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# REVIEW ARTICLE

## ADVANCES IN ROTARY ENDODONTICS - A REVIEW

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**ABSTRACT:**
The extent of endodontic treatment includes those aggravations and ailments of the pulp requiring pulp topping, pulpotomy or pulp extirpation and root canal treatment subsequently the influenced tooth is held for recommended practical reasons. The need of endodontic treatment is to hold the teeth by killing bacterial verdure in non-indispensable teeth and either avoidance as well as treatment of apical periodontitis i.e., disposal of microbial contamination from root canal. The accomplishment of root canal treatment is ascribed to intensive bio-mechanical preparation, contamination control and impeccable obturation. Cleaning and forming of the root canal framework is the most imperative stride towards a sterile trench, free from organisms. To accomplish this goal sufficient information of current innovation of instruments and instrumentation is required.

**Key Words:** Rotary endodontics, Hand preparation, Mechanical preparations, Recent advances.

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## INTRODUCTION:

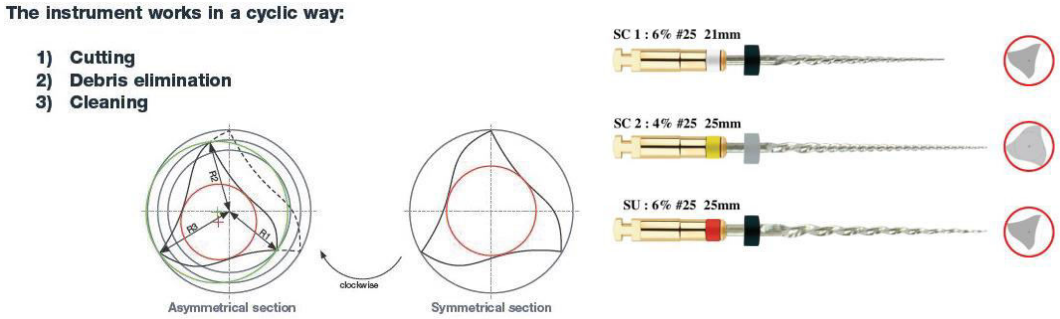
The point of hand and revolving instrumentation is to expel crucial and necrotic tissue from the root canal, formation of adequate space for saline system and solution, conservation of the uprightness and area of the apical channel life structures and to permit safeguard sound root dentine for legitimate working of the tooth.[1] Instrumentation has a key part in the course of treatment strategy to kill microorganisms in the root canal framework. It evacuates an adequate number of organisms from the open parts of the primary root canal by coordinate mechanical cleaning activity. Instrumentation likewise shapes the waterway in such a way which encourages compelling water system to expel the pulp tissue flotsam and jetsam and microorganisms in out of reach regions of root canal system.[2] The hand instruments were very effective however tedious when contrasted with rotational instrumentation. Hand instrumentation can push flotsam and jetsam along the side into the complexities of the root channel framework or even apically through the apical foramen when utilizing procedures that usually incorporate inclusions of records without revolution or pivot of documents a counter clockwise way. Interestingly, consistent clockwise turn will pass on garbage just in a coronal heading from the canal repercussions and apical foramen. The advantage of mechanical pivot is the upgraded capacity to gather and expel flotsam and jetsam from root trench framework. The revolving instruments decrease the instrumentation time, the strain for the instrument, and the administrator. Mechanical revolution gives a more consistent 360-degree engagement of the record tip in the waterway that constrains it to take after the trench and results in better control for keeping up the focal pivot of the channel in this way lessens the odds of aperture or edge arrangement. The adaptability of the rotational instruments helps in saving the tooth structure while adequately helps in cleaning and molding the channel. Further, the document always turning from 200 to 2,000 rpm, produces comes about more quickly than hand instrumentation. The presentation of new advancements has brought about change in nature of endodontic treatment. Late presentation of nickel–titanium (Ni Ti) turning instrumentation has demonstrated reliable, unsurprising, and reproducible outcomes and fruitful obturation. Further, the mechanical turn has the improved capacity to gather and expel flotsam and jetsam from the trench and the essential cone fit, never again should be a struggle.[3] The mechanical preparation and synthetic disease can't be considered independently and are generally alluded as chemico-mechanical or biomechanical readiness. The essential and critical piece of endodontic

treatment is mechanical readiness. In this way the endodontist ought to have sufficient information of present day innovation of rotational instruments and instrumentation to defeat the difficulties of root channel treatment.

