SAF SYSTEM

ReDent NOVA

Minimally Invasive Endodontics

Minimally Invasive Endodontics

for Better and Safer Treatment

SAF: Self-Adjusting File

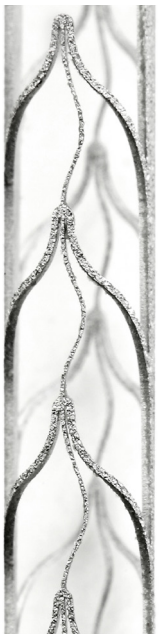
The Self-Adjusting File (SAF) represents a ***paradigm shift in modern endodontics*** as the first instrument that truly addresses the basic cleaning, shaping and obturation principles of endodontic treatment in all three dimensions.

The SAF is a hollow file designed as an elastically compressible, thin-walled pointed cylinder that is composed of a nickel-titanium lattice.

The SAF is used as a single instrument to achieve complete ***3D root canal cleaning and shaping*** in a minimally invasive way. Its hollow shape allows for the continuous flow of irrigant through its lumen to achieve superior disinfection.

The SAF's mode of operation eliminates many of the risks and drawbacks attributed to rotary NiTi files, leading to better and safer treatment.

The SAF is supported by dozens of research papers published in the leading endodontic journals, representing its superiority over rotary files and turning it into a true ***evidence-based endodontic concept***.



Increase your success rate!

- **Better shaping**, by adapting to the anatomy of the root canal
- **Better cleaning and disinfection**, through continuous irrigation
- **Avoidance of micro-cracks**
- Provides **better obturation with various techniques**
- Superior cleaning in **retreatment**
- **Increased Safety** during operation

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Mode of Operation

The SAF compresses to adapt to the root canal anatomy. Its attempt to re-expand shapes the canal by applying light continuous pressure along the entire circumference of the root canal wall.

The SAF uses 5,000 gentle vertical vibrations per minute, provided by the special RDT3 handpiece head. The SAF's abrasive surface acts similarly to sandpaper by scrubbing uniformly and gradually enlarging the root canal circumferentially. Slow, low-torque rotation occurs when the SAF is not engaged with the canal walls, allowing for circular repositioning throughout the process.

The SAF is extremely flexible and compressible. It does not impose its shape on the canal, but rather adapts to the canal's original shape. This is true both circumferentially and longitudinally, thus keeping the long axis of the canal in its original position.

The hollow design enables the SAF to be elastically compressed, as shown in the following image:

(A) #20 K-file inserted into a canal.
(B) SAF inserted into the same canal.
(C) SAF in its relaxed form.

A glidepath with a #20 file is required for the initial insertion of the SAF.

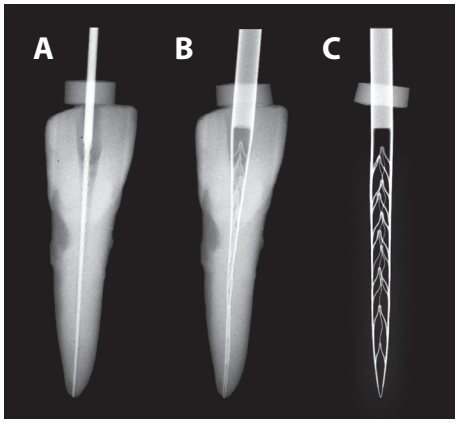


Image adapted from Metzger et al, J Endod 2010;36:679-690

Continuous irrigation

Continuous irrigation occurs simultaneously through the SAF's lumen during the entire procedure. The irrigant is carried with the file to the apical region and is exchanged several times during the treatment while being agitated by the SAF's sonic vibration. This effectively provides zero-pressure irrigation and eliminates the risk of irrigant extrusion beyond the apex.

