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## An interview with **David L. Cochran**

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*In an exclusive interview for Dental Press Implantology, Dr. David Cochran, president of the International Team for Implantology (ITI), answers to questions posed by Drs. Mauro Tosta, Wagner Duarte, Maurício Araújo and Waldemar Polido.*

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Dr. David L. Cochran is a graduate of the University of Virginia and received his DDS., MS. and PhD degrees in Biochemistry from the Medical College of Virginia (MCV). He was trained in Periodontology at the Harvard School of Dental Medicine where he also obtained a second Masters degree. He recently received an Honorary Doctorate from the University of Bern in Switzerland. Dr. Cochran is currently Professor and Chairman of the Department of Periodontics at The University of Texas Health Science Center at San Antonio, Dental School. Prior to his appointment at San Antonio, Dr. Cochran was Director of Postgraduate Periodontics at MCV. Dr. Cochran is a member of many professional dental organizations and is a Diplomate of the American Board of Periodontology. He is a fellow of the American College of Dentistry and the International College of Dentistry. Dr. Cochran has published numerous scientific articles and abstracts on various periodontal, biochemistry, and implant topics. He has received awards for his research work at both the national and international levels. Dr. Cochran is an active basic science and clinical researcher who has received funding from both the NIH-NIDCR and private industry.

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*David L. Cochran - President of ITI*

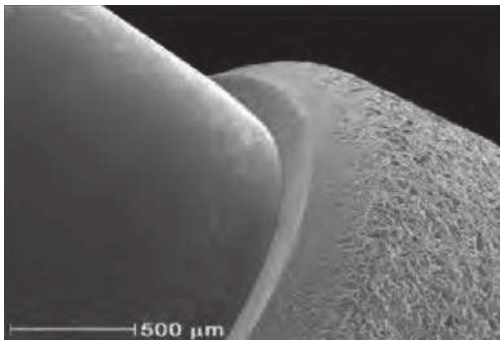
**During the past several years, the concept that “the tissue is the issue, but the bone sets the tone” has been predominant in Implant Dentistry. Based on our current knowledge, what do you think about the importance of soft tissues to peri-implant tissue stability and their contribution for the maintenance of peri-implant bone?** Wagner Duarte.

**DC.** That expression is certainly cute and clever, but I also believe it is a little misleading. Clearly, bone supports soft tissues, but bone also relies on soft tissue coverage as well as adequate blood supply, so I would question the “bone setting the tone.” In reality, vascular supply, soft tissues and actually function or stress on the bone is what controls bone metabolism. Remember that bone is a highly

dynamic tissue in metabolic equilibrium. Interferences with that equilibrium really is what results in bone formation or bone resorption. In regards to soft tissues around teeth and implants, I refer you to the important concept of the “inflammatory front” which takes place in the soft tissues and is absolutely critical to the bone. My friend Dana Graves and I published about this in the Journal of Dental Research, and I think this is an essential foundational concept for the oral cavity in regards to teeth and implants.

**What are your thoughts in terms of the biologic width around platform-switched implants with custom abutments and scalloped as well as superficial restoration margins?** Wagner Duarte

**DC.** Thanks for bringing up “biological width” as it reminds us that while we all get excited about the implant parts and pieces, the most important aspect of dental implants is that we are placing them in a host (the patient) and it is the biological reaction by the host which is the critical aspect. Platform-switched implants, no matter what kind of abutments and/or margins, means that there is an internal connection and an enlarged space for connective tissue to form. I think these are the critical issues. The internal connection, if well made and documented, has two roles. First, it provides stability, which is critical; and secondly, it excludes bacteria, which is also critical. Also, I believe that it is important that the space created



**Figure 1.** Scanning electron microscopy (SEM) of a two-piece experimental implant. Titanium-based implant surface was subject to chemical treatment with sandblasting and acid etching. The implant-abutment connection is of the internal conical type. The healing and definitive abutments have a smaller diameter compared to the outer diameter of the implant, leading to a non-matching implant-abutment diameter and a horizontal offset. Source: Cochran et al,<sup>1</sup> 2013.

by the horizontal offset allows a bulk of connective tissue to form, which helps to further isolate the bone from an inflammatory front (mentioned above). Epithelium covers connective tissue and adheres to titanium through hemidesmosomes, resulting in a linear dimension of epithelium and connective tissue or what we know as "biologic width."