**ADVANCES IN ROTARY ENDODONTICS:**

**Revo-S:**

This new sequence with only 3 nickel-titanium instruments simplifies the initial endodontic treatment and optimizes the cleaning. The asymmetrical cross section of the Revo-S facilitates penetration by a "snake-like" movement, and offers a root canal shaping which is adapted to the biological and ergonomic imperatives.This sequence has a cutting, debris elimination and cleaning cycle, which optimizes the root canal cleaning by improving the upward removal of the generated dentine debris. It also offers the choice of an apical finishing (AS30, AS35 and AS40), which is most closely adapted to the anatomical and ecological criteria of the canal. The Advantages of Revo-S is it enables a better root canal penetration due to a "snake-like" movement = better progression of the instrument toward the apical region of the root canal. Facilitates the elimination of debris upward the coronal thanks to the increased available volume for debris.Avoids the grooves to be obstructed and thus avoids the extrusion of debris beyond the instrument tip and apical foramen. Reduces the stress on the instrument thanks the rippling movement of the file along the canal walls: no screwing effect, more flexibility, and better ability to negotiate curves.The instrument works in a cyclic way.[4]A Customized Treatment Using 3 Instruments:




| SC1 (Shaper & Cleaner 1) N°25, 0.06 L 21 mm | SC2 (Shaper & Cleaner 2) N°25, 0.04 L 25 or 29 mm | SU (Shaper universal) N°25, 0.06 L 25 or 29 mm | AS 30 (Apical Shaper 30) N°30, 0.06 L 25 or 29 mm | AS 35 (Apical Shaper 35 N°35, 0.06 L 25 or 29 mm | AS 40 (Apical Shaper 40) N°40, 0.06 L 25 or 29 mm |
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|  |  |  |  |  |  |
| Extended helical machining up: more flexibility. Asymmetrical cross section: better upward removal of dentine debris. Efficient cleaning. | Symmetrical section: perfect guidance, no zipping. Respect of the canal anatomy until the apical constriction. | Recapitulates the action of SC1 and SC2. Smoothes the root canal walls. Optimal cleaning. Advantages: Excellent cleaning. Adapted active length. The extended cutting part in the coronal region increases instrument flexibility. Optimal upward removal of dentine debris. Apical Finishing:- AS30 AS35 AS40 | | Advantages: Shaping down to the working length: more accurate finishing of the apical 1/3. Efficient disinfection: the irrigating solution penetrates to the apical 1/3. The extended helical machining upto the coronal region enables a continuous bending of the instrument. | |

Advice and Recommendations: Rotation speed between 250 and 400 rpm Initial Penetration: The first step comprises an initial penetration of the canal using a conventional stainless steel hand instrument (usually a K file N°10 L21 mm), which provides information about the canal anatomy complementary to that obtained by the pre-operative X-rays. The instruments should be removed frequently from the canal and cleaned using a compress in order to eliminate the dentine debris.Operative dynamics: The instruments should be used with a rotation speed ranging between 250 and 400 rpm with a low amplitude in-and-out movement inside the canal (3 to 4 downward movements). Use the SC1, SC2 and SU instruments with a brushing motion (circumferential filing). SC1 and SU should be used in a free progression and without pressure. The AS instruments should be used without apical pressure, after using the SU. Their penetration depth corresponds to the working length. This length is shortened in thin root canals or with a marked curvature. They are then used in a step back motion (AS at WL, AS35 at WL – 0.5 mm, AS40 at WL – 1 mm if necessary).[5]

