Eight Months of Clinical Experience with the Self-Adjusting File System

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Abstract

Introduction: The Self-Adjusting File (SAF) system (ReDent-Nova, Ra'anana, Israel) has been recently introduced for the simultaneous instrumentation and irrigation of root canals. The SAF is claimed to adapt itself three dimensionally to the root canal, including its cross-section. It is operated with a continuous flow of sodium hypochlorite that is delivered into the root canal through the hollow file and claimed to be activated by sonic agitation of the irrigant. Our aim was to present for the first time clinical cases prepared with the SAF system and to describe a clinical classification of canals, according to their difficulty, with recommendations for endodontic treatment sequences for each category. **Methods:** This report is based on the experience of a single endodontist, who used the system to treat more than 50 consecutive primary endodontic cases over the prior 8 months. **Results:** A clinical classification was developed which enabled the operator to select a treatment protocol for easy and optimal glide path preparation to be effectively used with the SAF file in the various root canals encountered in the clinical environment. **Conclusions:** Clinical classification of canal difficulty makes root canal treatment sequences with the SAF simple and predictable. Many types of cases can be treated with the SAF system although a novice user is advised to advance slowly along the learning curve from simpler to more complicated canals. *(J Endod 2011;37:881–887)*

Key Words

Instrumentation, irrigation, obturation, self-adjusting file

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The primary goal of endodontic treatment is to cure or prevent apical periodontitis (1). Adequate shaping, cleaning, and obturation, followed by a good coronal seal, are prerequisites for a favorable outcome (2, 3). The introduction of rotary nickel-titanium (NiTi) files during the last 2 decades constituted a major leap in the shaping quality and efficiency for these procedures. The use of NiTi rotary instruments enabled faster and easier instrumentation with a better preservation of the canal center of mass and less procedural errors (4). Higher rates of good quality obturation have also been observed with the increased use of rotary NiTi files (5).

Nevertheless, many studies indicate that shaping is not equal to cleaning. It has been reported that NiTi rotary instruments may leave 40% to 60% of the root canal surface unchanged by the procedure (6–8). Shaping by rotary NiTi instruments was reported to be especially ineffective for cleaning long oval and flat canals (9–11). It was also reported that other systems, such as hand stainless steel files and the Endo-Eze Anatomic Endodontic Technology (AET) (Ultradent, South Jordan, UT) system (reciprocating files with milling motion), were also unable to overcome the challenges of shaping and cleaning oval canals (12). These drawbacks require special attention because the prevalence of canals with a long oval cross-section in their apical third ranges from 25% to 50% of cases (13).

This yet unmet challenge resulted in a new branching point in the "evolution tree" of endodontics. One branch consists of attempts to meet this three-dimensional (3D) challenge by advanced irrigation methods. This approach aims to complete debridement in mechanically inaccessible areas of the root canal by the action of sodium hypochlorite. Many devices have been introduced with this purpose in mind, including passive ultrasonic irrigation (14, 15), sonic activation of the irrigant by devices such as the Endoactivator (Advanced Endodontics, Santa Barbara, CA) or F Files (Plastic Endo, Lincolnshire, IL), and systems for dynamic irrigation such as RinseEndo (Duerr Dental, Bietigheim-Bissingen, Germany) (16). Negative pressure irrigation systems like the EndoVac (Discus Dental, Culver City, CA) represent yet another approach to meet the same challenge (17).

The other new branch is represented by the Self-Adjusting File (SAF) system, which was recently introduced by ReDent-Nova (18). The SAF is a hollow file designed as a compressible, thin-walled, pointed cylinder 1.5 mm in diameter and composed of 120-μm-thick nickel-titanium lattice. The SAF is operated using a trans-line (in-and-out) vibrating handpiece head (RDT3, ReDent-Nova) that generates 5,000 vibrations per minute at an amplitude of 0.4 mm. This innovative file is claimed to adapt itself to the 3D canal morphology both longitudinally and cross-sectionally (18). It may file up to 92% of the of root canal walls (19) while allowing for the continuous flow of fresh NaOCl through the hollow file by using a peristaltic irrigation device (VATEA, ReDent-Nova). The file is claimed to continuously activate the irrigant by its sonic vibration with an additional scrubbing effect on the canal walls by the closely adapted metal mesh, which is also continuously moved with a manual in-and-out motion by the operator. These three unique features likely contributed to the effective cleaning ability recently reported by Metzger et al (20).

