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CLINICAL TECHNIQUE

Shaping of the Root Canal System: A Multistep Technique

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ABSTRACT

Aim: The aim of this scientific work is to illustrate the technique of shaping the root canal system using the multistep technique.

Background: Over time, various endodontic instrumentation techniques have been put forward, from the "step-back" technique (apical–coronal) to the "crown-down" technique (coronal–apical), the "double-flared" technique, and the most recent "single-length" technique.

Technique: The multistep technique involves six steps, one of the main objectives of these being the safety of the use of mechanical instruments with a reduction in the risk that they fracture. This technique ("mixed") provides for the use of both manual instruments in stainless steel and mechanical instruments in nickel titanium (Ni-Ti).

Conclusion: The multistep technique is based on a standardized, flexible, and clinical protocol, which can provide for a reduction in the number of endodontic passages and instruments used and, therefore, a simplification of the operating procedure depending on both the difficulty of the root canals and the competence of the operator.

Clinical significance: This technique is a technique for shaping the endodontic space that allows the set objectives of endodontic therapy to be reached in a predictable way with a reduced risk of iatrogenic complications.

Keywords: Clinical technique, Endodontic, Files, Instruments, Nickel, Preparation, Reciprocating, Root canal, Rotary, Shaping, Titanium.

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BACKGROUND

Treatment of the root canal system involves endodontic preparation and filling.

The endodontic anatomy has not changed, in the same way that the mechanical and biological objectives of canal shaping formulated more than 40 years ago by Schilder in 1974[1] have not changed. What has instead profoundly changed over time is the technology that makes available materials, devices, and techniques that make endodontic therapy more effective, efficient, quick, and predictable.

Endodontic instrumentation has experienced continuous development since the mid-1990s with the advent of the nickel titanium alloy. A myriad of endodontic instruments has been proposed over time, and the endodontic community has become a true Tower of Babel.

TECHNIQUE

Many years of clinical and didactic experience have made it possible to develop a rational, standardized yet flexible and clinical canal shaping protocol, which makes it possible to carry out an effective and above all safe endodontic preparation, step-by-step, using any type of endodontic instrument.

The protocol calls for a mixed technique and may also encompass a hybrid technique.

The mixed technique consists of the use of endodontic instruments both in stainless steel and nickel titanium, and both manual and mechanical types (rotating, reciprocating, or mixed).

The hybrid technique, on the contrary, consists of endodontic instruments from different manufacturers, which can be integrated with each other.

There are six shaping protocol steps (Table 1).

The first step involves scouting, with the use of International Organization for Standardization (ISO) manual stainless steel instruments with small tip diameters (0.08, 0.10, and 0.15) and standard taper (0.02). These

Table 1: Steps of the root canal shaping

Scouting	*Preflaring*	*Glide-path management*	*Shaping*	*Gauging*	*Finishing*
Manual	Mechanical	Mechanical	Mechanical	Manual	Mechanical
	Rotary	Rotary	Rotary or reciprocating or mixed	Manual	Rotary
Stainless steel	NiTi	NiTi	NiTi	NiTi	NiTi
	Single file	Multi- or single file	Multi- or single file		
Working length	Coronal third	Working length	Working length		Working length
0.15/0.02			0.25/0.06		0.30 upward

NiTi: Nickel titanium

tools should be used precurved with a watch-winding motion and must reach the presumed working length. The 0.15/0.02 file is used to determine the initial electronic or radiographic working length and will be used as a patency file in the other steps of the protocol. This step serves to become acquainted with the endodontic system.

The second step involves the preflaring or early coronal preenlargement of the coronal third of the root canal, using "dedicated" nickel titanium rotary instruments (in clockwise continuous rotation), which have the following characteristics: larger tip diameter (from 0.25 to 0.35), larger taper (from 0.08 to 0.12), and shorter instrument length and working part. These tools are used exclusively in the first coronal 3 to 4 mm of the root canal. The goal of this step is to eliminate the dentinal triangle and canal interferences and conditioning, to allow direct rectilinear access first to the apical third before the canal curve. These instruments should be used selectively on the external wall in the molars to avoid the risk of lateral perforations (stripping) at the internal wall level (furca).

The third step involves glide path development, using "dedicated" nickel titanium rotary instruments (in clockwise continuous rotation), which have the following characteristics: smaller tip diameter (from 0.10 to 0.20) and moderate taper (from 0.03 to 0.05). These instruments must reach the established working length. They can provide for a multifile sequence with two or three instruments, or a single-file sequence with only one instrument. These instruments are the first rotary tools to reach the working length and serve to secure the subsequent mechanical tools.

The first three steps of the protocol are propaedeutic to the next step and ensure greater safety in canal preparation with mechanical instruments and a lower risk of fracture of endodontic instruments within the root canal.

