# بسم الله الرحمن الرحيم

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# Comparing shaping ability and cleaning ability of Fanta, OneCurve, and ProTaper Next Ni-Ti rotary file systems

# (An in vitro study)

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# *Dedication*

I would like to dedicate this work to my family who has been a constant source of emotional and moral support in every aspect of my life.

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| BR | BioRace |
| CBCT | Cone beam computed tomography |
| EDTA | Ethylenediaminetetraacetic acid |
| GF | Gentle file |
| KV | Kilovolt |
| mA | Milliampere |
| Mb | Mesiobuccal |
| Ni-Ti | Nickel-titanium |
| NaOCl | Sodium hypochlorite |
| OS | OneShape |
| OC | OneCurve |
| PTU | ProTaper Universal |
| PTN | ProTaper Next |
| PG | Proglider |
| PTG | ProTaper Gold |
| SAF | Self-adjusting file |
| SR | ScoutRace |
| SEM | Scanning electron microscope |
| TFA | Twisted adaptive file |
| WO | WaveOne |
| WOG | WaveOne Gold |

Endodontics is a specialized branch of dentistry that deals with the complex structure found inside the teeth. Endodontics is a greek word that means literally “inside the tooth”. The goal of endodontic treatment is to maintain natural tooth structure as much as possible. Root canal shaping is one of the most important steps in root canal treatment. It is mandatory for the effectiveness of all following procedures, including chemical disinfection and root canal obturation. But it should maintain the canal original path.

Moreover, mechanical preparation forms debris and smear layer that prevent the penetration of irrigants and medicaments into the dentinal tubules and prevent the close adaptation of root canal filling onto canal wall. This may lead to failure of endodontic treatment. So, evaluation of the amount of debris produced and smear layer removal is very important.

Many Ni-Ti files are introduced in the market with variable shapes. Fanta AF blue S one file (Fanta) is AF-H heat-treated Ni-TI file with S- shape cross-section from the middle of the file upward, and an almost oval cross-section at the tip. The manufacturer claims that Fanta files have a great cutting efficiency and flexibility as it has minimum radial contact. Moreover, the variable S-shape cross-section of Fanta file increases the volume of upward debris elimination.

OneCurve file is heat-treated Ni-Ti file with variable cross-section. The manufacturer claims that OneCurve files have high flexibility and cutting efficiency that respects the original anatomy of the tooth. The manufacturer also claims that the variable cross-section of OneCurve file increases file centering ability in the apical third and enhances the debris removal upwards at the middle and coronal parts.

Therefore, comparing shaping, and cleaning abilities of Fanta rotary file and one curve rotary file using ProTaper Next file as a control group was thought to be of value.

The importance of NiTi alloys in endodontic treatment is not questionable as these alloys possess interesting properties such as cyclic fatigue resistance, super elasticity, and shape memory due to the alloy`s reversible crystallographic changes.

NiTi alloy could undergo solid phase transformations between three different crystalline structures: austenite, martensite, and R-phase [(1)]. The changes between these three phases are due to the movement of atoms in a coordinated way changing the crystalline structure of the alloy. [(2)]

The austenite phase is a stable cubic crystalline structure which is considered the parent phase of the alloy because it can be recovered once the alloy is heated above a certain temperature [(3)]. The ability of the alloy to return to a parent phase gives it the property of shape memory.

The transition from the austenite phase to the martensite phase could occur due to the application of stresses such as stresses generated during root canal preparation[(4)]. This martensite phase gives the alloy the property of super elasticity as it could accommodate stresses without being permanently deformed. [(1,5)]

NiTi files were found to be more flexible with better cutting efficiency when compared to stainless steel files [(6)]. Also, the NiTi files allow more centered preparation and less transportation than stainless steel files. [(7-9)]

Fanta AF blue S one is a single Ni-Ti rotary file system. It is made of AF-H heat treated wire with variable S-shaped cross-section along the file with an almost oval cross-section at its tip according to the manufacturer. The manufacturer claims that AF-H wire gives the file more flexibility and This cross-section allows better debris removal, centering ability, and cutting efficiency. (10)

OneCurve is a single Ni-Ti rotary file system. According to the manufacturer, the file is made of heat-treated C-wire with controlled memory and the ability to be pre-bent with a variable cross-section along the blade. This cross-section suggests excellent debris removal and better centering ability in the apical third. (11)

ProTaper Next file is made of M-wire that gives flexibility and cyclic fatigue resistance as claimed by the manufacturer. The manufacturer also claims that the off-centered rectangular cross-sections give the file greater strength and the asymmetric rotation enhances the shaping efficiency as the rotation of the file differs from the center of mass resulting in only two points of the rectangular cross section touching the canal wall at a time. (12)

Shaping and cleaning the root canal system is critical for successful root canal treatment. This part of the study is reviewing the literature regarding shaping ability and cleaning ability.

# I) Shaping ability:

The main goal of root canal treatment is to remove any vital or necrotic pulp tissue, debris, and infected dentine while maintaining the original shape of the canal to eliminate most of the microorganisms from root canal system and to form a continuously tapered shape with the smallest diameter at the apical foramen and the largest at the orifice to clear the way for irrigation, medications, and obturation materials [13,14]

Adequate shaping ability of the root canal is the most important factor affecting the success of root canal treatment as it determines the efficacy of all subsequent procedures. [15,16]

Shaping of root canal system would cause canal transportation which is one of the major determinant factors of root canal treatment prognosis[17]. Also, the centering ability of instruments is critical to get root canal shaping without excess dentine removal[18] which may lead to weakening of the root structure as the more centered the preparation the more conservative the canal preparations which lead to more dentin preservation decreasing the stress on tooth structure. [19]