Consequently, this new conceptual branch aims for simultaneous 3D shaping, debridement, and disinfection of the root canal (18, 21). The 3D shaping effect of

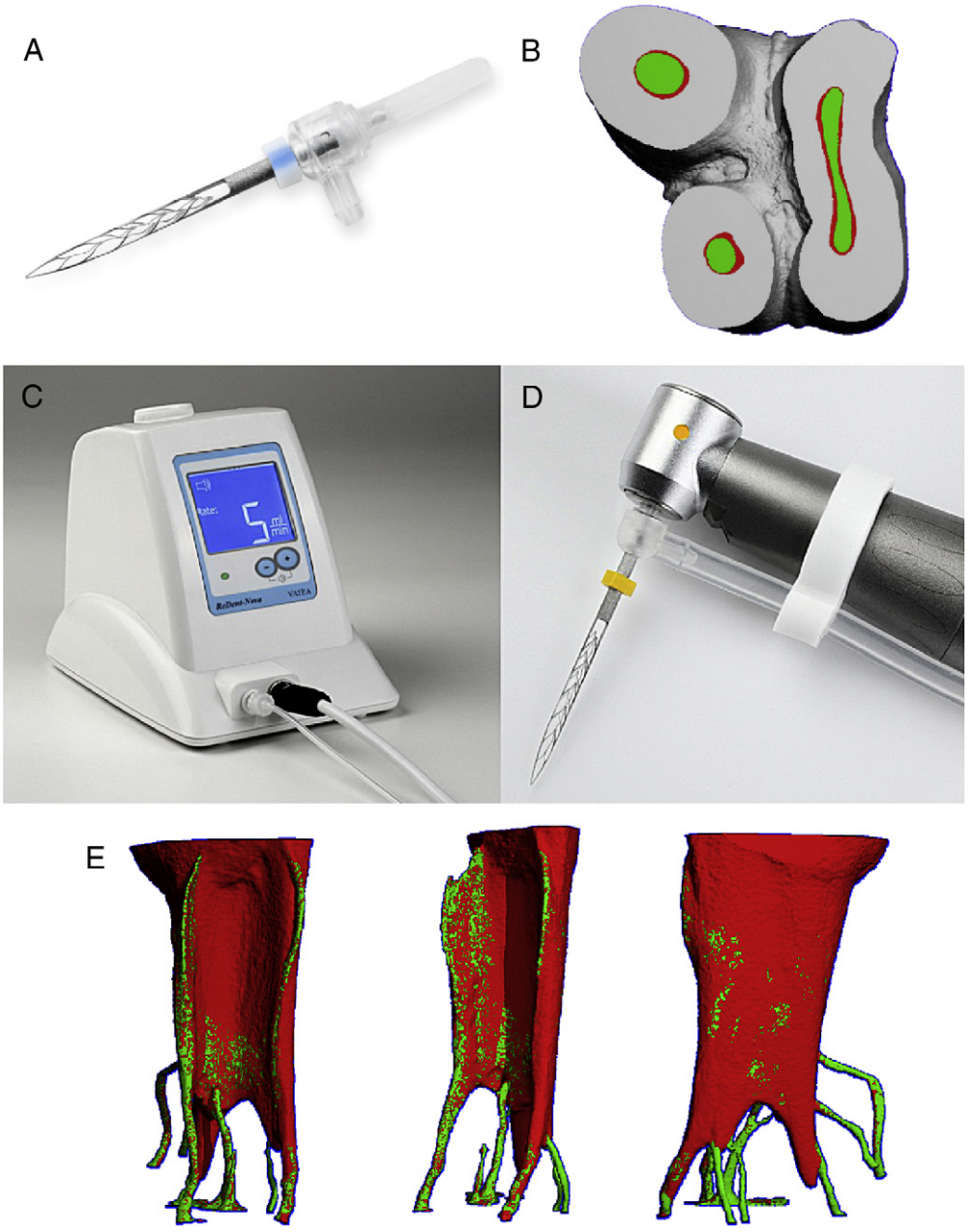

Figure 1. (*A*) A self-adjusting file. (*B*) A micro–computed tomographic cross-section of a long-oval root canal treated with the SAF. *Green,* before; *red*, after the procedure. Note the uniform removal of dentin around the circumference of the canal (image from ongoing study by M Solomonov and F Paqué). (*C*) The VATEA irrigation pump. (*D*) A SAF file with the irrigation tube attached to its hub. (*E*) A C-shaped canal after instrumentation with the SAF. *Green*, before treatment; *red*, after treatment (image from an ongoing study by M. Solomonov and F. Paqué).

the SAF file is most pronounced in long oval canals (Fig. 1*B*) and C-shaped canals in extremely challenging cases for instrumentation (Fig. 1*E*).