**GTX M Wire/M-WIRE**:

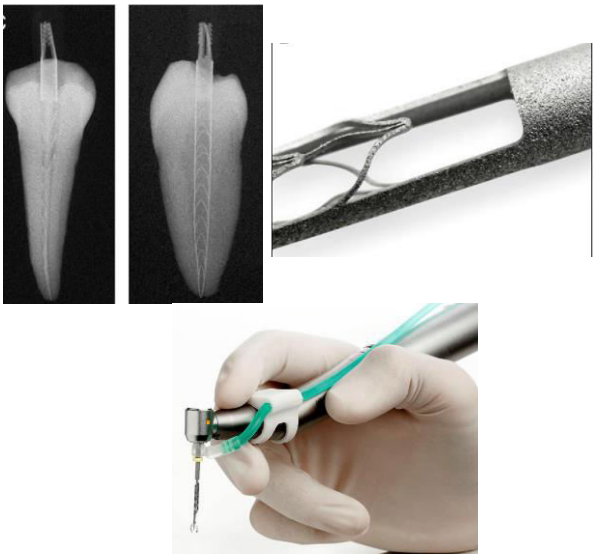
"M-Wire" was developed by Dr. Ben Johnson in 2009, the inventor of carrier-based obturation.Beyond geometry changes, this file is made of a new nickel titanium wire.Through a series of heat treatment and annealing cycles applied during the drawing of the wire, the resistance to cyclic fatigue—the most common cause of rotary file separation (Shen e coll. 2006) has been greatly enhanced. While this could be misunderstood to mean that files made of this advanced metal can be used again and again, it is rather intended to significantly reduce the chance of breakage when the instruments are used as before. Any file, regardless of design or metallurgy, will break when over-used.Suffice it to say that this new wire is a great advancement in answering the first priority of dentists polled about what they want from their rotary files—better resistance to fracture. Variable-width lands: GT Series X Files have the same reduced tip geometry, the same limited MFD, and they are still landed instruments but with a significant improvement—the land widths vary along the length of the file.[4]

Greater chip space: The final blade change is that the blade angles have been opened to a consistent 30° along the length of GT Series X Files, thereby nearly doubling the chip space between flutes. This increases the flexibility of these files and significantly extends the length of each cutting cycle. Where standard GT Files cut for about 4 to 6 seconds before clogging up, GT Series X Files will cut continuously for 10 to 12 seconds before they need to be removed and cleaned. Reduced file set: The final 2 changes from the standard GT line are a latch-grip handle that is shortened from 13 to 11 mm, and a reduced file set from 15 to 8 instruments in the set.GT Series X shaping technique: The technique for the use of GTX files is remarkably simple. After the canal has been negotiated to a size #15 or #20 K-file at full length (in the presence of a lubricant), the canal is rinsed out, replaced with full strength NaOCl, and rotary shaping commences - always starting with the 20- .06 GTX file. Due to the sophisticated geometry of these files they cut in steady, long 10-12 second cutting cycles at the recommended 300rpm. Pecking motions are inappropriate for landed-bladed instruments. The rule of thumb is that if the ¬file is advancing in an apical direction, it is allowed to continue cutting. The initial shape and ideal tapers for root forms. In small roots the objective is a .06 taper. Small roots are classified as: mandibular incisors, two and three canal premolars, mesial roots of lower molars and buccal roots of upper molars. Shaping these canals begins with the 20-.06 GTX file, which will generally cut to length in two cycles. Small canals that are very tight or curved will resist the 20-.06 GTX file in its second pass and will require a 20-.04 GTX file to cut to length. While a rare event, in extremely difficult cases a #20 NiTi K-file may be needed to achieve length, after which the 20-.04 and the 20-.06 will make it, as the tips of these two instruments have been relieved by the #20 K-file.Once the 20-.04 has achieved working length the 20-.06 will usually follow creating the desired .06 taper in these small canals. However, in abruptly, severely curved canals, the 20-06 GTX rotary file may balk at cutting to length - an ideal indication for bringing in a 20-.06 standard GT hand file. The objective in medium and large roots is to achieve a .08 taper. Root classification for these are: distal roots of lower molars, palatal roots of upper molars, lower cuspids, upper anteriors and single canal pre-molars. While perhaps the simplest technique is to just start all canal shapes with a 20-.06 GTX file, in medium and large canals, starting with a 30-.08 is usually going to get to the length after a couple of cutting cycles. If the 30-.08 resists cutting to length, the 30-.06 will invariably make it.Determining the apical diameter (apical gauging): Once a GTX file of at least an .06 taper has been cut to length, the apical geometry of the canal must be determined to insure that the taper of the preparation extends to the terminal point (apical continuity of taper), thereby confirming adequate cleaning and apical accuracy during obturation.[5]Easy taper identification: .08 Taper -Blue Stopper -4 Rings, .06 Taper -Green Stopper -3 Rings, .04 Taper -Red Stopper -2 Rings. Wider flutes and variable radial lands help efficiently move debris coronally and keep the instrument centered in the true canal path. Even The Handle Is Efficient. Black dot for easy identification. True grip handle for centric rotation. Bands