Better Shaping by adapting to the anatomy of the canal

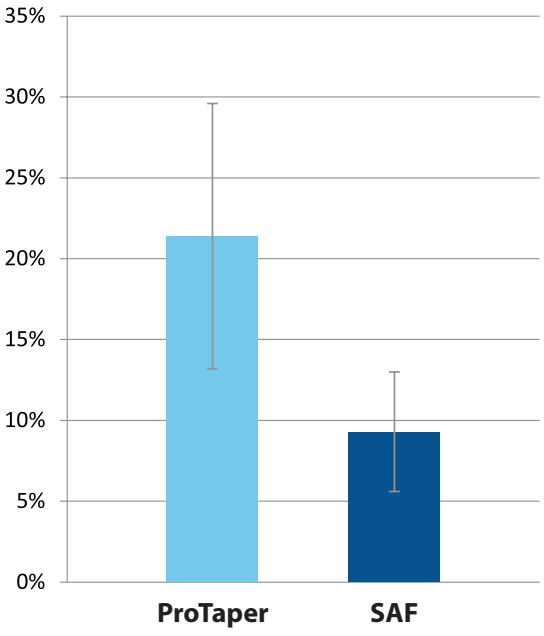
The SAF's adaptation to the shape of the canal enables its vibrational motions to circumferentially remove a uniform layer of dentin, while preserving as much sound dentin as possible. The filing motion of the SAF results in a "dentin powder" that is immediately washed away by continuous irrigation of the canal.

The Self-Adjusting File optimizes debridement quality in oval-shaped root canals

A histological analysis comparing SAF versus rotary instrumentation of canals with oval cross-sections and recesses shows that:

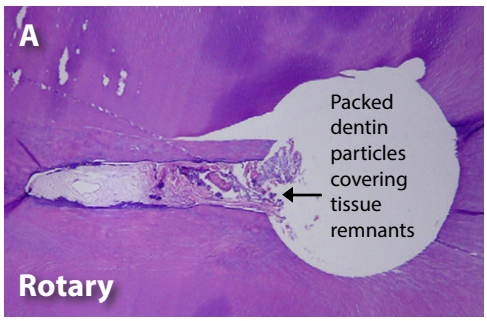
(A) **The rotary preparation with copious NaOCl irrigation left remnants of pulp tissue** in the uninstrumented area and pushed dentin particles into the recess, which could not be removed with sodium-hypochlorite.

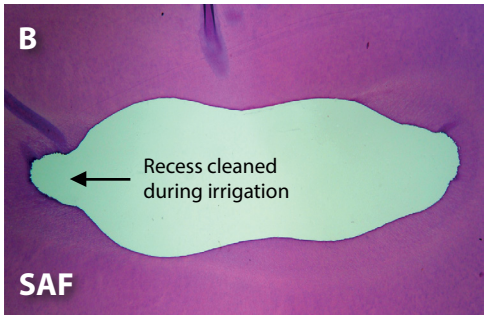
(B) **The SAF preparation is uniform and free of pulp tissue** due to the adaptability of the file and continuous irrigation of the canal.



Remaining pulp tissue (%)

Adapted from De-Deus et al, J Endod 2011; 37:701–705





Results: *"There was* ***significantly greater residual pulp tissue left after ProTaper system instrumentation versus SAF instrumentation*** *(21.4% vs 9.3%, P < .05)".*

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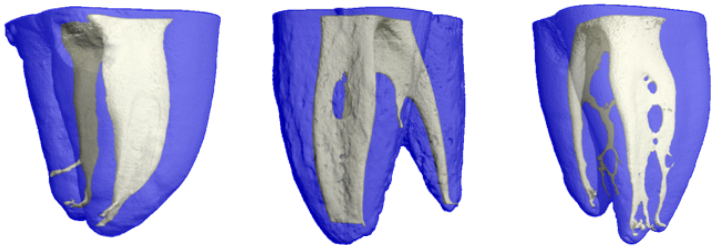
Better Shaping by adapting to the anatomy of the canal

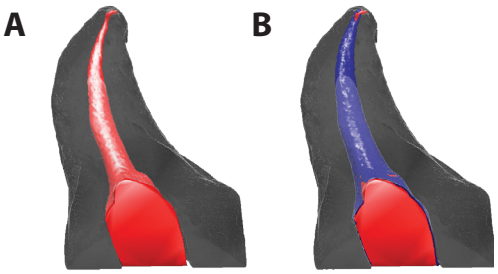
Root canal anatomy - micro-CT



Data from micro-CT Scans, courtesy of Dr. F. Paqué (Zurich, Switzerland).
Note the irregular canal systems that are common to mandibular molars.

