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INTERVIEW &
PHOTOGRAPHY
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TELL US ABOUT YOUR HISTORY. WHERE DID YOU GRADUATE FROM AND HOW DID YOU END UP AT THE UNIVERSITY OF SOUTHERN CALIFORNIA?

I believe I was attracted to ceramics very early on because I remember telling my parents that my dream was to make pottery ... so I did end up pretty close with dental porcelain. Of course, my brother Michel (the best dental ceramist in the world!) played a major role in my choice to study dentistry; and so did my own dentist, who impressed me so much with all his endodontic instruments and tools — so tiny and detailed, I was in awe.

Interestingly enough, endodontics is really not my cup of tea today. I embarked on my dental journey in 1986 at age 20, graduated from Geneva Dental School three years later. Little did I know that my career would be in academia. I was recruited immediately as a full-time faculty member, and Prof. Urs Belser, Chair of Fixed Prosthodontics and Occlusion, became my clinical mentor and still is today.



I have to admit that I was not impressed by the way we restored teeth in those days —not until I started to work with my brother and started to “see the light” through bonded porcelain restoration or BPRs. Simultaneously, Prof. Belser guided me in deciding to build my Academic credentials by starting research. This led me to Minnesota for two years (1997-1999) with Prof. William Douglas, who became my research mentor in biomaterials and biomechanics. Two years after getting my PhD back in Geneva, I was contacted by Dean Harold Slavkin who proposed that I visit USC and explore the possibility of being recruited. My wife and I prayed for this new opportunity, our conditions were fulfilled and we decided to take the leap of faith.

YOUR TEXTBOOK, “BONDED PORCELAIN RESTORATIONS,” IS ONE OF THE BIBLES OF ANTERIOR COSMETIC DENTISTRY. DESCRIBE THE EFFORT IT TOOK TO CREATE THE BOOK, AND WHY YOU WANTED TO BRING THIS TO THE MARKET.

You understand from the previous answer that BPRs struck me as a light bulb (it was in 1992), because of the possibility to combine the

DR. PASCAL MAGNE

DENTISTRY'S RENAISSANCE MAN

RESTORING NATURE WITH TECHNOLOGY, EXPERIENCE AND COMMON SENSE WHILE FULFILLING HIS DREAM THROUGH CREATIVE DENTISTRY

extremely beautiful and refined art of dental porcelain with the conservative approach allowed by adhesive composite resins. It was like an almost perfect synergy! Nobody had taught me this. Suddenly, we felt like this existing technique called porcelain laminate veneers was only the tip of the iceberg. It was only a very limited application of principles that were to be extended to new territories such as severely worn, broken down, fractured or eroded teeth. In other words, going from a purely cosmetic elective treatment to a socio-economic alternative to post and crowns!

Today, I have no other words other than “biomimetic approach” to describe the possibilities that were “hidden” from us by traditional retention and resistance form principles. I can comfortably say, more than 20 years later, that the concept is robust and keeps growing and developing with revolutionary concepts such as the bilaminar approach (lingual and labial veneers), ultrathin occlusal veneers, the additive luting technique, the deep margin elevation technique, etc.

The biomimetic movement gave birth to different think tanks (such as the famous Bio-Emulation group in Europe), and even an Academy in the United States (ABD or Academy of Biomimetic Dentistry), which proves the general interest in these techniques. What also greatly encourages me is to see the enthusiasm of the young graduates who embark on careers of independent practitioners while adopting the biomimetic concept successfully. It is important that this type of dentistry is teachable, practicable and economically viable. I believe that the test of time has proven it but there are still plenty of doubters, perhaps even more in the United States and in academia, and still lot of work to make sure that minimally invasive techniques are taught globally and recognized by social insurance.

WHAT IS YOUR EXPERIENCE WITH IN-OFFICE CAD/CAM?

It is interesting how CAD/CAM came into the picture during those same years when the “biomimetic” lightning struck me. We were involved in Geneva in teaching the first CEREC course in French in 1991. The limitations were huge, but the phenomenon had started and could not be stopped. My relationship to CAD/CAM went cold because

of those limitations, but my enthusiasm came back when graphic interfaces and milling technology became truly 3-D.

It stepped up even more when we started milling composite resins in 2002 with the Paradigm MZ100 block. Today, we all know that CAD/CAM is more than a restorative tool, it is a diagnostic tool, a prognosis tool, etc. Above all, it is a fantastic platform for the biomimetic approach and a supreme research tool,



First French-speaking CEREC 1 class taught by Dr. Magne in 1991 at the University of Geneva.

because restoration design and quality can be highly standardized. Finally, it is a necessary tool in the VDP (Virtual Dental Patient), a concept that has been so cherished by my mentors in Minnesota (Drs. Ralph DeLong and William Douglas) since the 1980s. It is interesting that I now find myself teaching in a place like USC, where Jean-Francois Duret was developing the first CAD/CAM restorations 30 years ago.