**With the advent of short and narrow-diameter implants, do you think that the effort/funding to develop new bone reconstructive techniques/material will gradually decrease?**

Wagner Duarte

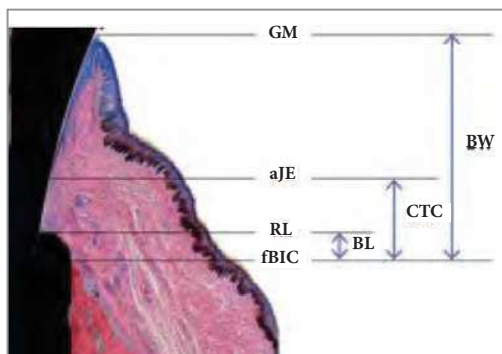
**DC.** No! Actually, I do not think efforts will diminish. New developments, new technology, and new knowledge occur daily, which is really exciting. Humans are very creative and we are blessed with many great minds in Dentistry and other fields where much innovation comes from. One example is material technology. Who would have anticipated 20 years ago that commercially pure (CP) titanium would not be the optimal dental implant material? Clearly, the titanium-zirconium two metal alloy (such as that found in Straumann's Roxolid implant) is stronger than CP titanium. With Roxolid, it has a unique chemical arrangement that allows for uniform dissolution in acid, which is special for surface preparation. I also understand that other technology, based on metal expansion/contraction properties, may ultimately

allow us to replace cementation and screw retention of implant parts. Ironically, such technology is used to operate your blinkers (turn signals) in the manual switches in your car.

**Regarding anterior sites with highly aesthetic demands, the ITI Treatment Guide recommends early implant placement (type 2) in order to minimize the risk of aesthetic complications. Nevertheless, several opinion leaders in Brazil prefer the immediate approach (type 1) associated with soft tissue grafting and gap filling with bone substitutes, so as to compensate for alveolar ridge contour alterations after tooth extraction. Would you please tell us your thoughts on that issue?** Mauro Tosta

**DC.** For me, it comes down to how you like to handle risk. If you are playing "Russian Roulette", how many bullets do you put in the gun? Immediate placement with both soft and hard tissue grafting is certainly possible, but can it be used routinely and have predictable and optimal outcomes? The literature says to me that the answer is no. Is it possible? Yes. Do I do it? No. In my mind and for my patient who has entrusted me with his/her care, they (and I) want predictably good outcomes. With immediate placement and hard and soft tissue grafting, you are asking a great deal from biology. This includes not only multiple tissue formation (which is complex in itself), but you

are also asking for multiple tissue integration (which is an even higher level of complexity to achieve biologically). Wound healing occurs in a very careful and delicate sequence of events over a period of time for each tissue that is being formed. Any interruption in that complex sequence and its effect on tissue integration will result in a less-than-optimal outcome for your patient. Do you want to take that risk for your patient who has entrusted you with their care, much less their time and pretty big money? My answer is no. I will take the more predictable, less risky approach for my patients. How many bullets do you want? One for osseointegration, one for bone augmentation, one for soft tissue formation, one for tissue integration, one for patient's compliance. Was that a six-shooter you were using?



**Figure 2.** Histology of hard and soft tissue on two-piece bone level implant after 6-month loading. Bone level (BL): distance from reference line (RL) to first bone-to-implant contact (fBIC); connective tissue contact (CTC): fBIC to the apical point of junctional epithelium (aJE); biologic width (BW): from fBIC to gingival margin (GM). Source: Cochran et al,<sup>1</sup> 2013..