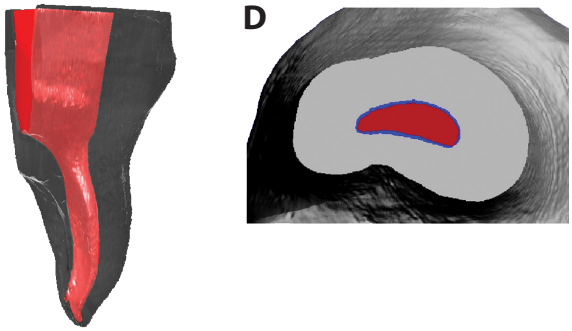
Preparation of curved canals

Adapted from Metzger et al, J Endod 2010;36:679-690 and Solomonov, J Endod 2011;37:881–887



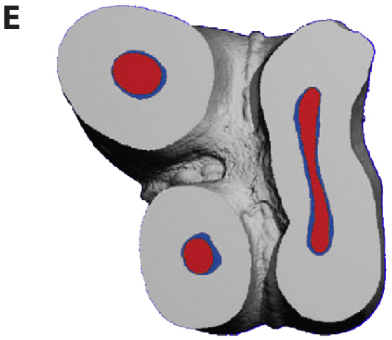
(A) **Red**: Before treatment
(B) **Blue**: After treatment

Note how **the long axis of the canal was preserved and that the entire canal wall was instrumented**.



Adaptation to challenging root canal morphologies

(C) A mesio-buccal view of the same flat canal, demonstrating a spoon-shaped concavity.
(D) Cross-section of the same canal, at 6 mm from the apex. Note the circumferential preparation.



(E) A rare case of a flat, long-oval palatal root belonging to a maxillary molar. Before (**red**) and after (**blue**) SAF preparation.

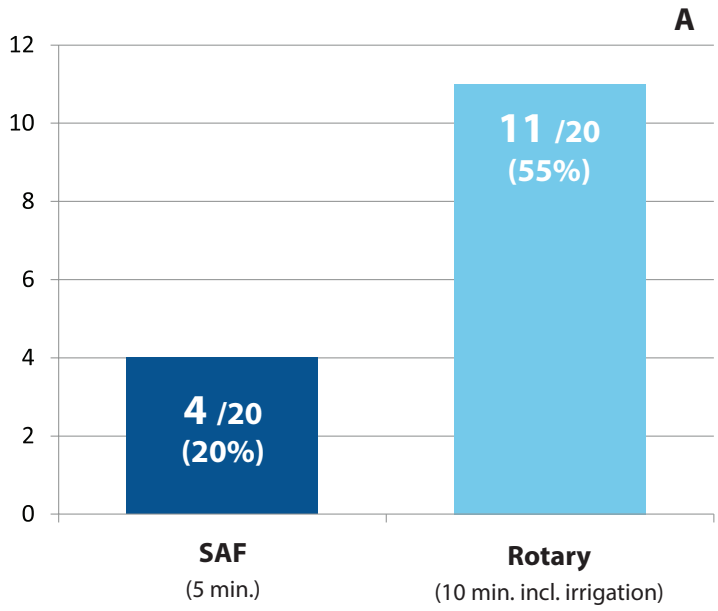
Note how **the SAF adapted itself and removed a uniform layer of dentin** along the entire circumference of the root canal.

Better Cleaning and Disinfection

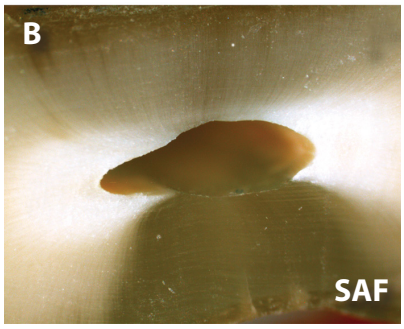
The adaptability of the SAF, combined with continuous and effective irrigation, provides superior cleaning and disinfection of the canal. This helps to avoid the packing of debris, thanks to the SAF's abrasive, non-cutting mode of operation, and continuous irrigation.

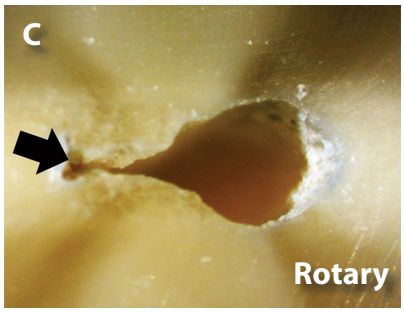
Ability of chemomechanical preparation with either rotary instruments or SAF to disinfect oval-shaped root canals

Adapted from Siqueira et al, J Endod 2010; 36:1860-65



Post-treatment positive cultures of E. Faecalis





Oval canals were incubated with *E. Faecalis* for 30 days and then prepared with either:

1. SAF System with continuous irrigation of NaOCl and EDTA;
2. Rotary files with copious syringe and needle irrigation of NaOCl and EDTA.

