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TruNatomy Niti Rotary Files: A Narrative Review of Their Potential and Limitations in Modern Endodontics

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ABSTRACT

This review critically evaluates the clinical performance of TruNatomy rotary files, a novel endodontic file system designed to optimize root canal preparation. The unique design and manufacturing process of TruNatomy aim to enhance flexibility, fatigue resistance, and cutting efficiency. While studies have demonstrated promising results in terms of dentin preservation, effective canal shaping, and high cyclic fatigue resistance, concerns have emerged regarding potential drawbacks.

Research has shown that TruNatomy may exhibit higher levels of debris extrusion and postoperative pain compared to some other rotary file systems. Additionally, its performance in complex canal anatomies may be limited by its lower buckling resistance. Although TruNatomy offers potential benefits, further comprehensive clinical studies are necessary to fully assess its long-term clinical performance, particularly in comparison to established rotary file systems. By evaluating the available evidence, this review aims to provide a balanced perspective on the clinical utility of TruNatomy and identify areas for future research.

INTRODUCTION

Successful endodontic treatment relies heavily on efficient and safe root canal preparation. This involves shaping the root canal system while minimizing damage to the surrounding tooth structure[1]. In recent years, significant advancements have been made in rotary file systems, with the introduction of innovative designs aimed at improving clinical outcomes. One such system is TruNatomy, a novel endodontic file system developed by Dentsply Sirona[2,3].

TruNatomy incorporates a unique design and manufacturing process, aiming to enhance clinical performance by optimizing factors such as flexibility, fatigue resistance, and cutting efficiency[4]. This review will critically analyze the available scientific literature on TruNatomy, examining its performance characteristics in comparison to other established rotary file systems. Specifically, we will explore research findings related to dentin preservation, canal shaping, cyclic fatigue resistance, debris extrusion, postoperative pain, and fracture resistance. By synthesizing the available evidence, this review aims to provide a comprehensive overview of the current understanding of TruNatomy's clinical potential and identify areas for further research and clinical application[5].

The choice of rotary file system for root canal treatment is a critical decision for endodontists. While numerous systems exist, TruNatomy and Niti rotary files are two popular options. This narrative review aims to compare these two systems based on available evidence.

TruNatomy files

TruNatomy files(Dentsply Sirona, Ballaigues, Switzerland) are a new system with a slim profile and regressive taper, designed to preserve dentin structure and reduce instrument separation risk. Clinical studies have shown promising results in shaping ability, cutting efficiency, and fracture resistance. The TruNatomy Orifice Modifier adapts the shape of the orifice to create an ideal entry point for the TruNatomy Glider and TruNatomy Shaping files, preserving coronal anatomy due to its flexibility, diameter, and heat-treated NiTi alloy[6,7]. The TruNatomy Glide Path File optimizes the glide path, allowing for a smooth transition between the K-File and the TruNatomy Shaping Files. It operates at higher speeds for greater cutting efficiency with less torque and encounters less resistance, ensuring precision and increased ease of use. Thermal treatment provides greater flexibility with improved fatigue resistance.TruNatomy Shaping Files are available in four different sizes and lengths to treat a wide range of cases: Prime, Small, Medium, and Large. The TruNatomy System (TRN) is a specially designed novel type of heat-treated NiTi instrument, available in three distinct sizes: small (20/0.04 taper), prime (26/0.04 taper), and medium (36/0.03 taper). These files have been subjected to various heat treatments, with the off-centered parallelogram cross-sectional design potentially contributing to higher cyclic fatigue resistance and elasticity[5,6,8,9].

Niti Rotary Files

Niti rotary files, on the other hand, are a well-established category encompassing various systems like ProTaper, WaveOne, and Reciproc. They are known for their flexibility and ability to navigate complex root canal anatomy. However, the specific performance characteristics can vary significantly depending on the individual Niti system[6,7].

TruNatomy Niti rotary files feature a slim profile with a 0.8 mm NiTi wire and a regressive taper, designed to minimize dentin removal while effectively shaping the canal. Its unique off-

centered parallelogram cross-section may enhance flexibility and resistance to cyclic fatigue [5,6]. Clinical studies have shown TruNatomy preserves more dentin compared to some other Niti systems, such as ProTaper Next, while demonstrating effective shaping ability in various canal anatomies and high resistance to fracture. Other Niti rotary file systems, like ProTaper, WaveOne, and Reciproc, utilize different designs and mechanisms of action, such as constant taper (ProTaper) or reciprocating motion (WaveOne/Reciproc), each with its own clinical advantages and disadvantages in terms of canal shaping and fracture resistance [8,9,10]. Features of Truanatomy and Niti Rotary Files are described in (**Table 1)**

Research shows that the type of horizontal cross-sectional design significantly influences the cyclic fatigue resistance of NiTi mechanical files. Files with an S-shaped design have higher cyclic fatigue resistance than those with rectangular and triangular designs [5,7]. The volume of metal mass at the maximum curvature point also contributes to file fatigue resistance. Mtwo files (VDW) with an S-shaped design and lower metal mass show higher fatigue resistance [9,10].