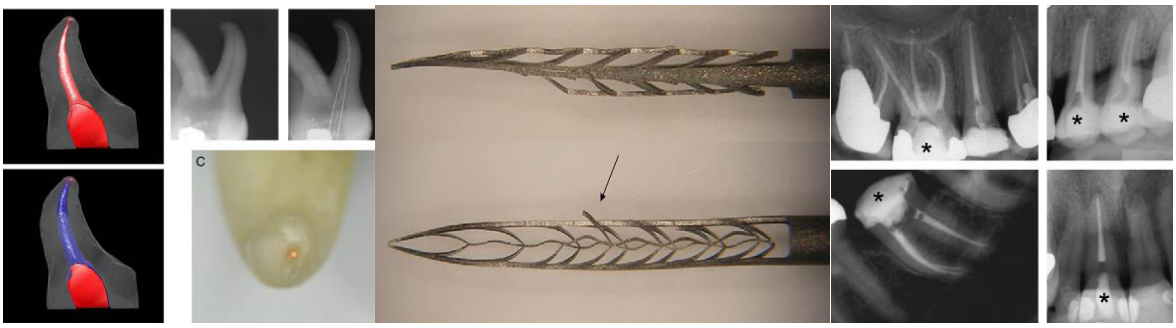
denote taper size with each ring equaling a taper factor of short, 11 mm handles offer easy placement in posterior teeth. ISO color sequence denotes tip size. Color-coded stop offers quick indicator of the taper. Calibration rings help in precisely setting the working length. Faster Speed to Desired Shape**:** Just as the GT Series X files' reduced core diameter and M-WireNiTi construction work together to increase flexibility, several powerful advantages combine together to increase speed to shape. Blades feature unique helical angles and variable radial lands that reduce contact against the canal wall for faster cutting. Wider flutes make fewer continuous rotations around the instrument from the tip to the end of the cutting zone. Sophisticated, open blade design reduces the chance of threading. Cutting efficiency is increased by the deeper chip space created by the wider flutes. Flutes hold more debris, reducing the number of strokes needed to shape the canal. This decreases the number of file rotations and reduces cyclic fatigue that can lead to file separation.[6] Consistent shape: Series X rotary files follow the true canal path, even in curved canals, for consistent, conservative shapes case after case.

**Self-Adjusting File (SAF):**

The SAF represents a new approach in endodontic file design and operation. Its main features are as follows:A three-dimensional adaptation to the shape of the root canal, including adaptation to its cross-section.One file is used throughout the procedure, during which it changes from an initially compressed form to larger dimensions.Canal straightening and canal transportation of curved canals are largely avoided because of the lack of a rigid metal core. The file does not have ''a will of its own.''High mechanical durability, thus overcoming the issue of separated nickel-titanium instruments.Hollow design that allows continuous irrigation with constant refreshment of the irrigant throughout the procedure. The SAF is a hollow file designed as a compressible, thin-walled pointed cylinder either 1.5 or 2.0 mm in diameter composed of 120-mm-thick nickel-titanium lattice.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. 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 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.The SAF is operated with transline (in and out) vibrating handpieces with 3,000 to 5,000 vibrations per minute and an amplitude of 0.4 mm. Such a handpiece may be the KaVo GENTLE power or equivalent combined with either a 3LDSY head (360_ free rotation; Kavo, Biberach. MK-Dent head (360_ free rotation; MK-Dent, Bargteheide, Germany) or RDT3 head (80 rpm when free and stops rotating when engaging the canal walls, recently developed by Re- Dent-Nova, Ra'anana, Israel).



The vibrating movement combined with intimate contact along the entire circumference and length of the canal removes a layer of dentin with a grinding motion. 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. An 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. It is used as a single file (of either 1.5- or 2.0-mm diameter) that starts as a narrow, compressed, shape and gradually expands in the canal while removing a uniform layer of dentin from its walls. Because the file adapts itself to the cross-section of a given canal, a canal with a round cross-section is enlarged as a round canal, whereas an oval canal is enlarged as an oval canal of larger dimensions. Uniform Removal of Dentin and Remaining Wall Thickness: The Self Adjusting File system is different from any available file system in two major respects. 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. The SAF vibrates when operated and removes a uniform dentin layer from the canal walls even in oval, flat root canals.