THERE ARE NUMEROUS MATERIALS AVAILABLE FOR CLINICIANS TO MILL CHAIRSIDE WITH A CAD/CAM SYSTEM. DO YOU FEEL THE IDEAL MATERIAL EXISTS TODAY? WHAT DO YOU FEEL ARE THE CHARACTERISTICS OF THE IDEAL MILLED RESTORATION?

Well, let me tell you that the ideal material is the natural tooth: enamel and dentin. This brings me to something very new that we did and something that may be a game changer in the CAD/CAM world.

In a recently published work¹, we have been able to produce a “natural” restoration from a wisdom tooth extracted from a donor. The trick was to position the natural crown ideally to avoid any occlusal adjustments of the natural occlusal surface while having a perfect fit with the preparation. This could be achieved only with a CAD/CAM system. This breakthrough opens the door for other full biomimetic solutions, including implants, etc. Ironically, while

IN WHAT SITUATIONS DO YOU FEEL THAT PORCELAIN IS THE INDICATED MATERIAL OF CHOICE? IN WHAT SITUATIONS WOULD YOU NEVER USE ALL CERAMIC? WHAT ARE THE ADVANTAGES OF RESIN OVER PORCELAIN, IF ANY? WHERE DO YOU FEEL THAT A RESIN RESTORATION IS CONTRAINDICATED?

I believe that the decision to use ceramics or composite resins should not only be based on the properties and performances of those materials, but also their location in the arch and the antagonistic teeth.

For posterior teeth, our research (in-vitro fatigue resistance) is clearly pointing at high-performance polymers (HPP) and lithium disilicate materials as the winners. I am particularly impressed with blocks made of composite resin that I like to call HPP because, unlike hand-made restorations that are full of interlayer gaps and porosities, the block can be manufactured under much better conditions using, for instance, heat and pressure. The mechanical properties are potentially improved, which gives them a stunning combination of flexibility (main property of dentin) and friendly wear-resistance (property of enamel).

Polymers also have many practical advantages compared to ceramics like speed of mill (no post-mill firing), millability in thin layers, much reduced wear of milling burs and less risk of fracture during pre-cementation functional occlusal tapping.² Finally, resins have this chameleon effect (they blend very

naturally over dental tissues).

The price we “pay” for all of this is the progressive loss of shape and surface texture, which does not happen when using ceramics, of course. Ceramics also have this wonderful surface finish (if handled appropriately) that facilitates hygiene and maintenance.

millions of dollars are spent on research on stem cells to produce a “biomimetic tooth in a Petri dish,” countless wisdom teeth are extracted and removed each day. Teeth that could be recycled and used to produce 100 percent biomimetic restorations. An irony ... What if God gave us third molars as a “spare wheel?” Do not throw them out please.



There are no situations where I would “never” use ceramics since the clinical performance of HPP and ceramics is very similar. I would tend to use my common sense and use ceramics in the presence of an existing ceramic occlusal coverage on the antagonistic tooth, for best matching wear. In the anterior dentition, there is no doubt that porcelain is the ideal material for indirect bonded veneer restorations (I would never used indirect composite resin veneers).

DO YOU FEEL THERE ARE ADVANTAGES TO A RESIN BLOCK THAT IS MILLED TO FABRICATE AN INLAY VERSUS A DIRECT COMPOSITE RESTORATION FOR A MOD PREPARATION? WHAT ARE THE DISADVANTAGES OF MILLING VERSUS PLACING COMPOSITE DIRECTLY?

Well, it is interesting that you ask that, as we designed a study specifically to investigate that question.³ Paradigm MZ100 inlays not only increased the accelerated fatigue resistance (100 percent survival in our test) but also decreased the shrinkage-induced crack propensity of remaining cusps when compared to direct restorations. I have to admit that while both restorative techniques yielded excellent fatigue results at physiological masticatory loads, CAD/CAM inlays seem more indicated for high-load patients.

WITH THE RISE IN POPULARITY OF FULL-CONTOUR ZIRCONIA, DO YOU THINK THAT STRONGER IS BETTER? OR ARE WE AT A POINT WHERE THE MATERIALS ARE “STRONG ENOUGH”?

I believe that strength of a material must be in inverse relation with the bond strength to the substrate. In other words, the stronger the material, the less we need to rely on bonding and the more we rely on retention and resistance form (full-coverage restorations). That should answer your question. People who don’t know how to bond or don’t want to bond need such strong full-coverage restorations to compensate.

The future is adhesive dentistry in the biomimetic approach because it is more conservative, as opposed to resistance form and retention that required much more cutting of intact tooth structure.⁴ Enamel is weaker than most ceramics, yet is lasts for a lifetime because it is perfectly united with dentin through the dentinoenamel junction.

