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Review Article

Retreatment of Oval-Shaped Root Canals – Difficulties and Treatment Approaches

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Abstract: The complex anatomy of oval-shaped root canals presents a major challenge for secondary endodontic retreatment. The positive outcome of the retreatment depends on the proper cleaning and reshaping of the root canal space. Despite the use of various retreatment techniques and the improvement of additional protocols, none of them has yet succeeded in cleaning the entire root canal from filling residue. The untouched irregularities of the oval-shaped canals represent a reservoir for debris and microorganisms that are the main cause of endodontic treatment failure or delayed healing process. Further research should be done to improve the retreatment protocols of oval shaped canals. The aim of this review was to observe the articles investigating the efficacy for retreatment of oval-shaped root canals in the last 10 years.

Keywords: Orthograde retreatment, retreatment techniques, oval canals, supplementary approaches.

INTRODUCTION

Orthograde endodontic retreatment is a laborious procedure requiring complete removal of the previous filling material, followed by a thorough shaping, disinfection and obturation of the root canal space (Karova E *et al.*, 2021). Different techniques for removal of root canal filling are described over the decades, including hand files, engine-driven nickel-titanium (NiTi) instruments specially designed for retreatment or others, specifically used for primary root canal shaping. Sonic and ultrasonic devices, heat, solvents, lasers and combinations between them are frequently added to the retreatment protocols (Cordeiro KF *et al.*, 2018; Rossi-Fedele G *et al.*, 2017). The use of automated instrumentation in endodontics improves significantly the quality of shaping procedures and at the same time reduces procedural time and errors (Velozo C *et al.*, 2021). NiTi endodontic instruments have been reported to be superior or equal to hand instrumentation when used in retreatment cases (Madani ZS *et al.*, 2015; Patil A *et al.*, 2018). However, none of the aforementioned lead to complete cleaning of the canal space from filling remnants during endodontic retreatment (Zuolo AS *et al.*, 2013; De-Deus G *et al.*, 2019).

Sometimes retreatment procedures are further complicated by the shape of the canals, as some of them are oval. Recent studies have revealed a high prevalence of oval-shaped root canals in various groups of teeth (Shrestha S *et al.*, 2018; Papic M *et al.*, 2022). The irregularities of this complex root canal anatomy, especially the sharpened notch of the oval parts, represent a reservoir for debris and microorganisms that are the main cause of endodontic treatment failure or delayed healing process (Tsenova-Ilieva I *et al.*, 2022). NiTi rotary instruments used for primary or secondary root canal shaping are known to rotate in the center of canal space, thus leaving the buccal-lingual extensions untouched by the flutes of the files (Karova E *et al.*, 2022). Retreatment of teeth with flattened canals should be optimized by using additional procedures to better remove the filling material (De-Deus G *et al.*, 2019; Rivera-Peña ME *et al.*, 2018).

The aim of this review was to observe the articles investigating the efficacy for retreatment of oval-shaped root canals in the last 10 years.

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DISCUSSION

To date, there are few studies investigating the effectiveness of retreatment of oval-shaped root canals. Over the past 10 years, several techniques and instruments have been proposed to remove filling residue from dentinal walls, including rotary and reciprocating NiTi instruments (Virdee SS *et al.*, 2017), innovative NiTi instruments adapting to the shape of the canal (Hassan E *et al.*, 2022; Keleş A *et al.*, 2014 May), sonic and ultrasonic devices and tips (Tavares SJO *et al.*, 2021), lasers (Keleş A *et al.*, 2015),etc.

According to the literature, engine-driven NiTi systems designed for retreatment or developed for primary endodontic treatment, driven by continuous or reciprocating rotation, are used for removal of the bulk of the filling material (Ma J *et al.*, 2012; Alakabani TF *et al.*, 2018; Martins MP *et al.*, 2017).Some of the authors concluded that NiTi instruments specifically designed for retreatment do not provide greater advantages over conventional techniques and NiTi instruments intended for primary root canal shaping (Rossi-Fedele G *et al.*, 2017; Alves FRF *et al.*, 2022). Although originally designed for primary endodontic treatment, reciprocating instruments can be successfully used for secondary endodontic treatment purposes (Rios MA *et al.*, 2014).

Few studies have compared the retreatment efficiency of different reciprocating systems or compared them to instruments using continuous rotation, achieving opposite results (De-Deus G *et al.*, 2019; Elsherief SM *et al.*, 2018; