Procodile & the EndoPilot®: A Novel Approach to Safely and Efficiently Shape Root Canal Systems

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Over the past several decades, advances in metallurgy, research and clinical techniques have made root canal preparation safer, efficient, faster, and more comfortable. This stated, while clinicians have dozens of choices in the current marketplace, adopting a new system can be challenging. This article was written to introduce a new instrumentation system (Komet Procodile) and motor (Komet EndoPilot®) that achieves and surpasses previous safety, preparation quality and efficiency benchmarks.

Pre-operative Treatment Planning

Aside from an assessment of the medical and dental history, it is essential to perform the following two steps prior to initiating root canal therapy: determination of a pulpal and periapical diagnosis and a comprehensive risk assessment (for file separation, perforation, canal location challenges, etc.).

No two root canal systems are the same, as some are longer, shorter, more or less calcified, curved, etc. In essence, canal systems are unique. As a result, the shaping techniques, algorithms, instrument sequences, etc. for any two roots, are, in practice, rarely identical, hence the need for the recommended preoperative risk assessment.

Prior to treatment, written informed consent, profound local anesthesia and a rubber dam should be in place. In addition, optimally, the clinician should use an advanced lighting and magnification source in the form of a surgical operating

microscope. Further preparation pre-operatively should also include an assessment of the estimated and anticipated true working length, any limitations in opening, tooth rotations/tipping, possible resorption, the strategic value and restorability of the tooth, vertical root fractures, possible open apices, and coronal fractures, among other similar important considerations that might influence treatment methodology. In short, the clinician should not start the case unless they are confident, they can finish the case well after having comprehensively evaluated the clinical scenario pre-operatively.

Figure 1: Clinically complex canal system, note the root curvature and canal calcification.

Access Preparation

Access should be as conservative as possible while achieving visual and tactile control over all intra-coronal procedures. Conservative in this context means removing only the tooth structure needed to obtain the aforementioned visual, tactile and microbial control. For access, there are a wide variety of Komet burs that provide efficient canal location whether the substrate is natural tooth structure (H1SE, 6801, 5801), PFM (6801, H34L), E. Max/Zirconia (ZR6801) and/or base metal (H34L, H40). Slow speed round burs for caries removal are also available in a variety of lengths and sizes (H1SML, K1SM). For refinement of axial walls in access preparation, the Komet EndoGuard bur prevents removal of dentin on the pulpal floor while improving lateral visibility and canal access.

Case complexity will determine if ultrasonic tips are required for canal location in addition to burs. The greater the calcification, obviously the greater the indication for ultrasonic tips. As an adjunct to ultrasonics, the EndoTracer (H1SML) is an extended length round bur useful for calcified canal location which aids in chamber floor visualization.

Figure 2: Burs for Endodontic Access

Achieving Canal Patency

If desired, once the canal is located, the orifice can be enlarged using a reciprocating Procodile Orifice Opener. These orifice openers provide an alternative to Gates Glidden drills for orifice definition.

Figure 3: Procodile Orifice Openers (.08, .10)

Once canal access is obtained, whether the orifice has been enlarged or not, a small hand K file (#6-10) should be placed to the estimated length of the root. (the root apex). A tactile “pop” should be felt when the hand file reaches the apical constriction. Komet hand file options include triangular cross section, square cross section and H file varieties in sizes from #6-140. Once the hand K file reaches the apex, the electronic apex locator should be placed on the file to achieve the first determination of true working length. Such exploration of the canal to the apex is also known as canal scouting. Generally scouting is done with curved instruments in a gentle and passive apical watch winding motion.

Once the true working length is obtained, the glide path is prepared. Figure 4.

The glide path creates a minimal enlargement of the canal into which larger bulk shaping files will be placed. Preparation of a glide path has two primary variations, hand preparation (using K files) or use of a glide path file (Komet ProGlider .03.15-20). Skipping the preparation of a glide path and moving straight to larger shaping files is a primary cause of file separation due to the risk of excessive torsion and/or possibly cyclic fatigue. Alternatively, and correctly, achieving a minimum #15 K file equivalent to the apex and/or more optimally a .03 tapered glide path (if prepared with the Komet ProGlider) minimizes these stresses. The resulting glide path allows for a smooth and reproducible insertion of the larger shaping instruments (such as the Procodile). After glide path preparation, a second electronic apex locator reading can verify the initial lengths and provide confidence in the true working length.

At all stages of the instrumentation (from scouting, glide path preparation, preflaring, and canal shaping), irrigation should be copious and frequent. One viable option is to refresh sodium hypochlorite (which acts as a lubricant and disinfectant) after every file insertion. The flutes of all nickel titanium files should be wiped, and the canal recapitulated with hand files to assure patency, again, after every file.

Figure 5: ProGlider (.03/15-20)

Canal Shaping with the Procodile

Procodile (Komet) is a counterclockwise (CCW) cutting system that uses clockwise (CW) reciprocation as a stress breaker with ReFlex® technology in either Dynamic or Smart mode (described below).

Procodile can be used in either CCW rotation or reciprocation. The EndoPilot is the optimal motor for Procodile, but a ProMark Motor (Dentsply) that powers WaveOne Files (Dentsply) could also be used to power the Procodile. While other motors with CCW rotational and reciprocating functions exist with which to power the Procodile, to the authors knowledge, no motor has the safety, sophistication of the torque control capabilities of the EndoPilot (described below).

Procodile features a variably tapered core which provides more chip space during canal evacuation, greater flexibility, and increased resistance to cyclic fatigue. In cross section, Procodile has two cutting angles and resembles the letter “S” in reverse.

After glide path preparation, the clinician can use either the .06/20, .06/25 or .06/30 Procodile powered by the EndoPilot. Which Procodile is used (size 20, 25, 30) is determined by the canal anatomy. If the .06/20 slides easily to length, it can be followed by the 25, etc. If the 25 does not advance easily, the .06/20 could be used. In any event, regardless of the apical size, the .06 Procodile creates a .06 taper throughout the canal. In essence, the bulk shape of the canal is prepared using an .06 taper.

Once the taper is prepared (after the .06 Procodile reaches the apex), the master apical diameter (MAD) is prepared. In essence, the apical diameter is prepared after bulk shaping (preparing the largest taper used throughout the entire root). Preparation of the MAD can be performed with either a .05 (35, 40) and/or the .04 Procodile (45, 50). Procodile rpm and torque are set automatically by the EndoPilot.

Every root is different. Some will easily allow a .06/30 to the apex in one insertion and will be followed up by a .05/35 and .05/40, etc. Alternatively, the .06/20 might need to be followed by the 25, 30, and .05 instruments, as above, for MAD preparation.

Once the preparation is disinfected, the canal is dried using matching sterile/standard Procodile paper points and fitted with matching Procodile gutta percha lubricated with KometSeal (epoxy resin cement sealer).

Figure 6: Procodile System

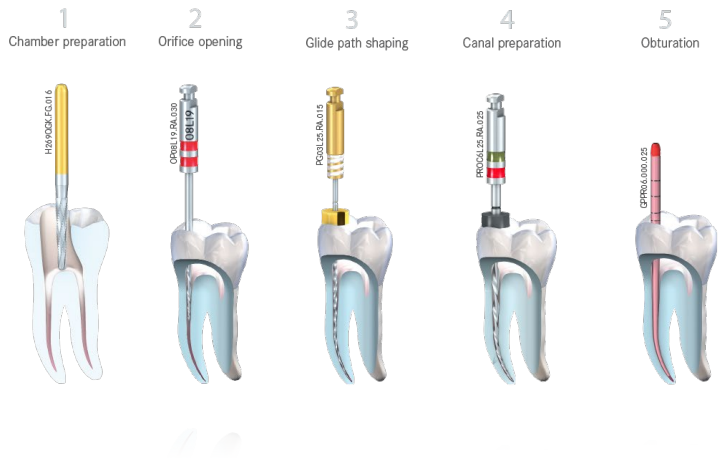


Figure 7: Procodile Paper Points

Figure 8: Procodile Gutta Percha

Clinical Considerations

Clinicians differ on using a single file versus multiple file technique to shape canals. Most often, single file or multi-file method selection is dictated by the complexity of the anatomy and, what exactly is being accomplished in the canal using a single file. In short, “single file” technique must be defined. For example, the questions must be asked, has the glide path been prepared, is the canal pre-flared? Or is the clinician expecting one file to scout the canal path, prepare the glide path, and shape the canal? This distinction notwithstanding, if a glide path has been prepared, and the clinician only wishes to prepare the canal to .06/25 dimensions, Procodile can be considered a single file system.

Procodile is presterilized which makes it simple to determine how many times the file has been used and simultaneously reduce contamination. While the manufacturer recommends that Procodile be used only once, such a recommendation does not take into account limited shaping in simple anatomies that have imparted relatively little, if any, stress to the file. Caution and good clinical judgement are important before deciding to use any nickel titanium file more than once.

Minimally invasive shaping techniques have become fashionable in some circles. Such techniques might be defined as removal of the absolute minimum dentin in the canal to adequately and optimally disinfect the canal system. While a comprehensive discussion of irrigation is beyond this paper’s scope, it is noteworthy that the more robust and effective the irrigation system and activation, the greater the degree of cleanliness possible with smaller prepared shapes (which conserve dentin and reduce long term fracture). The key clinical takeaway is that the amount of dentin removed should only be that which is absolutely necessary to provide visual, tactile and microbial control over the canal being prepared. Procodile, .06 taper, is

both large enough to provide adequate irrigation using any common activation system or irrigation regimen and yet small enough to conserve dentin, especially if Gates Glidden drills and orifice openers have not been used.

For reference, three excellent articles on CCW reciprocation, glide path and preflaring are Plotino June 2020 JOE (Influence of Negotiation, Glide Path, and Preflaring Procedures on Root Canal Shaping-Terminology, Basic Concepts, and a Systematic Review - PubMed (nih.gov)), Grande November 2015 JOE ((PDF) Current assessment of reciprocation in endodontic preparation: A comprehensive review - Part I: Historical perspectives and current applications. (researchgate.net)), and Plotino December 2015, JOE (Current Assessment of Reciprocation in Endodontic Preparation: A Comprehensive Review--Part II: Properties and Effectiveness - PubMed (nih.gov)).

The EndoPilot

Komet's EndoPilot is a highly sophisticated, comprehensive, and expandable torque and speed controlled endodontic system. The rechargeable system (15 hours with a full battery charge) has a touch screen with updatable firmware and a wireless/cordless foot pedal. The audio and visual signals of the EndoPilot are fully customizable. It has both rotational and reciprocating file powering capabilities in addition to both a static and real time apex locator function, whose length of preparation is customizable. Versions of the EndoPilot in Europe currently have a gutta percha extruder and heat source capability as well as ultrasonics. Future versions of the EndoPilot will be expandable to these capabilities in the USA.

The capabilities of the EndoPilot include creating “favorites” menus from all the major current file systems (50+) in addition to all of the Komet file systems (including the rotational Sky Taper and F360 systems). In addition, it is possible for the user to change the rotational speeds, torque settings, rotational/reciprocating motion settings and create custom file sequences. To the author’s knowledge, the EndoPilot is the only motor that allows customization of a reciprocating motion for any given reciprocating file.

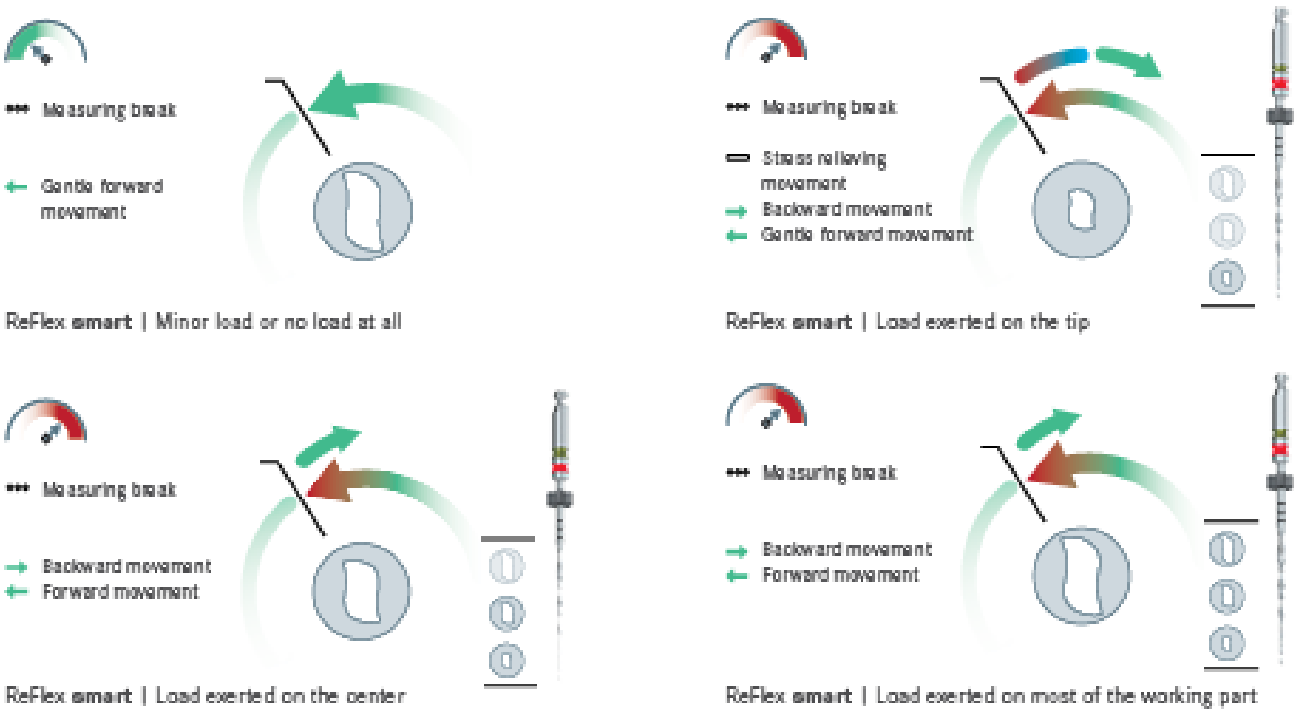
The EndoPilot, when using Procodile, has “Reflex technology” with two modes, Dynamic and Smart. ReFlex technology in these two modes can adjust from a left cutting rotary to a reciprocating motion based on the resistance detected during instrumentation. The reduced torque at the apex minimizes chip compaction and production of dentin mud apically. Utilization of these two modes gives the operator the ability to use a more sensitive torque control that increases safety (Smart mode) or one that is more efficient (Dynamic).

Mechanically, Smart ReFlex technology registers file tip, mid-file and shank torque and alters the files’ speed, direction and torque automatically. By contrast, Dynamic ReFlex technology, registers shank torque and corrects the files’ torque by moving into cutting with increased speed and efficiency. Clinically, this is manifest to the operator by the lights on the handpiece end. The clinician knows they are running at full torque and speed with the green light, that the motor is adjusting the torque through ReFlex technology when the red and green lights are flashing and that the file has stopped with a steady red light. Also, the file makes a hard stop when the file reaches the preset apical limit using the apex locator.

Figure 9: The EndoPilot

Figure 10: EndoPilot Dynamic ReFlex Technology

Figure 11: EndoPilot Smart ReFlex Technology



Obturation:

As mentioned, Procodile instruments are matched with Procodile gutta percha and paper points. It is advised to take a “cone fit” film on every case prior to obturation. Using Procodile gutta percha, the clinician can obturate the canal in whatever manner desired (warm vertical, single cone obturation, lateral condensation, etc.). KometBioSeal, a bioceramic sealer, is also an option and adjunct for single cone obturation.

This article was written to describe the novel Procodile nickel titanium instrumentation system and the EndoPilot motor.

Emphasis has been placed on the inherent safety, efficiency, and ergonomics of Procodile using the EndoPilot.

Dr. Richard Mounce is a 1991 graduate of the Oregon Health Sciences Center endodontic residency and currently practices in Alaska and Oregon. He is widely published and has extensive experience lecturing and writing globally.