The SAF System performed superiorly when eradicating infection:

(A) Positive cultures were found in 55% of the canals treated with rotary files for 10 minutes, whereas **only 20% of the canals treated with SAF for 5 minutes contained positive cultures**.

(B) Cross-section of an oval canal instrumented using the SAF.

(C) Cross-section of an oval canal instrumented using rotary files. Note the uninstrumented area (arrow).

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Better Cleaning and Disinfection

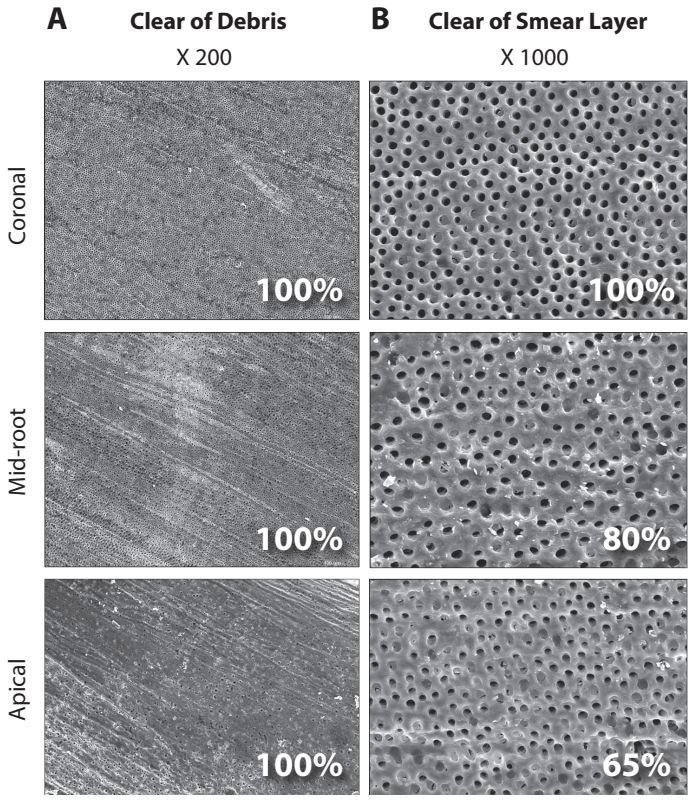
Evaluation of root canal wall cleanliness using scanning electron microscopy (SEM)

Adapted from Metzger et al, J Endod 2010;36:697-702

The SAF preparation with continuous flow of irrigants (NaOCl and EDTA) results in root canals that are **free of debris and almost free of a smear layer**.

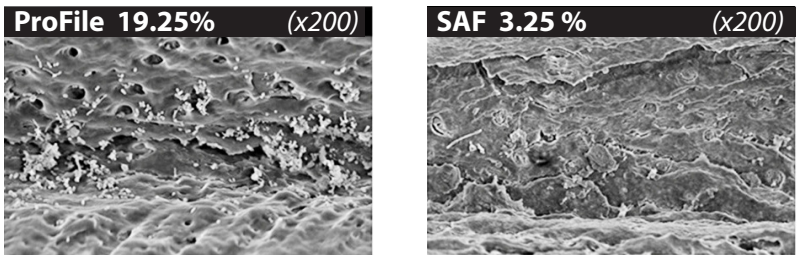
Col. (A) Following SAF preparation with NaOCl and EDTA: no ***debris*** was found in any part of the canal in all teeth that were studied.

Col. (B) Following SAF preparation with NaOCl and EDTA: no ***smear layer*** was found in the coronal part of the canal and a significant reduction in other parts was observed (80% mid-root, 65% apical third).



A comparative study of biofilm removal with hand, rotary NiTi, and SAF instrumentation using a novel in-vitro biofilm model

Adapted from Lin, Shen, Haapasalo, J Endod 2013;39:658-663



Percentage of the area inside the groove still covered with bacterial biofilm after treatment

A mixed-species bacterial biofilm was grown in a canal with a groove, to represent an apical recess.

