"A" sequence of irrigation

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Fig. 1_EndoVac system.

Fig. 1

_During the last several years, endodontics has progressed to the point where treatment has become less traumatic for the patient and less stressful for the dentist. While the use of nickel-titanium rotary instruments has allowed us to gain time during endodontic treatment, it can tempt us to neglect one of the main objectives of endodontics, that is the cleaning, or the chemical preparation, of the root canal system—we need to be clear on whether we are treating a canal or a root canal system. The main goal of root canal treatment is to completely eliminate the various components of the pulpal tissue, calcification and bacteria; to place a hermetic seal to prevent infection or reinfection; and to promote healing of the surrounding tissues, if needed.

There are many root canal preparation sequences available, such as crown-down, step-back and modified step-back. There are also many techniques for filling the root canal system, such as vertical compaction of warm gutta-percha, System B (SybronEndo) and lateral condensation. But do we have a protocol or a sequence for irrigation? In 2005, my irrigation protocol suggestions were published in an article in the *Oral Health* journal, and what follows here is an update thereof.

We must ask ourselves why we irrigate, and what irrigation protocol will provide the cleanest canal. In this context, let us remember that shaping is the result of endodontic instruments opening the space of lesser resistance, or what it is more commonly referred to as the main canal, while the cleaning results from irrigation. Therefore, there are two types of preparation. The first one is chemical and the second one is mechanical. It is the chemical preparation that will be discussed in the scope of this article.

It has been proven that there is a close correlation between these two types of preparation. In fact, apical preparation with a larger tip size and smaller taper, for instance ISO size 35.04 can help to reduce the level of colony-forming units dramatically compared with apical preparation of tip size 25.06. This outcome confirms that by performing a larger tip size apical preparation we can disrupt the biofilm mechanically, thus facilitating the work for the chemicals. Also, such apical preparation will allow for a greater quantity and stable concentration of the irrigating solution, which will therefore better eliminate the organic component and the smear layer from the root canal system walls. The files can clean only parts of the root canal system. They create a reservoir that can hold various irrigating solutions that will access and clean portions of the root canal system, which the instruments cannot reach. The access cavity, having four walls, will create a reservoir for the irrigating solutions to be frequently and continuously refreshed, which can be done safely with the EndoVac system (SybronEndo; Fig. 1) using the Master Delivery Tip for 20 to 30 seconds each time.

In endodontics, the most commonly used irrigating solution is sodium hypochlorite (NaOCl). It has many desirable qualities and properties. It has bactericidal cytotoxicity characteristics and it dissolves organic matter, while providing minor lubrication. However, NaOCl alone is not sufficient for complete cleaning of the root canal system. NaOCl has no effect on the smear layer and its high surface tension does not allow it to clean and disinfect the totality of the root canal system. For this reason, and depending on the specific clinical situation, one has to use other irrigants in combination with NaOCl.

The various irrigants that can be used consecutively and according to the clinical situation are as follows:
_17% EDTA (SmearClear, SybronEndo);
_0.2% chlorhexidine;
_5.25% NaOCl;
_50% citric acid; and
_distilled water.