**Dr. Cochran, do you believe in the reasonable use of Emdogain for the purpose of optimizing soft tissue healing? Such as in soft tissue grafting, root coverage techniques and bone augmentation procedures?**

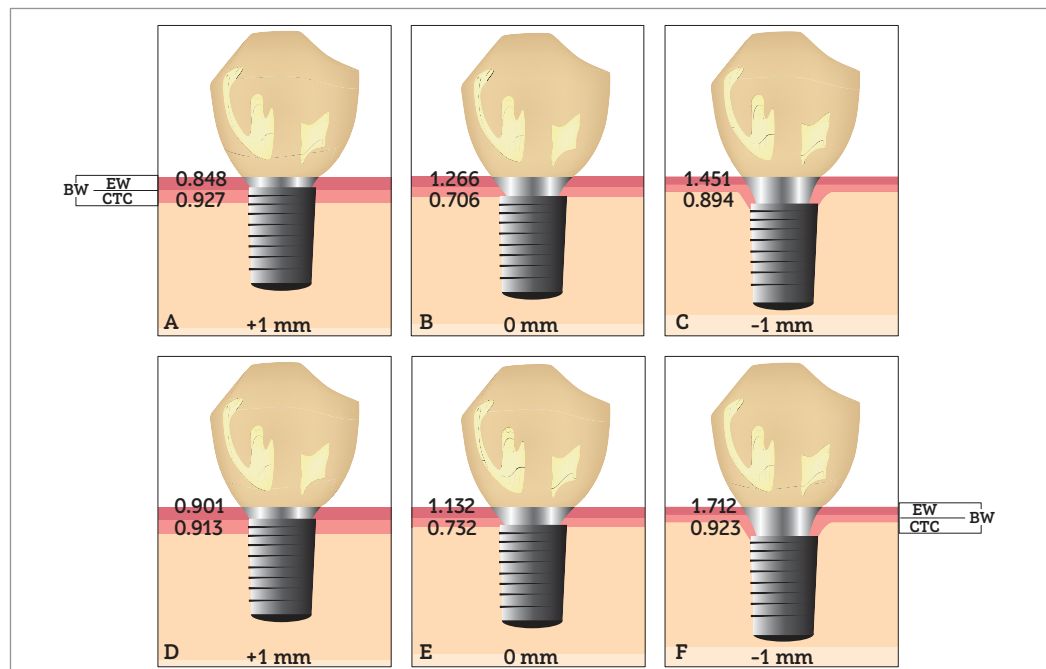
Mauro Tosta

**DC.** Yes. Emdogain is a preparation of enamel matrix proteins which includes not only amelogenin, but also ameloblastin and a pretty large number of other proteins. We and others have shown that these proteins are very angiogenic in several different assay systems. Interestingly, they also stimulate bone formation and we are pretty certain that they do not include bone morphogenetic proteins (BMPs). No tissue formation ever occurs without blood supply (angiogenesis) which alone, in my mind, justifies its use. Also, we have shown in baboons that Emdogain is excellent in forming cementum. Do you know of any better material available and supported by multiple literature references to grow cementum? Do you absolutely need cementum to have any periodontal regeneration? Of course you need cementum for periodontal regeneration by definition. Conversely, without cementum you will never have periodontal regeneration. Therefore, it is clear to me that if you want periodontal regeneration, you should use Emdogain to increase your chances of any periodontal regeneration, which is the goal. In fact, I think you should use Emdogain on every exposed root surface you encounter.

**Clinically, there still is a lack of an ideal bactericide filling material to be placed inside the implant/abutment interface, which does not resorb easily and does not interfere in the mechanical properties of the whole system. Please tell us your comments regarding this issue.** Mauro Tosta

**DC.** To my view, you should never ever need a bactericide. The mouth contains over 500 bacterial species living in biofilms that you will never eliminate. Thus, I would use implant components that eliminate the chances of promoting

bacterial growth near the bone (see my comments above about the “inflammatory front”). The easiest way to do this and, my preference, is to use a tissue level (non-submerged or one-part) implant. Second best, in my mind, is to use an implant/abutment component that has been shown to be capable of eliminating bacteria at that interface. This can be accomplished with internal Morse Taper stable connections. There are many internal connections available, but how much they are like a true Morse Taper varies, and so does their stability. Thus, you need to use a connection proven to



**Figure 3.** Dimensions of peri-implant soft tissue in submerged (A to C) and non-submerged (D to F) implants. In five of the six placement conditions considered, the connective tissue was located coronal to the implant-abutment junction. The connective tissue was slightly apical to the implant-abutment junction only in the implants placed 1 mm above the crest in the submerged group (BW = biological width; EW = epithelium width; CTC = connective tissue contact).

