the 'wonders of the natural tooth' and rework techniques and ideas whilst looking to a bright future.
Beauty is never far away in our line of work.

So... back to the future! ◆

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Watercolours: D. Olivier / Philippot