Clinical Experience

The SAF system has been used by the author for the last 8 months, during which more than 50 cases were completed with this new system. These cases included all consecutive primary endodontic treatment cases that were referred to the author's practice during this period. The present article is designed to share this experience with readers and to outline the concepts and protocols that were developed over this period of time.

Step One: Glide Path and Canal Classification

One of the most important steps when working with the SAF system is the initial preparation of a glide path that will allow free insertion of a #20 K-file to its working length. This, in turn, will allow insertion of the SAF to the full length of the prepared canal (22).

It is suggested to use this step to classify the following difficulty levels of an individual root canal: (1) easy canals: canals that allow a #20 file (or larger) to be inserted to a working length with no prior

Figure 2. (*A–C*) An easy canal treated with the SAF. (*A*) Before, (*B*) the SAF in the canal, and (*C*) after treatment. Note the preservation of the canal shape (narrow coronally and then wide) in the radiographs (*A*) before and (*C*) after treatment. This would not have been possible with rotary files. (*D–F*) Root canals with medium difficulty. Note that the bulk of dentin in the orifice area was preserved (*arrow*). A brushing motion at the orifice to straighten the canal is unnecessary with the SAF because the instrument can easily handle a double curve with no danger of breakage or transportation. (*G–I*) A difficult root canal: the mesiobuccal and distobuccal canals were defined as "difficult." The glide path was established using the following sequence: Mtwo 10.04 → Mtwo 15.05 → 20 NiTi hand file. The SAF was used later to clean and shape the canals.