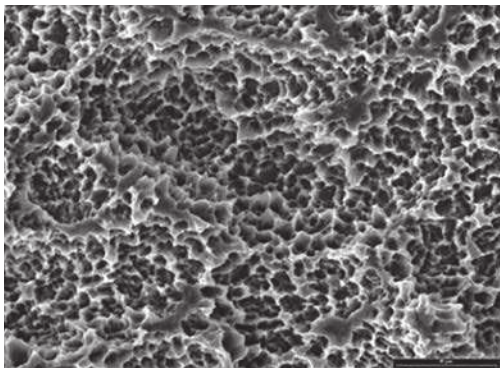
Source: Cochran et al,<sup>1</sup> 2013.

allow connection without bacterial contamination and its associated inflammation. Tissue-level implants are the easiest (and I think best) answer.

**Peri-implant disease appears to be an increasing problem in Implant Dentistry. Is there any measures to be taken to prevent such disease, particularly regarding the choice of implant surface?** Maurício Araújo.

**DC.** First, I think we have to be careful about saying peri-implant disease appears to be an increasing problem, as many (not you I am, for sure) will interpret that to mean that there is an increasing frequency of occurrence. What it can mean, and I believe is the truth, is that there is a rather small percentage of implants with moderate to severe peri-implant disease, but since the total number of implants is getting

larger and larger, even with a small percentage, you will see more of these implants, since a small percentage of a very large number can be a lot. I would use the analogy of the “old days.” When we first placed implants, the restorations were hard because the implants were placed wherever the bone was and that complicated restoration. Now, we can grow bone and place the implants in a restoration-driven approach, which makes it easier to restore. Therefore, with technology and knowledge, we have decreased complicated restorations and the same should be true for peri-implant disease. Similarly, we seldom (I hope) use butt-joint, flat interfaces that allow flexing and, hence, bacterial contamination, loose screws, and abscesses (like we used to see), and we are not placing these types of interfaces five millimeters below the bone to allow for restoration “running room” contour development. Similarly, manufacturers do not recommend tripodization of implants or multiple implants to replace a single molar, as it has occurred in the past. Interestingly, and to your question, we have recently published a paper showing that a rough implant surface in the soft tissues, compared to a more smooth machined surface, actually produced more mature connective tissue with the potential to have less inflammation. The bottom line is, the true effects of surface roughness in that soft tissues are still largely unknown, but the clear findings are to not place flat (butt-joint) interfaces at or below the crestal bone.



**Figure 4.** SEM of the SLA surface ( $100 \times 75 \mu\text{m}^2$ ) reveals macroroughness (resulting from sandblasting) and microroughness (resulting from acid etching). Source: Ferguson et al,<sup>1</sup> 2006.

**How far are we from using stem cell therapy technologies in daily practice?** Maurício Araújo.

**DC.** I believe that we are still very far away from using stem cell therapy in daily practice. I think we will first see extracellular matrices and various “smart” carriers developed to place in tissue voids with and without proteins to attract host stem cells before we ever see stem cell usage. In fact, there is some really superb new science that shows that the extracellular matrix from fat tissue (after the fat has been removed) provides an excellent material (consisting of proteins and growth factors) to condition soft tissues and reduce scarring. Thus, in my mind, carrier technology will continue to evolve at a much faster rate than cell therapy technology.

**In your opinion, what is the perfect profile of the abutment/implant interface?** Maurício Araújo.

**DC.** I do not believe that the profile of the abutment/implant interface is the most important issue; however, it likely does have some role (concave *versus* straight etc.). I actually expect that you meant to say what is the best type of interface. I think the perfect (if there is such a thing) interface is no interface at all, as available tissue-level implants and our data over the years prove this again and again. After that, if you do have an interface, it should be one that provides stability and bacterial exclusion. A true Morse Taper (< 6 °) internal connection

with a horizontal offset to provide a bulk connective tissue (to limit the “inflammatory front” from above and, thus, to protect the bone) would be the current second best connection. But again, no connection (a one-piece or tissue-level implant) is the perfect connection!