Conclusions: *"Although all techniques equally removed bacteria outside the groove, **the SAF reduced significantly more bacteria within the apical groove**..."*

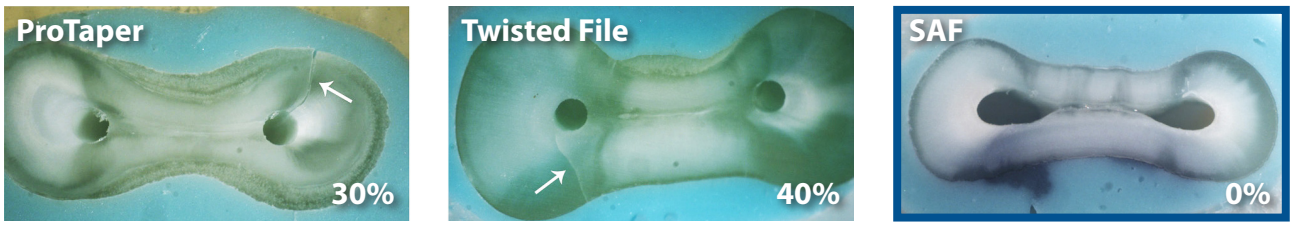
Avoidance of Micro-cracks

All rotary files, due to their solid central core and cutting blades, have a high probability of causing micro-cracks that may lead to vertical root fractures in the future. The SAF, because of its different mode of operation, does not cause such micro-cracks.

Dentinal micro-crack formation during root canal preparations by different NiTi rotary instruments and the SAF

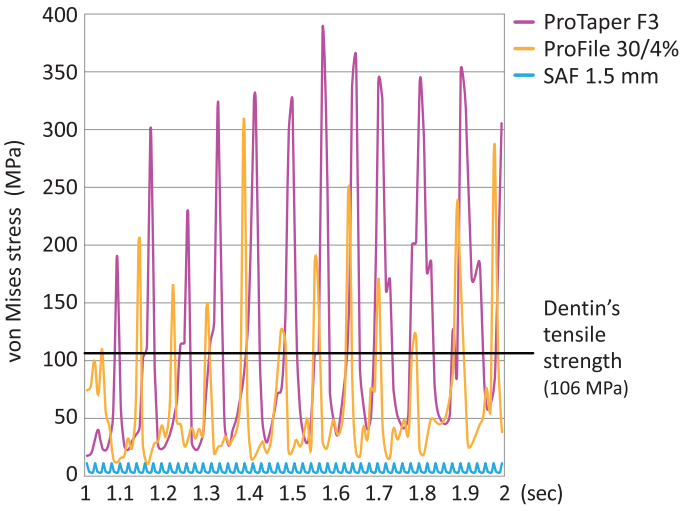
Adapted from Yoldas et al, J Endod 2012;38:232–235

% of micro-cracks after instrumentation



Conclusion: *"...NiTi instruments tend to induce various degrees of dentinal damage during root canal preparation. On the other hand,* ***the SAF file and hand instrumentation present satisfactory results with no micro-crack defects****."*

Stress generation during Self-Adjusting File movement: Minimally invasive instrumentation



Stress concentrations in apical root dentin during shaping

Adapted from Kim et al, J Endod 2010; 36:1195–1199 and Kim et al, J Endod 2013; 39:1572–1575

Rotary files induce high levels of stress in the dentin's outer layers, which may cause micro-cracks.

"The SAF induced the lowest von Mises stress concentration and the lowest tensile principal stress component in root dentin...".

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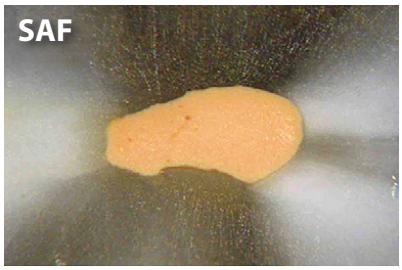
Better Obturation

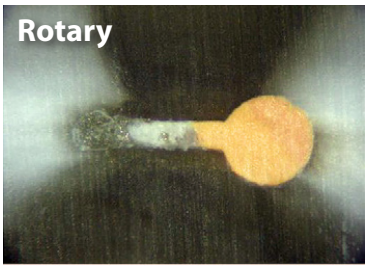
Optimal obturation following preparation with the SAF can be achieved with various common techniques, while only making slight adjustments to the chosen method in SAF-treated cases.

Root canal preparation and obturation in canals treated with rotary versus Self-Adjusting Files

Adapted from Metzger et al, J Endod 2010;36:679–690

Obturation with thermoplasticized gutta-percha and sealer.
Note the debris-filled untreated recess of the rotary-prepared canal, that hindered the flow of the gutta-percha and sealer.