In addition, we know very well that the

practitioner himself represents the most important variable during any dental treatment. I cannot help thinking that an average practitioner will likely experience fewer problems with biomimetic approaches compared to more invasive techniques.

For patients with severely worn teeth, it has been shown that the complications that arise from conventional prosthetic treatments are much more dramatic (often requiring root treatment or extraction) when compared to the complications of the more conservative treatments with direct composite resins.⁵ These are indeed easily repairable with fewer consequences the remaining tooth structure and teeth. This is explained by the principle of maximum tooth structure conservation. When it comes to cutting tooth structure, the motto “less is more” always applies!

YOU ARE A BIG ADVOCATE AND PROPONENT OF IDS, IMMEDIATE DENTIN SEALING. WHY SHOULD A CEREC DENTIST PRACTICE IDS WHEN THEY WILL BE PLACING THE FINAL RESTORATION THE SAME DAY?

Yes, of course because there are many advantages to IDS related to the dentin adhesive process such as bonding and sealing the freshly cut and clean dentin (uncontaminated), the wet dentin bonding (enamel can be bonded 100 percent dry separately during luting) and the ability to pre-polymerize a thick layer of adhesive resin without interfering with the seating of the restoration, which is paramount for the quality of bonding. Also, consider using composite resin in addition to IDS to improve the preparation design and surface (reinforce undercuts, smoothen internal contours, etc.). Using the IDS process and a CAD/CAM system, we have been able to generate restorations without a single adhesive failure even at very high loads, whether MOD inlays, thin occlusal veneers⁶ or even thick overlays.⁷

IF YOU HAD TO CREATE AN IDEAL BONDING SYSTEM, WHAT WOULD THE BE CHARACTERISTICS OF THAT BONDING SYSTEM?

My reference for bonding is the dentinoenamel junction or, I should say, dentinoenamel complex (more functional interphase including the inner aprismatic enamel and mantle dentin) — the “adhesive” characteristics of which are closely matched



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by some adhesive systems on the market (see end of previous question).

However, one of the main characteristic of the DEJ that may (or may not) still be lacking in existing dentin adhesives is the ability to prevent cracks from enamel to propagate into dentin. It is known that such a characteristic is provided by thick type I collagen fiber bundles organized with several levels of scalloping.⁸ Considering the DEJ as fibril-reinforced bond which is mineralized to a moderate degree⁸ should help refine the next generation of dentin adhesives.

WITH THE NEWER BONDING SYSTEMS, THE TREND OVER THE YEARS HAS BEEN TO REDUCE THE NUMBER OF BOTTLES AND TRY TO SIMPLIFY THE SYSTEMS. IS THIS THE PROPER DIRECTION THAT THE MANUFACTURERS SHOULD BE HEADING IN?

Ironically, those adhesives alluded to in the previous question, and which are almost able to match the DEJ or DEC, are from earlier generations, such as total-etch-and-rinse, three-steps adhesives. Based on my experience and research, I would personally favor such a system with filled adhesive resin. Everybody's legitimate dream and quest has been to simplify the application process into one step, which has not proven successful so far, according most of the scientific data.

WHERE DO YOU SEE THE STATE OF CAD/CAM FOR CLINICIANS IN FIVE YEARS? IN 10 YEARS?

I see much simpler systems, wireless intraoral cameras interacting with a tablet computer, which will be much easier for mobility and hardware upgrading, etc. I also see new manufacturing options such as 3-D printers allowing for much more anatomical detail and layering of the restorations. Above all, opening of the platforms in order to allow global access to the data.

WHAT FEATURES DO YOU FEEL THAT THE CAD/CAM SYSTEMS ARE LACKING THAT YOU WOULD LIKE TO SEE?

First and foremost, to be more affordable! This is a serious limitation for some countries that I visited (not the United States, obviously). There are many other technical features that I would like to see, as

outlined in the previous answer, but I would have to have you sign a confidentiality agreement before further answering this question ;-)

CAD/CAM IS A HOT ITEM IN DENTISTRY TODAY. IN YOUR OPINION, WHAT IS THE "NEXT BIG THING" IN DENTISTRY?

I believe in the extension of the digital technology to globalize the concept of the Virtual Dental Patient (merging of all data, CT scan, intraoral, dynamic occlusion, etc.), a patient that could travel over electronic pathways in order to access the best clinicians for consulting and refining of the treatment plan and for virtual simulation of the treatment. As stated earlier, this would require a major effort to establish an open platform and standardization to share the data.

WHAT DOES THE FUTURE HOLD FOR DR. PASCAL MAGNE?

My wish is to continue having the same love and passion for research, teaching and patient care, wherever it leads me in the world. I would love to expand and continue to propagate the knowledge of "biomimetic restorative dentistry" while becoming a more active partner to the industry in order to achieve all the goals mentioned in this interview. ■

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