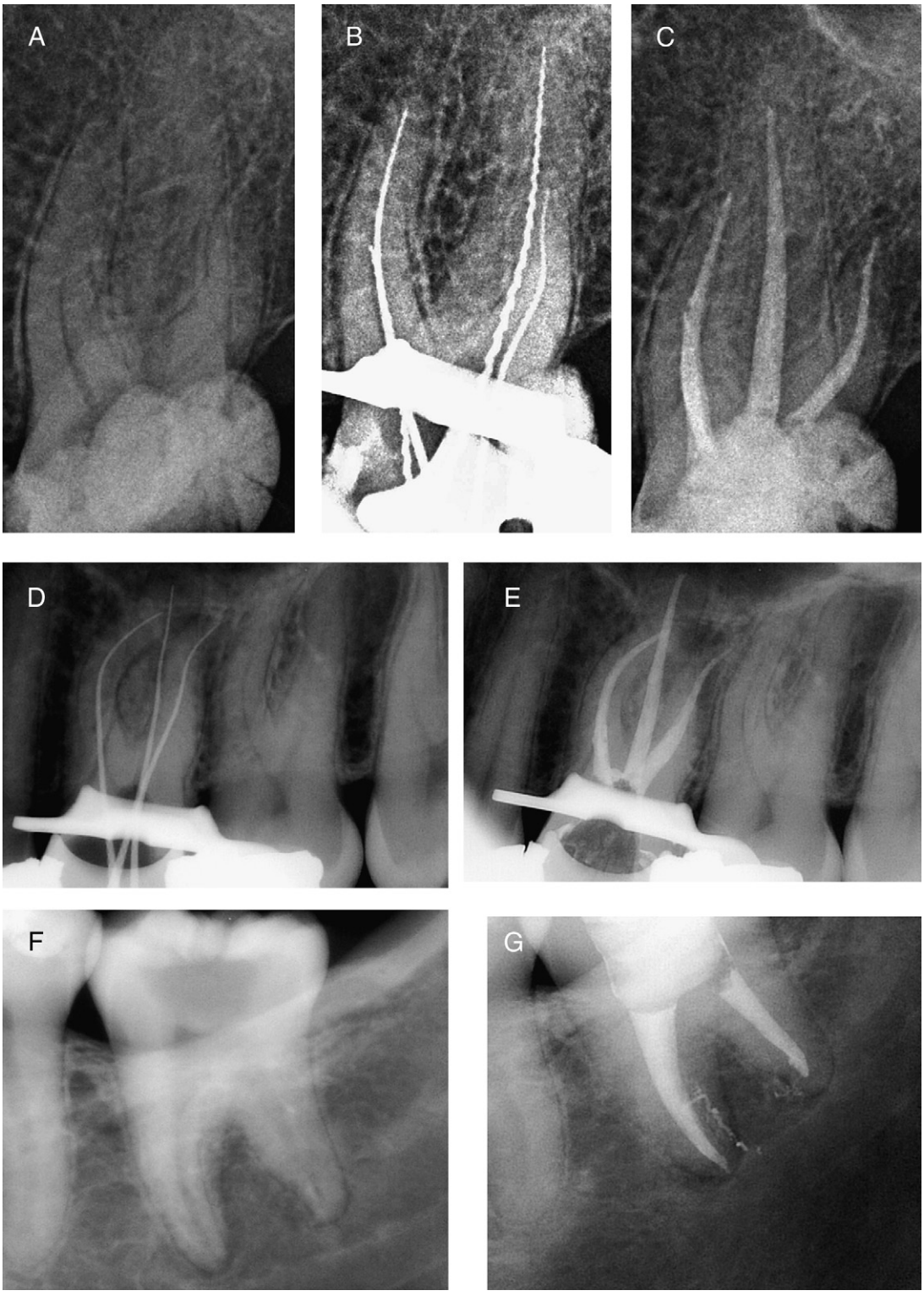

Figure 3. (*A–C*) A difficult root canal. The distobuccal canal was defined as "difficult." A glide path was established with the following sequence: PathFile 13.02 → 16.02 → 19.02 → 20 NiTi hand file. SAF was later used to clean and shape the canal. Note the double curve that was handled by the SAF with no straightening of the canal. (*D* and *E*) A difficult root canal. All three canals were defined as "difficult." A glide path was established using the sequence EndoWave MGP 10.02 → 15.02 → 20.02 → 20 NiTi hand file. The SAF was later used to clean and shape the canals. (*F* and *G*) Sealer extrusion: sealer extrusion through a lateral canal of a single, oval-flat canal of the mesial root of a second mandibular molar treated with the SAF system. Such extrusions are commonly associated with effective irrigation that removed the tissue plug from the orifice of the lateral canal.

