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Self adjusting file system: A Review

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Abstract

To discuss a new concept in endodontic world, the self-adjusting file (SAF), and compare its unique features compared with other rotary nickel-titanium file systems. As far as relatively straight and narrow root canals with a round cross-section are concerned the goal of cleaning and shaping may be easily and reproducibly achieved with rotary files. The SAF file is hollow and to adapt to the cross-section of the root canal it is designed as a thin cylindrical nickel-titanium lattice. A single file is used throughout the procedure. A transline- (in-and-out) vibration is performed when it is inserted into a path initially prepared by a # 20 K-file and operated. The circumferential pressure allows the file's abrasive surface to gradually remove a thin uniform hard-tissue layer from the entire root canal surface, that gives canal a similar cross-section but of larger dimensions.

Keywords: Cleaning debris, flat root canals, EDTA, sodium hypochlorite.

1. Introduction

In root canal treatment procedures, the cleaning and shaping of root canals is a key step. The subsequent stage of root canal obturation may also be jeopardized, leading to the potential failure of treatment unless the all tissue remnants and debris are removed [1,2]. Any material left between the canal wall and the root canal filling may prevent intimate adaptation between the two and may provide a space for bacterial leakage and bacterial proliferation.

The smear layer and some amounts of debris may be present on the walls of the root canals, even with the simplest morphology. A thick smear layer represents a potential gap between the root canal filling and the root canal wall that may be capable of accommodating approximately five layers of bacteria. Moreover, the smear layer may block or prevent the free access of antibacterial agents to the bacteria that may have penetrated into the dentinal tubules.

Available recent file system generates a smear layer and leaves debris in the root canal, and rinsing with sodium hypochlorite alone is unable to render the canal free of debris and smear layers [3–11]. But after adding the application of chelating agents such as EDTA may dramatically improve the overall efficiency of the procedure [8-13]. The apical third of the root canal always presents a problem in regard to the ability to achieve the same level of cleanliness, even when the coronal and middle thirds of the canal are relatively clean [5,6,9,12]. The presence of a smear layer and debris may prevent sealer adaptation to the canal walls and allow penetration of irritants into the periradicular tissues, initiating or sustaining periradicular inflammation [13,14].

The Self-Adjusting File system has two main features. First, the SAF is a hollow and flexible file that adapts itself three-dimensionally to the shape of the root canal, including the ability to adapt to its cross-section [15]. It removes a uniform dentin layer from the canal walls even in oval, flat root canals [15]. The SAF allows for maintaining a flat canal as a flat canal with slightly larger dimensions. Second, it allows for the continuous irrigation of the root canal throughout the procedure, with additional activation of the irrigant by its vibrating motion that creates

turbulence in the root canal. Irrigation may be provided by any physio-dispenser type of device or by a special rinsing unit such as the one used in the current study, which delivered the irrigant at a flow rate of 5 mL/min.

The continuous flow of the irrigant through the file combined with the vibrating motion may have an effect on the cleaning ability of the file in the root canal at large and particularly in its difficult-to-clean cul de sac region, the apical third of the root canal [16]. This challenging portion of the root canal may benefit from the unique mode of action of the SAF file.

The SAF is a hollow file designed as a compressible, thin-walled pointed cylinder with 1.5 or 2.0 mm in diameter composed of 120-mm-thick nickel-titanium lattic. The 1.5-mm file may easily be compressed to the extent of being inserted into any canal previously prepared or negotiated with a # 20 K-file [17]. The 2.0-mm file will easily compress into a canal that was prepared with a #30 K-file.

When inserted into a root canal, it adapts itself to the canal's shape, both longitudinally (as will any nickel titanium file) and along the cross-section. In a round canal, it will attain a round cross-section, whereas in an oval or flat canal it will attain a flat or oval cross-section, providing a three-dimensional adaptation. The surface of the lattice threads is lightly abrasive, which allows it to remove dentin with a back-and-forth grinding motion [17].

2. How self adjusting files work?

The SAF is operated with transline (in and out) vibrating hand pieces with 3,000 to 5,000 vibrations per minute and amplitude of 0.4mm. Such a hand piece may be the KaVo GENTLE power or equivalent combined with a 3LDSY head (360 free rotation; Kavo, BiberachRiss Germany). The hollow design allows for continuous irrigation throughout the procedure. A special irrigation device (VATEA, ReDent-Nova) is connected by a silicon tube to the irrigation hub on the file and provides continuous flow of the irrigant of choice at a low pressure and at flow rates of 1 to 10 mL/min.

The SAF is inserted into the canal while vibrating and is delicately pushed in until it reaches the predetermined working length. It is then operated with in-and-out manual motion and with continuous irrigation using two cycles of 2 minutes each for a total of 4 minutes per canal. This procedure will remove a uniform dentin layer 60- to 75-mm thick from the canal circumference. The SAF file is designed for single use.