The primary goal of endodontic therapy is mechanical enlargement and shaping of intricate root canal systems for disinfection. Endodontists have access to a wide range of file systems with various design characteristics and benefits. ProTaper Ultimate (PTU) files are commonly used in restricted accessibility or curved canals. TruNatomy has advantages like maximum flute diameter, reduced distance between active cutting flutes, and shorter handles. ProTaper Gold (PTG) files are more elastic and fatigue-resistant. MicroMega One RECI is more resistant to cyclic fatigue due to heat treatment and reciprocating action [11].

Feature	TruNatomy	Niti Rotary Files (General)
Design	Slim profile, regressive taper, unique cross-section	Variable: ProTaper (constant taper), WaveOne (reciprocating motion), Reciproc (reciprocating motion)
Material	Nickel-titanium (NiTi)	Nickel-titanium (NiTi)
Dentin Preservation	Potentially greater due to slim profile and regressive taper	Varies depending on specific Niti system
Shaping Ability	Effective in clinical studies	Effective in clinical studies, varies with system complexity
Fracture Resistance	High in some studies	Varies depending on specific Niti system
Flexibility	Flexible	Generally flexible, varies with system design
Learning Curve	May have a shorter learning curve due to simpler design	Varies depending on specific Niti system
Clinical Outcomes	Limited long-term data available	Limited long-term data available for direct comparison

Table 1 TruNatomy vs Niti Rotary Files(General) [3,5,6,9,10]

Comparative Analysis

Dentin Preservation: TruNatomy's design may result in less dentin removal compared to some Niti systems, potentially leading to improved tooth structure preservation.

Shaping Ability: Both TruNatomy and Niti systems have demonstrated effective shaping abilities in clinical studies. However, the specific performance can vary depending on the complexity of the root canal anatomy.

Fracture Resistance: TruNatomy has shown promising results in terms of fracture resistance in some studies. However, more research is needed to directly compare it with various Niti systems.

Clinical Outcomes: Limited data exists on long-term clinical outcomes comparing TruNatomy and Niti systems. More research is necessary to evaluate their impact on treatment success. [5,7,9,10]

Study	Focus	Key Findings	Specific Observations
Riyahi et al. (2020)[12]	Cyclic Fatigue Resistance	Superior to Twisted Files and ProTaper Next.	- Demonstrates potential for improved clinical durability.
Kumar et al. (2021)[13]	Canal Transportation	Least canal transportation among TruNatomy, ProTaper Gold, and HyFlex EDM.	- Statistically significant differences at middle and coronal levels.
Reddy et al. (2021)[14]	Cyclic Fatigue Resistance	Highest among TruNatomy, ProTaper, HyFlex EDM, and Reciproc blue.	- Superior performance in middle, apical, and S-shaped curvatures.
Shaheen & Elhelbawy (2022)[15]	Shaping Ability & Buckling Resistance	Comparable to XPS in preserving curvature.	- Lower buckling resistance compared to WaveOne Gold. - Positive correlation found between canal transportation and buckling resistance.
Roshdy & Hassan (2022)[16]	Debris Extrusion	Higher debris extrusion compared to WaveOne Gold.	- Emphasizes the potential for debris extrusion regardless of instrument design or motion.
Silva et al. (2022)[17]	Dentin Preservation & Canal Enlargement	TruNatomy and ProTaper Gold showed similar results.	- Minor differences in dentin removal (ProTaper Gold removed more coronally) Slight difference in apical transportation (lower in TruNatomy for mesial canals)
Bhojwani et al. (2022)[18]	Postoperative Pain	Higher incidence compared to WaveOne Gold.	- Suggests potential for increased patient discomfort.
Selvaraj et al. (2023)[19]	Instrument Deformation	Minimal deformation observed.	- Compared with Hero Shaper, showing both systems as safe for limited use.
Akshay et al. (2023)[20]	Retreatment Efficacy	Effective in removing obturating material.	- Higher apical debris extrusion compared to RaCe and ProTaper retreatment. Shorter removal time than ProTaper retreatment.

García-Castañeda et al. (2023)[21]	Shaping Ability in Long Oval Canals	Comparable to BlueShaper, DC Taper, and HyFlex EDM.	- No significant differences found among the systems.
Patel et al. (2023)[22]	Fracture Resistance of ETT	Higher fracture resistance with 4% taper compared to ProTaper Next.	- Highlights the impact of taper on root strength.