**You have witnessed and actively participated in the evolution of Implant Dentistry, from the Branemark smooth surface and external hexagon era to today’s micro roughed surfaces and internal connections. How do you summarize this evolution, and what are your predictions for the future?** Waldemar D. Polido.

**DC.** Like all changes in Medicine/Dentistry, there is a long lag time before discoveries become accepted and translated to patient care, and this lag period can be frustrating. For example, the scientific literature was abundant and clear that more rough surfaces on an implant were more osteoconductive than more smooth surfaces, such as machined titanium; but many were reluctant to accept the data. One criticism was that much of the data was from animal experimentation (which was very necessary) and it was not clear that the phenomenon translated to patient care where the results of osseointegration are more difficult to discern. Also, if animal results do not translate to patient care, then the results are much less interesting. That is why I wrote an early paper (published in the Journal of

Periodontology in 1999) that examined reported implant outcomes in the literature comparing machined-surfaced implants (the vast majority at that time) to implants with a roughened surface. The purpose was to determine if the multitude of animal results translated to patient care and in certain clinical indications. The data clearly showed that, in certain clinical indications, smoother implant surfaces were less successful than rougher surfaced implants; therefore, confirming that animal studies (on many types of implant surfaces) translated similarly to patient care. Because many individuals did not want to believe the results, there were a couple "letters to the editor" being highly critical of the paper which was correct in its findings. For the future, I am confident that new technologies and findings in material sciences and matrix/carriers, as well as other biological fields, will continue to fuel advancements in Implant Dentistry.

**In your busy life, you always find time to dedicate to different associations, being president of the most important Periodontics and in Implant Dentistry associations in the USA and in the world, as president of the ITI. Can you tell us why it is important to take part in such professional organizations?** Waldemar D. Polido.

**DC.** I feel very blessed to be in the science and health professions and have the opportunities that I do. I also love to collaborate and work with outstanding

colleagues in the United States of America and around the world. Taking part in the various organizations and associations has allowed me to make friendships with many people, and is a great honor to know and work with such outstanding individuals in the specialty of Periodontics and in Implant Dentistry. I also strongly feel that it is important to give back to one's profession, and being in academics has allowed me the chance to be involved in these organizations at local, national, and international levels. Importantly, for the most part, working in these organizations is fun, and ultimately I believe the work in these groups benefits our patients.

**As one of the main researchers regarding implant surfaces, osseointegration period was reduced from 3-4 months to 4-6 weeks. Meanwhile, many still promote immediate loading as the main technique. What are the next steps on the influence of implant surfaces, and how it relates to immediate loading?**

Waldemar D. Polido.

**DC.** I think that it is absolutely critical to understand the difference between what is possible and what provides predictably reliable outcomes, particularly with evidence-based knowledge and our understanding of biology. I have commented on this above as well. In Dentistry, especially, everyone likes to try different techniques with a view to improving their outcomes. This is certainly healthy as it helps to

understand and explore how we can improve what we do. At some point, however, improvements need to be subjected to randomized clinical trials with standardized techniques and carefully evaluated outcomes. Furthermore, any such techniques need to be understood well enough to be highly reproducible and predictable. Immediate implant placement with soft and hard tissue integration relies on a large number of variables that need to be carefully considered and managed. The likelihood that all these variables workout

optimally at once is small; thus, the technique, while it can be undoubtedly successful, is a very risky treatment modality in certain clinical situations. Of course, every patient and clinical indication is different, so each case must be carefully evaluated before the clinician and patient decide on the final treatment plan. I feel a strong obligation to treat my patients as predictably, reliably and with the smallest risk possible for a good outcome. For these reasons, I find indications for immediate placement to be very few.

Interviewers:

**Maurício Araújo:** Professor of Periodontics, Department of Dentistry, Universidade Estadual de Maringá (UEM), Maringá, Paraná, Brazil.

**Mauro Tosta:** Head of the Postgraduate Program in Implant Dentistry, CETAO, São Paulo, São Paulo, Brazil.

**Wagner Duarte:** Professor of Periodontics and Implant Dentistry, IPESP, Brasília, distrito Federal, Brazil.

**Waldemar Daudt Polido:** Editor-in-chief of Dental Press Implantology.

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