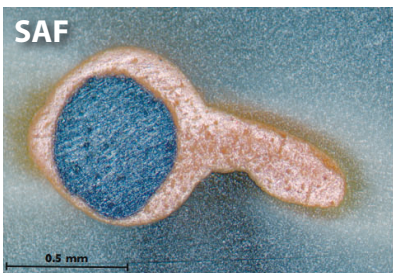


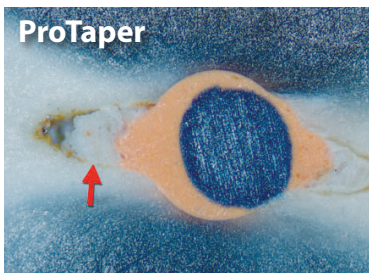


"In the SAF-prepared flat root canal, the entire circumference of the canal was prepared, thus allowing ***root canal filling penetration into the buccal and lingual areas of the canal****."*

SAF cleaning-shaping-irrigation system optimizes the filling of oval-shaped canals with thermoplasticized gutta-percha

Adapted from De-Deus et al, J Endod 2013;38:846–849





Obturation by Thermafil.
Conclusion: *"Instrumentation of the flat-oval canals with* ***the SAF system led to a significantly higher percent gutta-percha–filled area*** *compared with ProTaper instrumentation with syringe and needle irrigation."*

Superior Cleaning in Retreatment

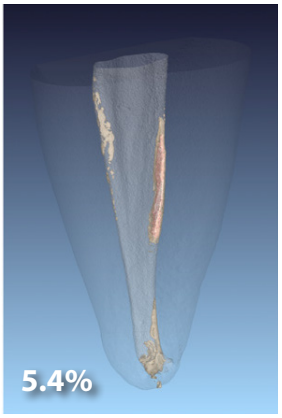
The SAF is not a penetrating tool and cannot remove the bulk of gutta-percha. However, it is efficient in the removal of gutta-percha remnants, sealer and residual infection that are left in the canal after the removal of the main core of gutta-percha by rotary files.

SAF in retreatment: A high-resolution micro-CT study

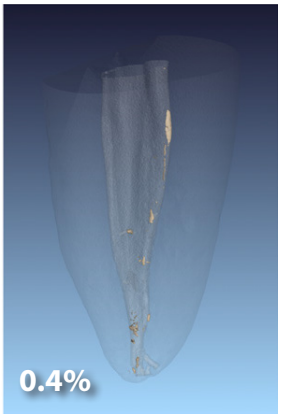
Adapted from Solomonov et al, J Endod 2012; 38:1283–1287

Group 1 was treated with ProTaper.
Group 2 was treated with ProFile and then SAF.
The volume of gutta-percha remnants was calculated for the two groups (see image).

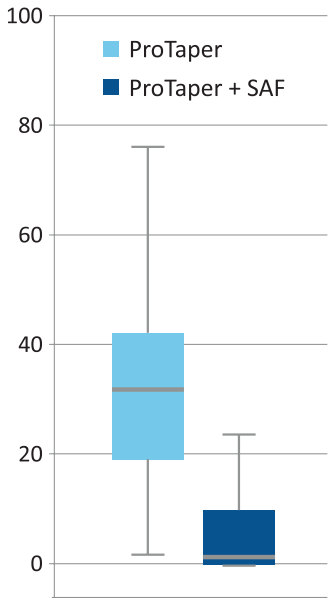
Conclusion: *"...the ProFile and* ***SAF procedure was more effective*** *than the ProTaper procedure and left significantly less root filling residue in the root canal".*



ProTaper D1-D3, F1, F2
(10 min.)



ProFile 25/6% + SAF
(5 min.)



% of canal area containing radiopaque residue at the apical third

The effectiveness of SAF to remove residual GP after retreatment with rotary files

Adapted from Abramovitz et al, Int Endod J 2012; 38:1004–1006

The average canal cleanliness at the apical third of curved root canals was assessed and scored (see graph).

