
Shock of paradigms on the instrumentation of curved root canals

Jesus Djalma Pécora

DDS, MSc, PhD, Professor and chairman, Department of Restorative Dentistry, School of Dentistry
of Ribeirão Preto, University of São Paulo

Alexandre Capelli

DDS, MSc in Endodontics, Department of Restorative Dentistry, School of Dentistry of Ribeirão
Preto, University of São Paulo



Before we begin demonstrating the shock of paradigms on the instrumentation of curved root canals, it is relevant to make some important considerations concerning the word *paradigm*.

Every point of view is supported by certain premises regarding the nature of reality. When this fact is accepted, the premises work as hypothesis; when it is disregarded, the premises work as belief. The assemblies of hypotheses generate the theories and the assemblies of theories create the paradigms¹.

Therefore, a paradigm is a sort of general theory of objectives, capable of either comprising most of the phenomena known in its field or providing them with a context.

It may be assumed that every scientific theory or paradigm is continuously opened to modifications or refutation. Nevertheless, the successful theories may invariably tend to be considered as correct. They turn into normative paradigms, become unquestionable concepts and begin to determine the right way to act, do and think.

It is mandatory to be open-minded to question the paradigms that involve our profession, because whenever a paradigm acquires an extraordinary impact over those who adhere to it, it may become an indisputable belief.

Most of the times, such adherence may create a strong connection, which leads both clinicians and researchers to admit solely their own theory, for it seems evident to them that there is no other way to be. It constitutes the so-called settlement of the paradigm.

In Endodontics, a paradigm has been created. Theories and techniques for instrumentation of curved root canals establish that the use of a #25 file in the apical portion fulfills all the requisites for cleaning and shaping of the root canal system. The theories emphasize that, beyond this numbering (#25), failures such as deviations, perforations, zipping, etc, may occur frequently^{2,3,4,5}.

Therefore, one created the paradigm of the instrumentation of curved root canals, stating that the apical portion must be instrumented up to the #25 file. As regards the manual instrumentation, this approach is partly correct, considering that root canal instrumentation used to be performed with stainless steel instruments that did not present flexibility beyond this numbering (#25). However, over the twentieth century, the researchers have widely reported that, indeed, the cleaning of curved root canals was defective, whether the examination had been accomplished under optical or scanning electron microscopy. To date, none of the techniques available is able to yield an accurate cleaning of the apical portion of curved root canals⁶⁻¹⁹.

Despite the evidence provided by the outcomes of scientific researches, the paradigm remained emphatic as regards the method for preparation of curved root canals, which is instrumentation of the apical portion up to a #25 file.

Nevertheless, studies on dental anatomy revealed that the anatomic diameter of the apical portion of the mesio-buccal canals of maxillary molars corresponds to that of a file size #20 or #25. So, it may be assumed that when a #25 file is the last one used for instrumentation, the cleaning of the root canal is not efficient. As a result, if the cleaning of the canals is not appropriate, especially considering teeth with necrotic pulps with or without lesion, the use of too much interappointment dressing is required.

Although there is strong evidence of lack of cleaning and preparation of the apical portion, the paradigm persists even in spite of the outstanding technological advance, because all the evolution experienced was adapted to the existing paradigm.

This paradigm remained successful along the whole 20th century; however, it began to be modified in the 21st century by the following approaches:

- a) The existence of extremely flexible manual and rotary instruments fabricated from nickel-titanium (NiTi) alloys, mainly those of .02 taper. As far as the operator is familiarized with the technique of instrumentation and have the skills to perform it, the apical portion of curved root canals may be safely prepared using NiTi #40, #45, #50 or #60 instruments (.02 taper), with no risk of causing deviations, perforations or zipping;
- b) The real determination of the apical anatomic diameter or the real determination of the initial instrument. For such purpose, the canals must be previously enlarged at the middle and cervical thirds with modern instruments (Orifice Shaper, Flare, Coronal Shaper, LA Axxess).
- c) Achievement of optimal shaping and cleaning of the apical portion by effective microsurgery of the root canals using three or four instruments above that determining the real anatomic diameter. Therefore, in this region, dentin will be removed at approximately 150 to 200 microns.

This change of attitude, based on the aforementioned features, led these new hypotheses to create other theories and a new paradigm on the instrumentation of curved root canals. So, this new insight will gradually widen the scopes and modify the

way of thought of researchers and clinicians, but will still be open to further investigations and newer theories.

The introduction of a new paradigm may face extraordinary difficulties because it creates a shock of paradigms. Whenever a shock of paradigms occurs, antagonisms and faulty communication among the researchers are commonly observed.

There are those who remain locked to the past, to the ancient paradigm of instrumentation of curved root canals, not taking into account that it was based on the use of non-flexible stainless steel files.

Moreover, the corporations that produce rotary instruments have not become aware of the new paradigm, according to which the instrumentation of curved root canals may be carried out with nickel-titanium instruments. They insist on divulging these new technologies as to be utilized according to the principles of the ancient paradigm. Such corporations insist on advising the use of these instruments based on the Crown-Down technique transposed from manual instrumentation. This is an error to be avoided, because the proposed instrumentation makes the tip of the instrument to be engaged during the preparation, thereby leading to instrument breakage as a consequence of torsional load. To overcome the problem of fracturing of rotary instruments it is necessary to change the idea of the Crown-Down instrumentation, derived from manual instrumentation. A new concept of rotary instrumentation was proposed (*Free tip preparation*), according to which, the tip of the instrument works freely inside the canal most of the time, acting as a guide to the instrument, thereby minimizing the possibility of fracture by torsion significantly²⁰.

Another shortcoming attributed to the manufacturers is to fabricate instruments in which the taper of #25 files is increased, but the tip of the instrument is maintained. Therefore, although the canals instrumented using files size #25/ .04 or .06 taper are well shaped, the apical portion remains underprepared and not thoroughly clean, since the contaminated dentin is not appropriately removed. In addition, it is known that the

greater the taper of a NiTi instrument, the lesser its flexibility. Thus, it is important that the apical third of curved root canals be prepared with .02 taper files, in order to prevent failures and provide a more accurate cleaning. A NiTi instrument size #60 / .02 taper is flexible enough to be utilized in curved areas.

Therefore, the instrumentation (microsurgery) of the apical portion of curved root canals must be accomplished with .02 taper files, for this region may be prepared with three, four or five instruments beyond the real anatomic diameter. However, the real anatomic diameter must be previously determined.

The development of this new paradigm will be clearly demonstrable by further studies. An open-minded approach is essential for progress and Endodontics is now leaving behind the art stage (handicraft) to reach the technological stage, in which the general practitioner will be able to perform the treatment of curved canals successfully, as long as he/she is familiarized with the technique of instrumentation.

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