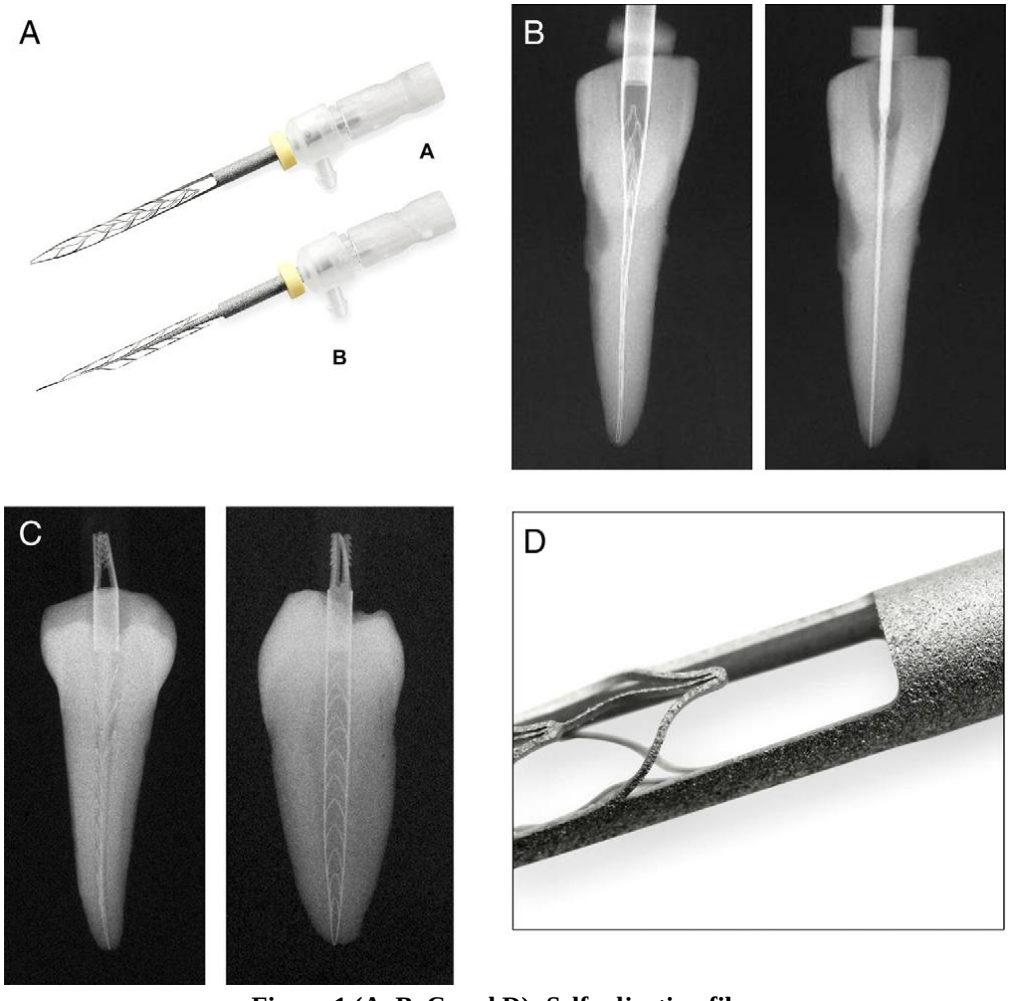

Figure 1 (A, B, C and D): Self adjusting files

3. Features

3.1 A Self-adjusting File that Adapts Itself to the Three-Dimensional Anatomy of Root Canals

The SAF file is different from any current nickel-titanium rotary file. If the canal is flat, oval, tear shaped, or simply large, this mode of preparation may leave untreated recesses, mainly buccally or lingually to the machined part of the canal.

3.2 Uniform Removal of Dentin and Remaining Wall Thickness

Rotary nickel-titanium files may result in uneven thickness of the remaining dentin wall, when operated in flat root canals. The uneven thickness may be even more pronounced, when excessive apical preparations are used in an attempt to include as much of the irregular canal space in the preparation as possible [18,19].

3.3 Prevention of Canal Transportation

The SAF file is extremely flexible and pliable. It does not impose its shape on the canal but rather complies with its original shape. This is true both circumferentially and longitudinally. The long axis of the apical part of curved canals is kept closer to its original place than reported for rotary files: a mean center-of-mass shift of 68.8, 7.7 mm compared with the shift of 120 to 135 mm previously reported by Peters *et al* with rotary files in similar canals. In curved canals, the thicker rotary nickel-titanium files have a tendency to transport the canal to the outer side of the curvature.

3.4 High Durability

The SAF file is extremely durable and may go through rather severe abuse before a mechanical failure will occur. It does not have a core as do other nickel-titanium instruments. Any strain applied to it is distributed along many of its delicate parts, and the total endurance is a function of the accumulated endurance of each of these individual parts. [20]

3.5 Root Canal Obturation

Obturation using lateral compaction using chloroform-dipped customized master cones (3, 32) is of particular interest because it allows the operator to actually visualize the shape of the SAF-treated root canal as reproduced on the customized master cone. Such master cones are presented in Figure 1B.

3.6 Continuous Irrigation with Sodium Hypochlorite

Irrigation of the root canal with copious amounts of sodium hypochlorite during root canal treatment is widely recommended [21,22]. It has been well documented that when exposed to its target of bacteria and tissue debris, sodium hypochlorite loses its activity rather quickly.[23]

4. Advantage

4.1 Debris

Root canal preparation using the SAF combined with the alternating irrigation protocol rendered all root canals clean of debris.

4.2 Smear Layer

The combined action of the SAF with the continuous irrigation regimen resulted in a root canal surface clean of smear layer.

5. Conclusion

The SAF represents a new approach in endodontic file design and operation. Its main features are as follows:

1) A three-dimensional adaptation to the shape of the root canal, including adaptation to its cross-section.
2) One file is used throughout the procedure.
3) Because of the lack of a rigid metal core, canal straightening and canal transportation of curved canals are largely avoided.
4) High mechanical durability, thus overcoming the issue of separated nickel-titanium instruments.
5) Continuous irrigation with constant refreshment of the irrigant throughout the procedure because of Hollow design.

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