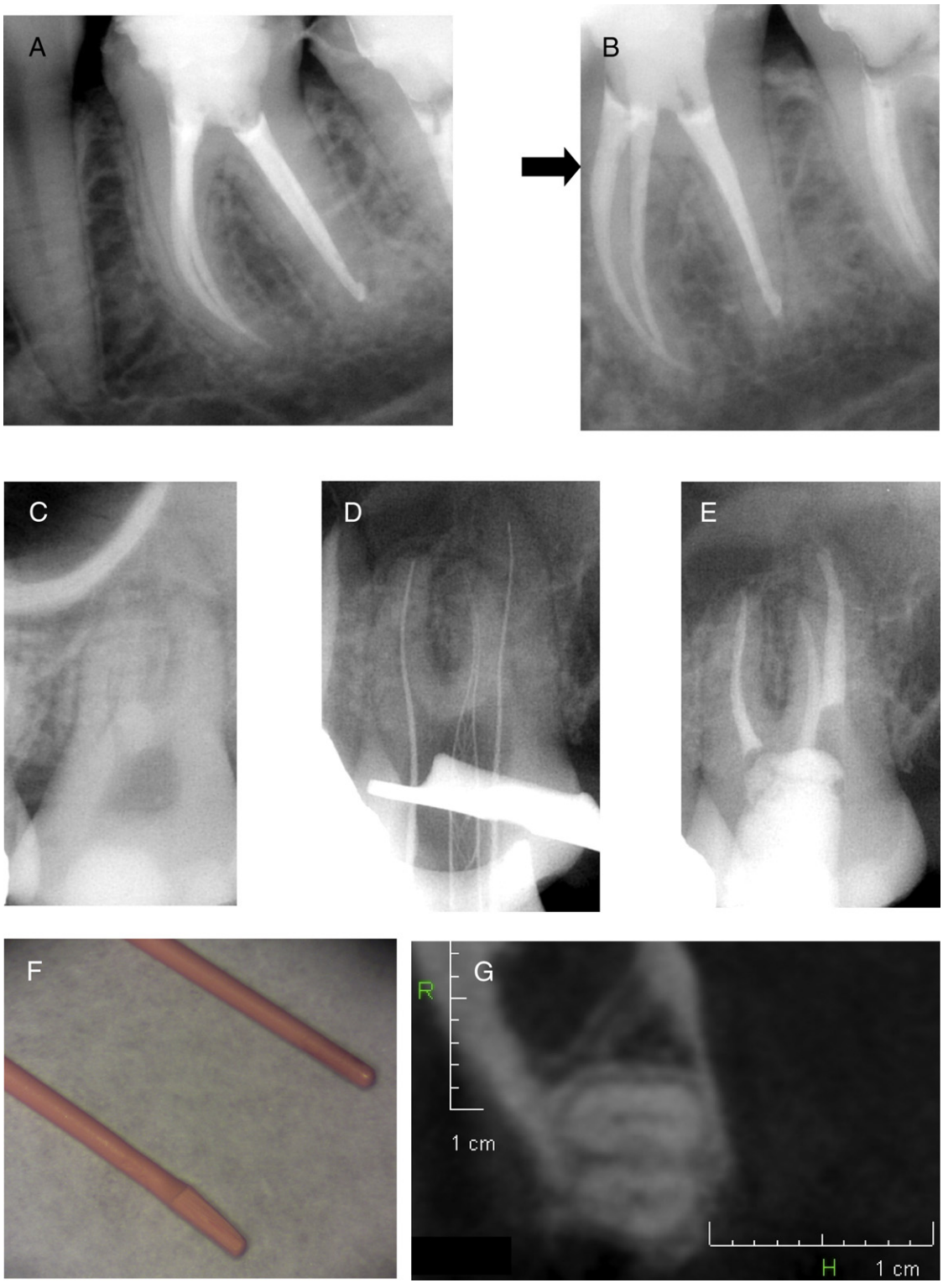

Figure 4. (*A* and *B*) Oval mesial canal of a lower molar: the second diagonal projection shows that one of the mesial canals treated with the SAF had an oval cross-section (*arrow*). (*C–E*) Obturation with the combination method: customized master cones were prepared using the chloroform-dip technique. They were allowed to dry and reharden and then used with sealer as a first cone followed by hot compaction. (*F*) A chloroform-dipped customized master cone: the cone has an imprint of the apical part of the canal on its surface. It was allowed to dry and reharden before use. (*G*) A flat oval canal: a section of a cone-beam computed tomographic image showing an oval-flat root canal in the mesial root of a second mandibular molar.

instrumentation, (2) medium canals: canals that allow only #15 file to be inserted to a working length, and (3) difficult canals: canals that allow only a #10 file (or smaller) to be inserted to a working length.

Step Two: Instrumentation Protocols

Instrumentation protocols should be chosen according to the degree of difficulty expected in a given canal, based in the first instrument to bind (FITB) in the apical part of the canal.

Easy Canals (FITB ≥#20)

In easy canals, the SAF file is used for 4 minutes with continuous sodium hypochlorite irrigation at a flow rate of 4 mL/min. A short in-and-out pecking motion is used continuously to prevent binding of the file in the canal and to allow the file to change its position in the canal during every outbound stage of the pecking motion. The endpoint of the procedure is the completion of 4 minutes of continuous operation.

Medium Canals (FITB = #15)

In medium cases, either a Profile 20.04 (Dentsply-Tulsa, Tulsa, OK) or Mtwo 15.05 (VDW, Munich, Germany) rotary file or similar instruments may be used to establish the glide path required by the SAF file followed by a #20 NiTi K-file. The SAF system is then used as described for the easy canals. For mandibular molars, there is no need to remove the bulk of dentin in the coronal mesial part of mesial canals, as is commonly needed with rotary instruments. The SAF file can easily negotiate a double curve with no risk of file separation or transportation of the canal (Fig. 2*D* and *F*).

Difficult Canals (FITB ≤#10)

In difficult canals, one of the following glide-path establishment protocols may be applied using special path-establishment instruments from either the Mtwo system, PathFile (Dentsply-Maillefer, Ballegues, Switzerland), or EndoWave MGP (Morita, Tokyo, Japan). The purpose is to establish a glide path that will allow a #20 hand file to reach its working length effectively, safely and with minimal canal transportation.