The fourth step involves the actual shaping of the root canal, using a rotary (in clockwise continuous rotation), reciprocating, or mixed motion (clockwise continuous rotation/reciprocating) instruments, which have different characteristics depending on the various manufacturers. These instruments must reach the established working length. They can provide for a multifile sequence with multiple tools or a single-file sequence with only one instrument. Usually, multifile sequence tools are multiuse, while single-file sequence tools are recommended single use (without clarifying, however, whether they are to be considered mono-canal, mono-dental, or mono-patient). The purpose of this step is to mold a minimum predetermined shape into the working length with a tip diameter of 0.25 and a taper of 0.06. These minimum predetermined sizes enable the most advanced techniques of root canal filling with warm gutta-percha to be utilized effectively thereafter.

The fifth step involves gauging using ISO manual nickel titanium instruments, with tip diameters from 0.25 upward (0.30, 0.35, 0.40, etc.) and standard taper (0.02). The purpose of this step is to empirically verify the diameter of apical preparation, which may be larger than 0.25, namely, the amount achieved in the shaping step.

The sixth step involves finishing the apical third using rotary nickel titanium instruments (in clockwise continuous rotation), which have the following characteristics: tip diameters >0.25 and moderate taper (from 0.06 to 0.02). One rule to keep in mind is that when the tip diameter increases, the taper should not increase as a result, as it would increase the rigidity of the instrument – even though made from nickel titanium – with the risk of apical transportation. These tools must reach the working length. The purpose of this step is to finish the apical third by performing a more accurate mechanical cleansing of the main apical foramen, but above all by connecting the apical preparation diameter with the minimum predetermined taper molded at the end of the shaping step, creating a shape of retention and resistance in the last apical 5 mm to reduce the risk of root canal overfilling.

This shaping technique is, therefore, defined as a multistep technique as it involves several steps that follow one after the other to ensure greater safety in the use of mechanical instruments while at the same time achieving the objective of the adequate shaping of the root canal.

The problem of shaping was, therefore, "worked out" so that efficiency could be improved in the use of dedicated endodontic instruments with a specific function in the different parts of the root canal and during the various steps of endodontic work.

"One-file" techniques, although often advertised on the market, do not exist; therefore, as in this case

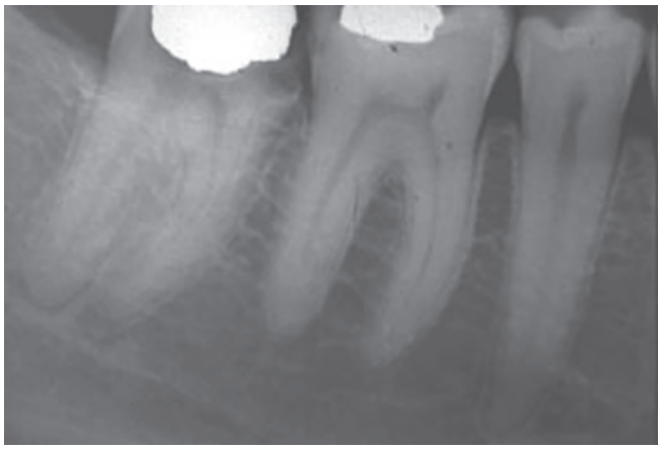

Fig. 1: Preoperative X-ray: Right second lower molar with secondary caries and pulpitis

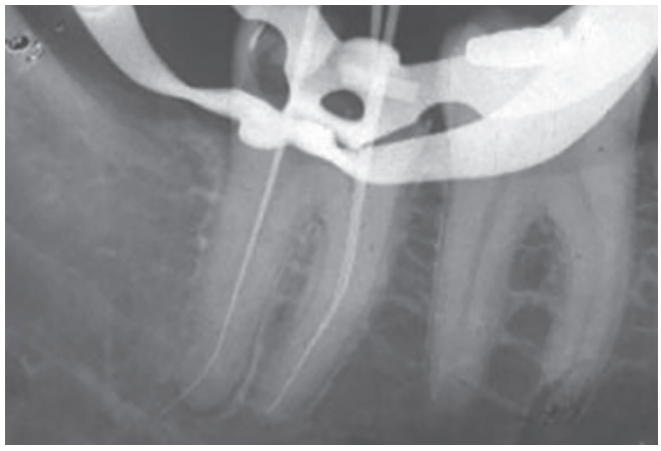

Fig. 2: Intraoperative X-ray: Radiographic working length determination

reference is made to the use of a single-file instrument in the shaping step, but to complete the canal shaping more than one endodontic instrument is necessary. Scouting with manual stainless steel instruments is an indispensable initial step of canal preparation, which facilitates familiarity with the root canal and establishes the working length (Figs 1 and 2). Preflaring with dedicated rotary nickel titanium instruments quickly eliminates all interferences in the coronal third of the root canal, allowing rectilinear access for subsequent mechanical instruments. Dedicated rotary nickel titanium instruments for glide-path management are the first mechanical instruments to reach the full working length, creating a safe path for the mechanical instruments used for the actual shaping. In this way, the shaping step is safer and can be performed with a multifile or single-file sequence and in any case with a single-length technique. At this point, the apical preparation diameter may be verified and finally, if necessary, apical finishing performed, which provide adequate groove filling (Fig. 3).

