An interview with

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Interviewer
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1) To begin this interview, tell us about your academic background and the line of research you work in.

I am from São Paulo, born in 1967 in the Brás neighborhood in the central zone of São Paulo - a neighborhood of workers and "homeland" of Italian immigrants - and spent my entire childhood on the edge of the train tracks, in a village of residents of Italian origin. Today, I know that watching my father studying and preparing seminars and classes, all done by hand or on the orange Olivetti typewriter, also had a direct influence on my main professional choice: to be a teacher. In 1985, at the age of 17, I started to attend college at the old FZL (now UNICID), which brought me much more than just a graduation degree in Dentistry in 1988, as it showed me several teaching methods, the differences in learning theoretical, practical laboratory and clinical activities, and the opportunity to, in the third year, immediately identify myself with Endodontics. In 1989, I started as a monitor in the Endodontics discipline at FZL and had my first contact with FOUSP, where I also did a practical internship. At the same time, I continued to work at dental clinics during the night and at colleagues' offices in the rare free periods. After finishing the specialization course, in 1992 at FOUSP, I started the didactic internship, in which I already accompanied other undergraduate professors. As a matter of fact, it was through the course's final paper, "Electrical tests: advantages and limitations", that I started to explore the road of endodontic diagnosis and pulp testing, which is still my main line of research. I started to carry out my first studies, producing fruits such as the first presentations in national congresses, in 1991 and 1992, with the theme "Auxiliary resources for diagnosis in Endodontics". Also, at the end of 1992, the first publication in a journal came out: "Evaluation of pulp vitality in young permanent teeth with complete root formation". As I had already advanced the credits for my doctorate, I defended my doctorate at the end of 1998 with the paper: "Relationship between the sensory response time and the temperature observed internally in the buccal wall when applying tetrafluoroethane as a pulp sensitivity test", which allowed me to apply for a teaching position. In April 1999, I signed my first contract with USP. A series of other paths were opened by the work at FOUSP, especially the opportunity to

effectively participate, in addition to undergraduate studies, in professional training courses, refresher courses and specializations, to begin to scientifically orient undergraduate and graduate students (there are already 23 masters and 7 PhDs graduated, besides 7 in progress), as well as, since 2000, coordinating the Dental Trauma Center at FOUSP (CADE-Trauma). In 2014, feeling ready for other challenges, a huge step was taken when I defended my free-doctorate at FOUSP, entitled: Pulp testing: from the "ice age" to the "technological age". From 2018 to early of 2020, I coordinated the graduate program in Dentistry at FOUSP. In 2019, the apex of my university career was presented to me, when I had the opportunity to apply and be approved as a full professor in Endodontics at FOUSP, also presenting on "Pulpal testing in endodontic diagnosis". As you can see, the master beam of my main studies is the endodontic diagnosis and its particularities, always trying to understand, discuss and offer more accurate and reliable resources for its accomplishment.

2) What is your view on the endodontic diagnostic stage today?

If an endodontic examination is performed inadequately, little will be known about the real state of the pulp. Knowledge in Endodontics should be used to make a judgment about which patients and which teeth should undergo treatment, and where to act to prevent this indication. Unfortunately, a significant number of endodontically involved teeth are not diagnosed or treated. In fact, the vast majority of all endodontic procedures are only performed after patients have symptoms; this has to be improved.

3) What are the main difficulties the dental surgeon faces when making this diagnosis?

Specifically within the endodontic diagnosis, the greatest difficulties arise when we try to determine the clinical status of the pulp, due to the impropriety of directly inspecting the content and pulp consistency; the subjectivity inherent in the diagnosis itself, regarding the patient's responses; and the imprecision of the resources generally used in this evaluation. The importance of endodontic diagnostic knowledge, in particular, also encompasses a broad knowledge of resources that can assist in determining the clinical

the clinical status of the pulp and periapice. The most commonly used tests in endodontic diagnosis require prior knowledge about their mode of action, application site, expectations of obtaining a positive or negative response for the various dental groups, depending on the patient's age, structural condition of the tested tooth, and psychological condition of the patient, among many other factors that must be analyzed.

4) What about the resources that are available?