Such protocols may include the following: (1) Mtwo 10.04 → Mtwo 15.05 → 20 NiTi K file (Fig. 2*G–I*), (2) PathFile 13.02 → 16.02 → 19.02 → 20 NiTi K file (Fig. 3*A–C*), and (3) EndoWave MGP 10.02 → 15.02 → 20.02 → 20 NiTi K-file (Fig. 3*D* and *E*). Other similar instruments may be used to gain the same goal: a canal that allows a free passage of a # 20 K-file to the working length.

Radiographic Presentation of Cleaning, Shaping, and Irrigation with the SAF System

The ability of the SAF to effectively clean and shape oval canals was well established by micro–computed tomographic studies (18, 19). The larger cross-sectional diameter of oval canals is directed buccolingually and thus is not often seen in a clinical radiographic projection. Nevertheless, in some cases, when more than one final radiograph is taken, such as the one presented in Figure 4*A* and *B*, one may see the result of cleaning and shaping of an oval canal. One of the mesial canals clearly had a buccolingual dimension that failed to be detected in the orthoradial radiograph (Fig. 4*A*) but is evident in the angulated projection (Fig. 4*B*).

In the laboratory, the efficacy of cleaning by irrigation systems is commonly studied using scanning electron microscopy (20). Clinically, an effective irrigation is often expressed by sealer extrusion through lateral canals. Effective irrigation with NaOCl may dissolve and remove the soft tissue plug at the orifice of a lateral canal, thus allowing sealer extrusion during obturation. This indirect evidence of effective irrigation is presented in Figure 3*G*. A single flat-oval mesial canal in a mandibular molar was cleaned and shaped with the SAF system. Upon obturation, sealer was extruded through a lateral canal (Fig. 3*F* and *G*). This can potentially be viewed as indirect clinical evidence of effective cleaning by irrigation.

Step Three: Obturation

When SAF is used in canals that originally had an oval cross-section at their apical region, this oval shape will usually be enlarged as an oval cross-section of larger dimensions (18). When used with conventional warm gutta-percha compaction methods, this may result in excessive sealer extrusion. To avoid sealer extrusion, a combination technique may be used; lateral cold compaction with NiTi spreader is initially used followed by vertical condensation with hot plugger, heated to 100°C by a BeeFill Pack system (VDW) or similar, and followed by condensation with cold Mashtou hand-plugger (Dentsply-Maillefer). This combination technique allows for good control in the apical part, thus avoiding excessive sealer extrusion.

When applied in large canals with #50 or greater apical size, a chloroform-dipped customized master cone may be prepared and used in the first stage followed by hot vertical compaction (Fig. 4*C–F*). The master cone, which is allowed to dry and reharden before use, carries on its surface an imprint of the apical part of the canal (Fig. 4*F*).

Conclusions

Based on our experience in more than 50 clinical cases, it may be concluded that the SAF system has a place in the everyday endodontic practice of both general practitioners and specialists. It provides a practical solution for the thus far unsolved problem of mechanized cleaning and shaping of canals with oval and oval-flat cross-sections.

The increasing use of CBCT in endodontic practice (Fig. 4*G*) will most probably result in the identification of many canals presenting non-round cross-sections: a clear indication for SAF system usage. As with any new system, this system also has a learning curve. For a novice, it may be helpful to first practice on extracted teeth. One may then advance to clinical use in 10 incisors and then 10 premolars, and only then should the newly gained skills be applied to molar endodontics.

Acknowledgments

The author denies any conflicts of interest related to this study.