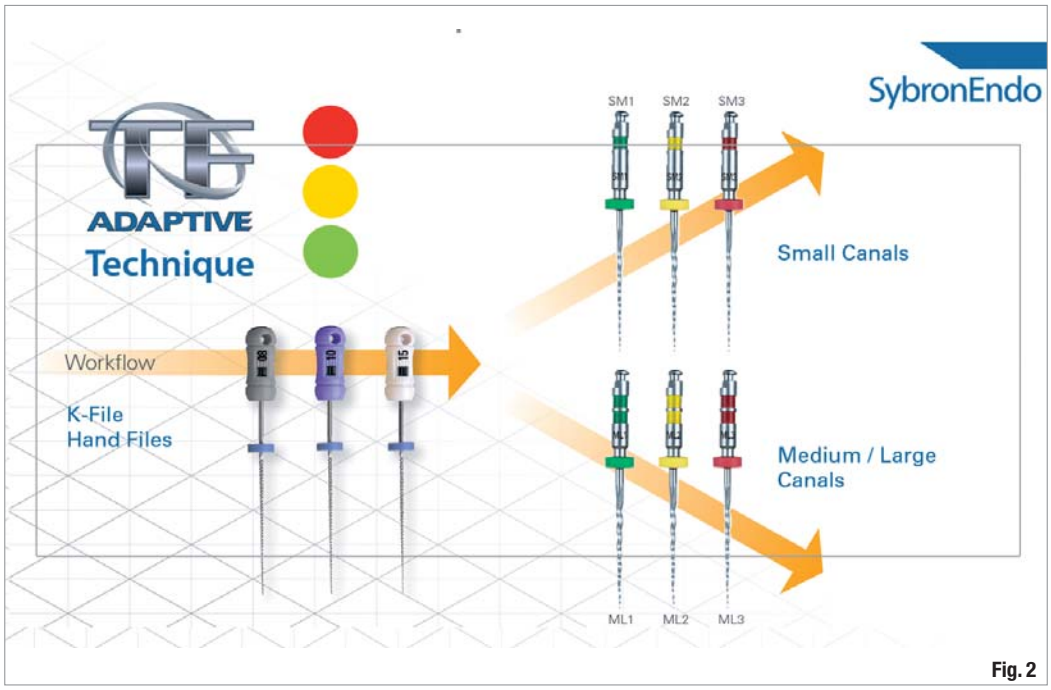

Fig. 2

Fig. 2_SM1 file and SmearClear (Sybron Endo).

In general, after preparing the access cavity, an endodontic file is introduced into the root canal. However, when a file is introduced immediately, it spreads bacterial toxins into the root canal system and into the periapical area, which will negatively affect the prognosis of the endodontic treatment owing to the likelihood of a post-operative flare-up. The breakdown and the accumulation of the pulp tissue and its collagen during the initial file penetration may, from the very beginning, create an organic plug within the root canal.

_Irrigation sequence during root canal treatment of a vital tooth

In this clinical situation, we have to face the challenge of treating the complexity of the different components of the pulp, and eventually the presence of bacteria and the smear layer produced during canal enlargement. We suggest beginning the treatment with 30-second irrigation with NaOCl via the Master Delivery Tip to destroy the majority of the pulp tissue inside the access cavity and provide a better view of the canal orifices by controlling bleeding and preventing any collagen plugs from forming. Also, chemical interaction between NaOCl and collagen can help us detect the presence of canals by observing the gas bubbles coming out from the orifice into the access cavity.

A second application of NaOCl and its activation is performed with a K-file (size 8 or 10). This will disorganise the pulpal tissue in both the cervical and middle thirds of the root canal. The M4 handpiece (SybronEndo), with its reciprocating movement of 30 degrees, on the Elements motor can be a great tool

Figs. 3a & b_Case 1: Treatment of a maxillary second molar. The patient was referred, since only two canals had been found and the tooth was still symptomatic. It took some time to find the third canal, which shared the same orifice but split off deeper inside (a). The post-op X-ray shows the isthmus filled between those two canals and a lateral exit in the middle of the palatal root that was causing an external infection (b).