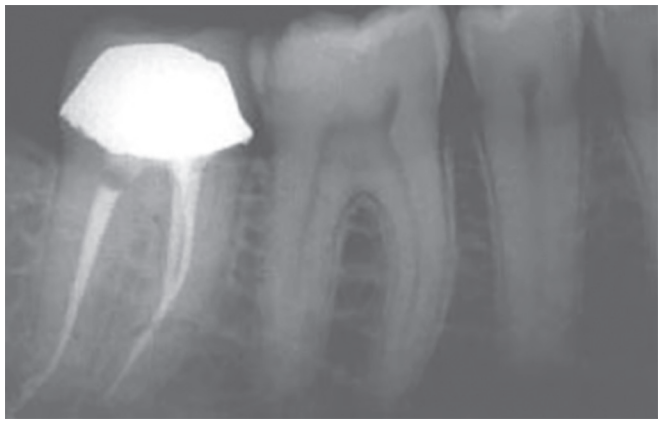

Fig. 3: Postoperative X-ray: Root canal treatment and a full porcelain-fused-to-metal crown

DISCUSSION

Schilder was the first endodontist to encode a protocol both for root canal shaping with manual stainless steel instruments with the "step-back" technique,[1] and filling.[2]

Other techniques were also subsequently introduced including "step-down" and crown-down.[3,4]

The step-back technique involves an apical–coronal approach, with instruments from the smallest to the largest diameter, all brought to the established working length. After having reached the apical preparation diameter considered suitable, instruments of increasingly large diameter are used, but at an increasingly short working length, creating taper.

The crown-down technique, on the contrary, involves a coronal–apical approach with instruments with the largest to the smallest diameter, brought as far as the canal allows, without therefore wishing to reach the set working length immediately. The working length is reached progressively, and the apical preparation diameter is established.

Over time, a hybrid approach was proposed with the "double-flared" technique, in which both above-mentioned techniques were integrated.[5]

In Italy, Riitano[6] introduced the "three-step" technique, which also included the use of mechanical stainless steel instruments (RISPI, Micro-Mega, Besancon, France), and above all studied canal instrumentation in-depth in relation to endodontic anatomy.[7-11]

Ruddle[12-15] proposed various concepts and different strategies in approaching endodontic shaping.

Malagnino et al[16-18] explored shaping techniques with rotary nickel titanium instruments and in 2011 presented the "simultaneous" technique which, through a crown-down approach, involved the use of every rotary nickel titanium instrument up to the full working length ("single-length" technique).

Gallottini[19-21] emphasized the effectiveness of mixed shaping techniques and mechanical nickel titanium

instruments in the endodontic treatment of curved canals and in complex cases.

Ruddle[22] highlighted the importance of the endodontic access cavity in the use of mechanical nickel titanium instruments. Mounce[23] reported the effectiveness of manual scouting with hand stainless steel instruments also with techniques using mechanical nickel titanium instruments, and Ruddle et al[24] illustrated the various options in managing the glide-path step.

Ruddle and Machtou[25,26] emphasized the role of the new geometries of mechanical nickel titanium instruments. The effectiveness of the reciprocating movement and reciprocating single-file nickel titanium files in endodontic shaping has also been demonstrated.[27,28] Riitano et al[29] and Ruddle[30] highlighted the importance of the apical third finishing.

CONCLUSION

In recent years, endodontics was characterized by continuous technological development,[31] which, however, apparently changed the rules of the game, because both endodontic anatomy and the objectives for reaching endodontic success are the same as always. Technology has undoubtedly affected the efficacy and efficiency of endodontic therapy, reducing operating times and improving the predictability of treatments carried out by general dentists. However, the axioms of endodontic shaping remain unchanged and are still valid today.[32]

To become disentangled from this wide-ranging commodity-related offering, it is necessary to be clear about a well-defined clinical protocol, which through knowledge, skills development, and experience can be flexible, but nevertheless fundamental for the purpose of reducing the risks of endodontic failure.

The use of a protocol may also allow the use of endodontic instruments from different manufacturers, potentially developing a hybrid technique with the aim of improving endodontic performance regardless of recommendations by dental companies.

In fact, it is often preferable, and even a guarantee of better results, to integrate different systems of endodontic instrumentation, rather than using only one system in a hard-line way.

Our protocol provides for six steps, but depending on the difficulties of the clinical case, with the proper experience, the steps may eventually be reduced, even skipping some steps that may be superfluous, therefore shortening operating times.

Simplification can sometimes lead to fewer mistakes because there are fewer steps to be taken, but excessive simplification with nonexpert operators or in difficult clinical cases can produce negative effects.

For these reasons, a multistep technique is advised.

CLINICAL SIGNIFICANCE

The multistep technique is a root canal instrumentation technique, which is based on standardized, but flexible, clinical protocol, which is found to be effective, safe, and predictable.

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