Table2 Summary of TruNatomy Niti Rotary File Research Findings[12-22]

Research on the TruNatomy endodontic system has yielded a mixed bag of results. While it demonstrates promising characteristics like effective dentin preservation and excellent cyclic fatigue resistance, suggesting improved clinical durability, it also presents potential drawbacks. Studies have shown that TruNatomy may have a higher incidence of debris extrusion and postoperative pain compared to some reciprocating systems. Furthermore, while it effectively removes obturating material during retreatment, it also exhibits higher apical debris extrusion in this context. These findings underscore the need for further comprehensive clinical research to fully evaluate TruNatomy's long-term clinical performance, including its impact on patient outcomes, before widespread adoption in routine endodontic practice**(Table2).**

Almohareb RA et al [23] investigated the impact of multiple autoclave cycles on the cyclic fatigue resistance of three heat-treated nickel-titanium files: EdgeTaper Platinum (ETP), ProTaper Gold (PTG), and TruNatomy Prime (TN). Results showed ETP had greater resistance to cyclic fatigue than TN in all autoclave groups and PTG after five cycles. Repeated autoclave cycles improved ETP files' resistance, but not TN and PTG's.

Elnaghy AM et al [24]evaluated the dynamic cyclic and torsional fatigue resistance of TruNatomy instruments (TRN) compared to HyFlex CM (HFC), Vortex Blue (VB), and FlexMaster (FM) instruments. The instruments were tested for their fatigue resistance using an artificial canal and counting the number of load applications before fracture. The results showed that HFC instruments had greater fatigue resistance, while FM had higher resistance to torsional stress.Previous studies have shown that instruments with larger sizes (larger cross-sectional diameters) are more susceptible to cyclic fatigue than smaller instruments[25] .This result was attributed to the larger effect of compression and tension stresses generated on the external surface of the file, as that surface is located farther away from the central axis where the effects of these stresses are minimized or negated [26].

Kiran K K et al[27] compared the canal transportation and centering ability of two different NiTi rotary systems, TruNatomy (TN) and ProTaper Gold (PG). The study used cone-beam computed tomography (CBCT) to compare canal transportation and centering ability in preparing curved root canals. Results showed significant differences between the two systems in canal transportation at 5mm from the apex and centering ratio at 3mm from the apex. The PG system showed better centering ability at the apical third of the root canal. Both systems can be considered suitable for curved root canal preparation.

Priyadarshni P et al [28] to compare dentinal microcracks produced by TruNatomy, Neoendo Flex, and Neoendo Neohybrid files during root canal preparation. Four groups of 25 samples were assembled from 100 mandibular premolar teeth. Results showed that TruNatomy files created fewer cracks compared to Neoendo Flex and Neoendo Neohybrid files.

The study by Eren et al [29] compared the effects of WaveOne Gold, TruNatomy, and conventional hand files on remaining dentin volume in the coronal part of the root and preparation efficiency in mandibular molar teeth. The researchers used 36 canals and 12 root canals in each group. Three-dimensional images were evaluated for remaining dentine volume and change in root canal volume. Results showed no significant difference between the groups in terms of mean differences pre and post-preparation. The most significant differences after preparation were observed in the WaveOne Gold group and the least in the TruNatomy group.

The study by Rego LF et al [30]evaluated the dynamic cyclic fatigue resistance of new and used glider rotary instruments in up to 6 root canals. 72 TruNatomy Glider files were used for root canal preparation and tested in a curved metallic artificial canal. The instruments were divided into four groups: control, 2U, 4U, and 6U. The time to failure (TF) and number of cycles to failure (NCF) were significantly affected by the number of file uses. The study concluded that the TruNatomy Glider can be used as a glide path for up to 2 mesial canals of mandibular molars.

TruNatomy Niti rotary files, characterized by their slim profile, regressive taper, and unique off-centered parallelogram cross-section, have demonstrated promising results in certain aspects of endodontic treatment. Research has shown that TruNatomy exhibits superior cyclic fatigue resistance compared to some conventional systems, potentially enhancing clinical durability. Studies have also indicated that TruNatomy can effectively shape canals while preserving dentin, a crucial factor in maintaining tooth structure. However, concerns have arisen regarding increased debris extrusion and postoperative pain compared to some other systems, emphasizing the importance of meticulous irrigation techniques and careful patient monitoring. Furthermore, lower buckling resistance compared to certain reciprocating systems highlights the need for cautious use in complex canal anatomies. While TruNatomy shows potential, further research, including long-term clinical trials, comparisons with newer technologies, and optimization of clinical protocols, is necessary to fully evaluate its clinical efficacy and safety in routine endodontic practice.

CONCLUSION

TruNatomy and Niti rotary files represent two distinct approaches to root canal treatment. TruNatomy's unique design may offer advantages in terms of dentin preservation, while Niti systems provide a wide range of options with varying characteristics. The optimal choice depends on the specific clinical situation, the operator's experience, and personal preference. Further research is needed to provide more definitive conclusions regarding the comparative performance of these systems.

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