Fig. 3a

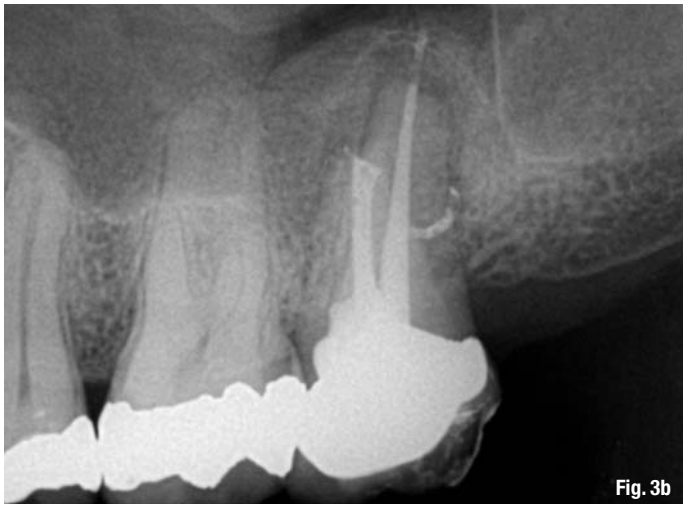

Fig. 3b

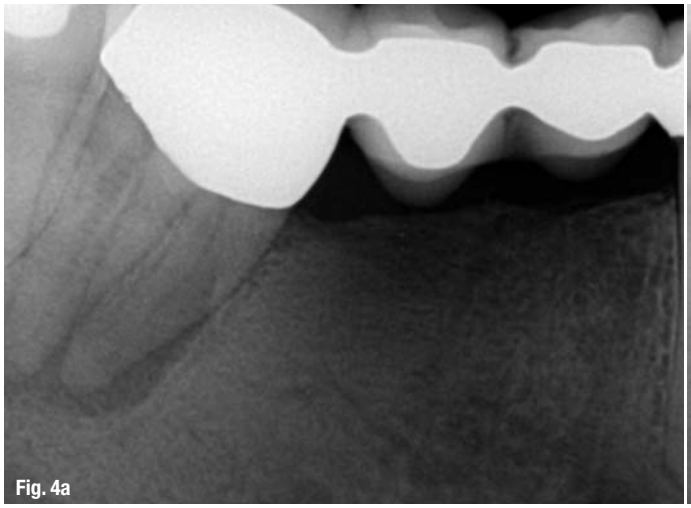
Fig. 4a


Fig. 4b

Figs. 4a & b_Case 2: The patient was referred to establish whether it was possible to save the molar (a). As no crack was found, a single-visit treatment was performed, and the six-month follow-up found good healing (b).

for creating a space of lesser resistance in the root canal system, agitating the NaOCl inside it in order to promote chemical interaction and helping dissolve the organic components.

Once the preparation of the canal has begun, with the use of the SM1 file (Fig. 2), or any rotary file, SmearClear (17% EDTA, cetrimide and surfactants) must be used. EDTA is an organic acid that eliminates the mineral component, or the smear layer, formed during the root canal enlargement. The greatest amount of smear layer is produced during the use of rotary files. A surface tension inhibitor will allow for better contact with the dentine and, hence, for a higher efficiency of the product.

It is advised to alternate between EDTA and NaOCl from the beginning of the preparation in order to eliminate the mineral layer before it thickens and becomes condensed inside the canal system, closing access to lateral and accessory canals and dentinal tubules, which would altogether mean that by the end of the preparation the system would be blocked with only the main canal open. I like to compare this technique to cleaning out the snow during a week-long snowstorm: if we do not clean the snow from our door daily, we will be blocked off inside by the end of the storm and it will take a great deal of effort to remove the snow afterwards to open the door.

Ultrasonic activation of the irrigating solution with a small-diameter file is recommended for more efficient chemical preparation. However, we need to ensure that the tip stays at least 5 mm away from the working length to avoid pushing any chemical outside the root canal and into the periodontal ligament and supporting bone. Each time a rotary file is used, an irrigating solution must be present inside the canal, and this should be EDTA. The use of EDTA early in the sequence facilitates the flow of the other irrigants, especially NaOCl or chlorhexidine, into the lateral canals, isthmuses and the whole root canal system, allowing for proper chemical preparation of the root canal system. Also, 17% EDTA plays an important role in the reduction of inflammatory reaction by inhibiting the affinity of macrophages to the vasoactive peptides in the pulpal tissue. The total exposure time of 4 to 5 minutes for EDTA inside the canal must not be exceeded.

After using the SM1 file (TF Adaptive sequence, SybronEndo), we need to neutralise the acidity of the EDTA in order to avoid a chemical interaction between the acid and the base. (As a general rule, one should always avoid any kind of chemical interactions inside the root canal. Saline or distilled water can be used to wash out the previous chemical prior to the use of a different one.) Specifically, an acid and a base interaction leads to the formation of gas bubbles, which can create the so-called dead water zone, or vapour lock, not only at the end of the main canal or at the entry to a lateral canal, but also anywhere inside the root canal system. The interaction can also form a small protective layer of air bubbles on the surface of the collagen fibres, preventing their good contact with NaOCl for a better dissolving action.