Conclusion: *"The use of the SAF after rotary instrumentation using ProTaper Universal retreatment files* ***resulted in a significant reduction in the amount of filling residue*** *in curved canals...".*

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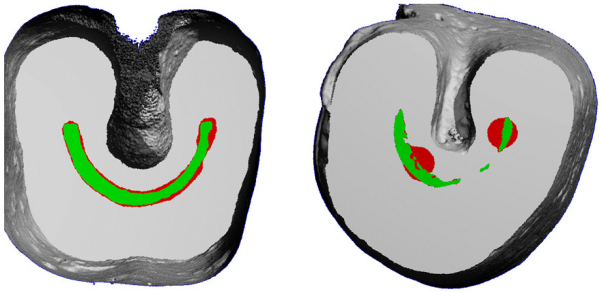
Increased Safety During Operation

No excessive removal of dentin

Adapted from Solomonov et al, J Endod 2012; 38:209-214

The SAF preserves sound dentin, retains the anatomical long-axis of the canal and avoids creation of "danger zones".
This is possible thanks to the SAF's lattice-like structure, its ability to adapt itself to the canal's original anatomy and its mode of operation, which grinds the dentin by using vertical vibrations. The apical diameter is expected to be enlarged by 2-3 ISO sizes.

C-Shaped canals - Danger zone



SAF **ProTaper**

Green: Before preparation
Red: After preparation

Virtually no file separation

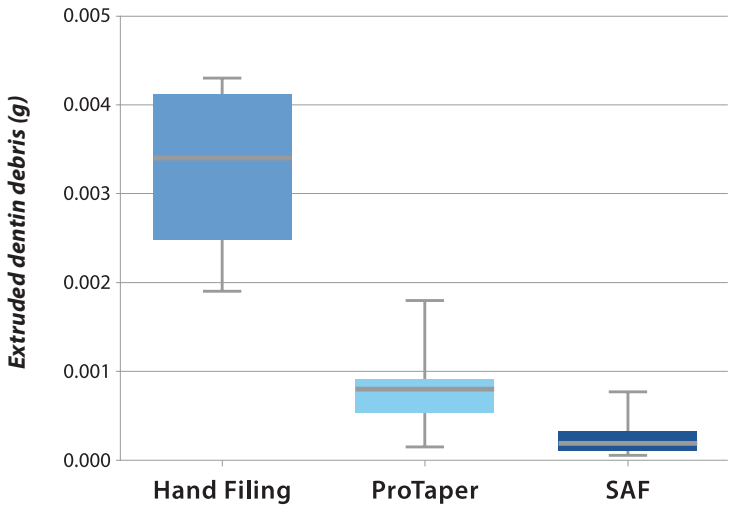
Adapted from Solomonov et al, J Conserv Dent 2015;18:200-4

Due to the SAF's lattice-like structure, tearing of an arch is evident long before complete separation occurs. In the rare event of tip separation, the separated part can easily be retrieved.
Solomonov et al showed in a clinical survey that in ***only 15 out of 2517 cases (0.6%) the SAF separated, and that while in 12 of the cases the files were easily retrieved, only 3 cases remained lodged, but were bypassed and obturated successfully***.

Virtually no extrusion of irrigant and debris

Adapted from De Deus et al, J Endod 2014;40:526-9

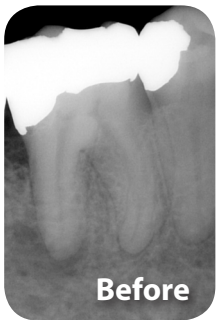
The SAF's mode of operation, through the use of abrasive vibration, does not cause debris extrusion. The low-rate, zero-pressure irrigation action allows for flow through the lumen of the SAF to the apical region, permitting a free backflow towards the coronal access cavity to help avoid extrusion of irrigant and debris.

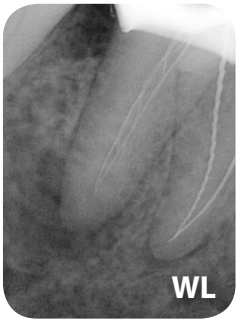


DENTAL CLINIC

Clinical Cases

1st mandibular molar - Case courtesy of Dr. Michael Solomonov (Tel-Aviv, Israel)



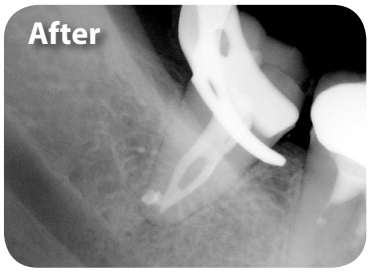


Note the oval shape of the distal canal and the obturation of the wide isthmus between the mesial canals.

1st maxillary molar - Case courtesy of Dr. Oscar von Stetten (Stuttgart, Germany)

Note the irregular shape of the canals, especially the palatal and mesio-buccal canals, and the penetration of sealer into lateral canals.