In this regard, along with the expectation of identifying a symptomatic tooth in a symptomatic irreversible pulpitis, or the absence of response in a picture of pulp necrosis, it is important to recognize and distinguish, among the available semiotechnical resources, those that are most appropriate and useful for each particular case. For to obtain the correct diagnosis, it is of unconditional relevance to know the diagnosis, to know the resources available, making a comprehensive analysis of the numerous approaches related to pulpal testing, highlighting their limitations and the factors to which pulpal responses are conditioned, and discuss the biological basis, in order to optimize the knowledge on the subject. The reliability of pulpal tests is still a debatable fact, because they present various degrees of success. From a technical point of view, all current pulpal tests have shortcomings, especially in terms of accuracy, reliability and reproducibility, which makes them a challenge within Endodontics. It is always important to remember that the tests commonly used with the intention of assessing pulp condition do not necessarily analyze pulp vitality, and many even fail to obtain sufficient data on the presence, or even identify the severity, of pulp inflammation. So why are such tests routinely used in daily endodontic practice? The answer is that the tests, especially the thermal and electrical so-called "sensitivity" tests, somehow try to reproduce the symptoms and, through this response, locate the source and assume the intensity of the problem. Certainly, such intention further reinforces the subjective character of the evaluation by means of sensory stimulation resources, since some patients tend to exaggerate the response, while others underestimate or fake the pain felt. In current practice, the best thing

we can do is to know how to optimize the performance of tests, especially thermal tests – and particularly with refrigerant gas – by better understanding the responses that are produced in various clinical situations, and interpreting them appropriately.

5) What is the direction of the new tests that can be used?

First of all, endodontic diagnosis, particularly the evaluation of pulp vitality, does not only comprise technical knowledge of tests, resources and devices, which are generally easy to apply. The diagnosis of the pulp state requires knowledge of the pulp physiology, especially of the microcirculation and innervation, which, together with the information given by the patient, and the adequate use of pulp sensitivity and vitality tests, will help form hypotheses and give the right course of treatment. The relative reliability of tests that evaluate only the sensory response of the pulp is well recorded in the literature. Numerous articles present the difficulties encountered in making responses when using sensitivity tests, and the limitations they present, exposing the need that in order to obtain a reliable diagnosis, a series of other tests must be performed. The fragility of sensitivity testing becomes evident in some situations, especially when nerve sensations are inhibited or compromised, for example, after dental trauma or excessive orthodontic movement. In these cases, and others, the methods that are based on the pulp's vascular response show better results, because the blood flow or oxygenation values are objective records of the pulp circulation, that is, a real indicator of pulp vitality. Optical devices, which analyze the various absorption properties of different substances within the dental pulp, have been closely researched to determine whether pulsation and blood volume are of viable application as pulpal tests. What has been observed is that so-called physiometric tests (such as pulse oximetry and laser Doppler flowmetry) have shown very promising results in assessing pulp vitality. Their objectivity and non-invasiveness, besides not using painful stimulus to generate patient response, result in greater patient acceptance, which starts to cooperate more with the professional. Other tests, such as infrared thermography, based on the possibility that temperature changes measured on the dental crown may indicate changes in pulp vitality, have also been studied.

6) And what other challenges in the diagnostic area are we currently facing?

Many studies, in all areas of knowledge, have tried to give direction to scientific research to design a model that "mimics" our sensations, responses to stimuli etc., resulting in a better understanding of what "Artificial Intelligence" is. In Machine Learning, a subfield of AI, algorithms are applied to perform tasks by learning patterns from collected data. Will we be able to transform hundreds or thousands of data, obtained from the diagnostic stage that we usually perform, into algorithms capable of reproducing or mimic the endodontic reality? Endodontics works a lot with the issue of "pain", which in itself is a data that is sometimes subjective and personal, just as the response to certain stimuli also considers the experience acquired by the patient. I see a possibility of improvement in terms of obtaining more logical and feasible decisions, which can result in a more accurate diagnosis, as well as the standardization of some diagnostic procedures; however, at the moment, the system is still very complex, high cost, and with many biases, and there is no adequate training, which does not yet allow its immediate application.

7) Finally, a message to the readers.

The up-to-date dental surgeon should consider technology as another aid in endodontic diagnosis, because the use of resources should in no way replace the scientific and technical training and experience of the professional. One must be careful not to replace professional knowledge with technological resources, and overlook the clinical examination, the anamnesis, and even the use of conventional methods, of which the advantages, disadvantages, limitations, and harmful effects they can cause are already known. Another consequence of the advance of technology to be considered is the so-called "seduction of the devices" and the false security they can impose. Professionals and patients, more and more, are seduced by new devices, by the visual presentation (with lights, graphs, and numbers), which convey the concept of accuracy, because they generate physical documents that can be shown and discussed; that is, there is a false idea that the greater the quantity of values presented, the greater the accuracy of the tests. The professional ends up transferring his responsibility to the results obtained by the tests, and his judgment and prognosis are tied to a series of numbers and graphs that a certain test has generated, without considering the clinical signs and symptomatology reports of the patients. For endodontic diagnosis, it is not enough to just collect the data and impose the treatment. It is up to you to take as many answers as possible, to logically organize this information, and, from that point on, to presume the diagnosis and give direction to the therapy. Furthermore, to be held hostage to technological resources is also to be at the mercy of the technical flaws and exclusions that every device or software presents. Invest in knowledge, train yourselves in techniques, update yourselves and try new resources, continuously.