Irrigation with NaOCl for 30 seconds is performed with the Master Delivery Tip, followed by rinsing with saline or distilled water prior to the next application of EDTA and the use of the SM2 file. Once the file has been used, the acid is neutralised, and EndoVac's MacroCannula is used to remove and deeply neutralise the previous chemical. Then, another 30-second irrigation with NaOCl is performed in each canal prepared with the SM2 file with the MacroCannula. The idea is to create an area of negative pressure inside the root canal system to draw the NaOCl delivered into the access cavity deeper into the system safely, thus creating a current of fresh irrigant inside the root canal system for a more efficient chemical interaction and organic tissue dissolution.

The same sequence is used for the SM3 file. An EDTA solution is placed during apical preparation with this final rotary file, followed by saline or water, but using EndoVac's MicroCannula, since it fits into the apical area and its lateral holes can create negative pressure (short-term vacuum) exactly at the working length, removing all the air bubbles as well. Then, 30 seconds of NaOCl irrigation in each canal follows, with a small modification: since the MicroCannula holes are small, it needs a bit more time to evacuate fluids from the apical area; therefore, irrigation with the Master Delivery Tip is performed for 10 seconds, followed by a 5-second pause, for three such cycles in each canal.

Finishing the chemical preparation of the root canal system starts first with flushing out NaOCl with saline and drying the space with the MicroCannula. Then, chlorhexidine is introduced into each canal for 10 seconds to inhibit the dentine's matrix metalloproteinases for better stability of the bonding, since we use bonded root canal sealer for obturation. The final and very important step is to flush all the chemicals from the root canal system with distilled water or saline. The reasoning is as follows:

_Since water is not compressible, using the cannulas to suction the fluids from the root canal system will allow the sealer to enter and seal the system.
_Any chemical can be toxic and pushing chemicals outside the root itself with the master cone can create some inflammation, which may result in post-operative pain; therefore, it is best to remove all liquids remaining in the canal.
_Chemicals can interact with the components of some sealers and consequently reduce either their bonding or sealing ability, or even react with some radio-opacifiers, such as bismuth, and cause a chemical reaction that could destroy the obturation material. Oxygen can inhibit bonding, while EDTA can also have a negative effect on the sealer–dentine interaction.

_Irrigation sequence during root canal treatment of a necrotic tooth

The main difference between vital and necrotic teeth is the absence, though partial, of the pulpal parenchyma with the abundance of bacteria present in the latter. For this reason, the irrigation sequence is different. Irrigation should be initiated with either NaOCl (5.25%) for its antibacterial effect or with chlorhexidine (0.02%) for 30 to 40 seconds to eliminate the various bacterial types present in the root canals and dentinal tubules. Distilled water is used to neutralise the effect of each of these irrigants. Then, the same irrigation sequence as described previously for vital teeth is repeated.

_Discussion

Many types of irrigants can be used, such as hydrogen peroxide, anaesthetic solutions, physiological serum, and deionodised water. What is proposed is an irrigation sequence that may be more complex depending on the clinical situation. The alternation between irrigants (NaOCl, chlorhexidine, distilled water, and EDTA) is essential for the cleaning of the root canal system.

The reduced preparation time when using rotary NiTi instruments is balanced by copious irrigation for better cleaning of the root canal system, which will contribute to the increased success rate of endodontic treatment.

The chemical preparation will help us succeed in adequate cleaning of the main canal and its systems. Cleaning is followed by 3-D obturation to fill all the cleansed and prepared canals.

_Conclusion

The irrigation procedure is often dismissed as simple during endodontic treatment; however, it must not be overlooked, since it is crucial to the success of endodontic treatment.

Irrigation, which is too often reduced to a needle on the tray, has to be systematically evaluated in order to become an endodontic entity with a precise time schedule and procedural systematisation._

Acknowledgement: I would like to thank Yulia Vorobyeva, interpreter and translator, for her help with this article.

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