2nd mandibular molar - Case courtesy of Dr. Massimo Mori (Genova, Italy)



Note the penetration of obturation material into the cleaned area of confluence of the two canals and the sharp apical curvature.

3rd mandibular molar - Case courtesy of Dr. Ajinkya Pawar (Mumbai, India)

Note the penetration of obturation material into the cleaned lateral canals, as well as the preservation of the uneven canal taper.

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SAF System Products

SAF edge SYSTEM *including the* EndoSTATION™ mini

The SAF[edge] System is a ***modern multifunctional endodontic instrumentation system***, providing an easy and ergonomic solution for working with ***Self-Adjusting Files***, as well as with ***Rotary*** endodontic instruments.

The lightweight and rechargeable EndoStation[mini]™ is equipped with an integral peristaltic pump, and includes two interchangeable micromotors (SAF and Rotary). The unique ***ZipperLine™*** cable embeds the irrigation cable into the micromotor cable for ergonomic operation.

SAF pro SYSTEM *including the All-in-one* EndoSTATION™

The SAF[pro] System is an advanced endodontic instrumentation system, providing a comprehensive solution for working with ***Self-Adjusting Files***, as well as with ***Rotary*** and ***Reciprocating*** files.

The EndoStation™, an ***all-in-one endodontic motor***, engineered and manufactured in collaboration with ACTEON, is equipped with an integral peristaltic pump that enables simultaneous and continuous irrigation with the SAF System. It is operated by a footswitch, and supplied with an RDT3 handpiece head to operate the SAF. An optional rotary contra-angle handpiece allows to operate rotary and reciprocating files.

All operational modes have adjustable programs and settings that allow for achievement of the best outcome.

SAF basic SYSTEM *including the VATEA Irrigation Device*

The SAF[basic] System includes the VATEA, ***a supplementary irrigation pump to various endodontic motors***, providing the ability to use the SAF System with continuous simultaneous irrigation.

The VATEA is rechargeable and is controlled by a footswitch. It is supplied with an RDT3 handpiece head that operates the Self-Adjusting Files, as well as a handpiece or an adapter that is compatible with a wide variety of endodontic motors.

Self-Adjusting Files

The SAF-neo is available in three standard lengths (**21** mm, **25** mm and **31** mm) and two diameters (**1.5** mm and **2.0** mm).

The SAF 1.5 mm is designed for canals with an initial apical size of ISO 20-35.
The SAF 2.0 mm is designed for use in wider canals with an initial apical size of ISO 35-60 commonly found in retreatments or younger patients.

The SAF is available in sequence set packages with the Pre-SAF instruments, or in refill blister packages.

SAF 1.5 mm ***SAF 2.0 mm***

21	25	31	Length (mm)	21	25
16	18	21	Active part (mm)	16	18

Pre-SAF glidepath instruments

The Pre-SAF rotary instruments are designed to provide the necessary glidepath preparation for the Self-Adjusting Files. The ***Pre-SAF OS*** is an orifice shaper, the ***Pre-SAF 1*** (size #15/.02) is intended for narrow canals and the ***Pre-SAF 2*** (size #20/.04) allows the insertion of the 1.5mm SAF to working length even in curved canals, as shown in research (Kfir et al., Int Endod J 2016).

The Pre-SAF instruments are available in sequence set packages with a 1.5mm SAF, or in refill blister packages.

Pre-SAF OS ***Pre-SAF 1*** ***Pre-SAF 2***

RDT3 handpiece head

The RDT3 handpiece head operates the SAF in a vertical vibration (0.4 mm amplitude, 5,000 rpm) as well as a slow, low-torque rotation that repositions the SAF. This combination, together with pecking motions applied by the dentist, enable the asymmetrical SAF to circumferentially scrub the canal walls.
The RDT3 is designed to sustain prolonged exposure to sodium hypochlorite and is available in two models that are compatible with various endodontic handpieces.

RDT3-NX
X-Smart / EndoMate / EndoSequence

RDT3-NX NSK
Incl. WaveOne / Reciproc

RDT3 KaVo
Incl. WaveOne / Reciproc

ReDent NOVA
Minimally Invasive Endodontics

The Self-Adjusting File

Better Shaping

Better Cleaning & Disinfection

Avoidance of Micro-cracks

Better Obturation

Superior Retreatment

Safety in Operation

ReDentNOVA

Minimally Invasive Endodontics

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