Rather than machining a central portion of the root canal into a round cross-section, the SAF allows for maintaining a flat canal with slightly larger dimensions. Second, this hollow file 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. The adaptation of the file to the root canal's cross-section is expected to limit the potential gross debris accumulation in untreated areas of oval, flat canals. 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. This challenging portion of the root canal may benefit from the unique mode of action of the SAF file. 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. When the SAF is used to enlarge the canal to similar dimensions, it tends to keep the apical part of curved canals closer to its original location.

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.When torque durability was tested, the SAF can be turned 7_360_ before separation with torque durability of 29.7 g/cm. When the American Dental Association cyclic fatigue test is applied, SAF can be rotated for more than 150 hours at 900 rpm with a 5-mm deflection with no mechanical failure.The SAF can be operated for 27 minutes in extracted human teeth before any structural failure appears. This represents more than 6 times the 4-minute operation time per canal, which is sufficient to achieve the desired results. It is of particular importance to note that even when structural failure did occur, it was not of the separation type that is encountered with other nickel-titanium files. Detachment of one of the arches at one of its ends was the typical mechanical failure. The damaged file could easily be retrieved from the canal, facing none of the challenges that a separated rotary nickel-titanium file presents.[7]

**TWISTED FILE (TF):**

With the introduction of the Twisted File (TF) with proprietary R-phase technology, mechanical root canal preparation has become safer and more predictable. Maintaining the grain structure of NiTi during file production results in a stronger and more flexible rotary instrument. Grinding into the grain of Ni-Ti actually compromises the integrity of the grain structure and lowers the amount of torsional force that an instrument can withstand. This can increase the risk of instrument separation. The principle of respecting grain structure is a key element in withstanding stress, such as cutting wood. Each plank possesses a unique grain structure that must be preserved for maximum strength. Similarly, each TF file is unique. Those subtle differences are due to not tampering with the grain structure of the alloy during the manufacturing process. Simply, TF allows the clinician to perform with confidence and efficiency because it is the only endodontic file manufactured by twisting nickel titanium for unsurpassed strength and flexibility. R-phase technology gives the crystalline structure of TF a greater elasticity and greater flexibility range than other rotary NiTi files. This elasticity, combined with the ability of the flutes to unwind, allows TF to tolerate more stress for better safety. TF exhibits incredible resistance to fracture because the natural grain structure is maintained during the manufacturing process. TF can perform side-cutting with great efficiency, while still successfully negotiating a complex curvature.

Sharpness of edges maintained: The proprietary surface treatment (DeOx) maintains the sharpness of the flutes and the structural integrity. A one-piece design provides greater strength and structural integrity, eliminating the possibility of galvanic corrosion. Employing a variable pitch in an instrument's design alleviates the "pull-in" effect when the

file is shaping the canal. For most cases, TF requires three files or less to shape to working length. Uses: Confirm Coronal Patency Prior to using TF, achieve straight line access to the coronal 1/3 and establish an apical glide path with at least a #20 hand file.File Usage: With the file rotating freely as you enter the canal, advance the file with a single continuous and controlled motion until the file engages dentin, and then withdraw the file. Do not force the file apically. Step 1 - Take the TF .08/25 until it engages dentin and then withdraw immediately. Wipe the flutes, irrigate and recapitulate with a stainless steel hand file to confirm patency. Repeat Step 1 with the same TF file until TWL is achieved. If significant resistance is met before TWL is achieved, proceed with the TF .06/25 using the same steps. Step 2 - Next insert the TF .06/30, following the procedures in Step 1. For #30 tip size apical shape, you can stop at this point and begin your obturation.Step 3 - For final apical shape larger than #30, use the following appropriate tip size:.06/35 for #35 tip size, .04/40 for #40 tip size. Motor speed: 500 RPM. Wipe the flutes of the file after each insertion. Irrigate and recapitulate with a stainless steel hand file before you move to the next TF file in the sequence.[8]

## CONCLUSION:

Rotational instruments for biomechanical planning of the root channel have enormously improved the consistency and reproducibility of the root trench for exact obturation. It additionally limits the aperture and edge arrangement in root channel when utilized sensibly. The nickel titanium rotational instruments because of shape memory impact and unrivaled versatility have limited the odds of instrument break amid root channel planning of the bended canal. Consequently legitimate learning of the physical and mechanical properties of every rotating instruments and its wise use as indicated by the producers direction can spare the seat side time of administrator as well as increment high rate of achievement in endodontic practice.

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