References

1. Orstavik D, PittFord TR. Essential endodontology. 1st ed. Oxford: Blackwell Science; 1998.
2. Peters LB, Wesselink PR, Buijs JF, van Winkelhoff AJ. Viable bacteria in root dentinal tubules of teeth with apical periodontitis. J Endod 2001;27:76–81.
3. Ray A, Trope M. Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and the coronal restoration. Int Endod J 1995;28: 12–8.
4. Cheung GS, Liu CS. A retrospective study of endodontic treatment outcome between nickel-titanium rotary and stainless steel hand filing techniques. J Endod 2009;35: 938–43.
5. Molander A, Caplan D, Bergenholtz G, Reit C. Improved quality of root fillings provided by general dental practitioners educated in nickel–titanium rotary instrumentation. Int Endod J 2007;40:254–60.
6. Peters OA, Schonenberger K, Laib A. Effects of four NiTi preparation techniques on root canal geometry assessed by micro computed tomography. Int Endod J 2001;34: 221–30.
7. Paqué F, Ganahl D, Peters OA. Effects of root canal preparation on apical geometry assessed by micro–computed tomography. J Endod 2009;35: 1056–9.
8. Paqué F, Balmer M, Attin T, Peters OA. Preparation of oval-shaped root canals in mandibular molars using nickel-titanium rotary instruments:a micro-computed tomography study. J Endod 2010;36:703–7.

9. ElAyouti A, Chu A-L, Kimionis I, Klein C, Weiger R, Löst C. Efficacy of rotary instruments with greater taper in preparing oval root canals. Int Endod J 2008;41: 1088–92.
10. De-Deus G, Gurgel-Filho ED, Magalhães KM, Coutinho-Filho T. A laboratory analysis of gutta-percha-filled area obtained using Thermafil, System B and lateral condensation. Int Endod J 2006;39:378–83.
11. De-Deus G, Reis C, Beznos D, Gruetzmacher de Abranches AM, Coutinho-Filho T, Pasiornik S. Limited ability of three commonly used thermoplasticized gutta-percha techniques in filling oval-shaped canals. J Endod 2008; 34:1401–5.
12. Taha N, Ozawa T, Messer H. Comparison of three techniques for preparing oval-shaped root canals. J Endod 2010;36:532–5.
13. Wu M-K, R'Oris A, Barkis D, Wesselink P. Prevalence and extent of long oval canals in the apical third. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;89: 739–43.
14. Al-Jadaa A, Paqué F, Attin T, Zehnder M. Necrotic pulp tissue dissolution by passive ultrasonic irrigation in simulated accessory canals: impact of canal location and angulation. Int Endod J 2009;42:59–65.
15. Al-Jadaa A, F.Paqué F, Attin T, Zehnder M. Acoustic hypochlorite activation in simulated curved canals. J Endod 2009;35:1408–11.
16. Gu LS, Kim JR, Ling J, Choi KK, Pashley DH, Tay FR. Review of contemporary irrigant agitation techniques and devices. J Endod 2009;35:791–804.
17. Hockett JL, Dommisch JK, Johnson JD, Cohenca N. Antimicrobial efficacy of two irrigation techniques in tapered and nontapered canal preparations: an in vitro study. J Endod 2008;34:1374–7.
18. Metzger Z, Teperovich E, Zary R, Cohen R, Hof R. The self-adjusting file (SAF). Part 1: respecting the root canal anatomy- a new concept of endodontic files and its implementation. J Endod 2010;36:679–90.
19. Peters OA, Boessler C, Paqué F. Root canal preparation with a novel nickel-titanium instrument evaluated with micro-computed tomography: canal surface preparation over time. J Endod 2010;36:1068–72.
20. Metzger Z, Cohen R, Zary R, Teperovich E, Paqué F, Hülsmann M. The Self-adjusting File (SAF). Part 3: removal of debris and smear layer—a scanning electron microscope study. J Endod 2010;36:697–702.
21. Siqueira JF, Alves FRF, Bernardo M, Almeida BM, Machado de Oliveira JC, Rôcas JN. Ability of chemomechanical preparation with either rotary instruments or Self-Adjusting File to disinfect oval-shaped root canals. J Endod 2010;36: 1860–5.
22. Hof R, Perevalov V, Eltanani M, Zary R, Metzger Z. The self-adjusting-file (SAF). Part 2: mechanical analysis. J Endod 2010;36:691–6.

ERRATUM

The affiliation and address of the corresponding author for the article, "Genetic Predisposition to Persistent Apical Periodontitis" by Morisani et al (J Endod 37:455-9, 2011) were incorrectly provided. The correct affiliation and address are: From the Department of Endodontics, Case Western Reserve School of Dental Medicine, Cleveland, Ohio. Address requests for reprints to Dr Anita Aminoshariae, Department of Endodontics, Case Western Reserve School of Dental Medicine, 10900 Euclid Avenue, Cleveland, OH 44106.

The Journal regrets this error.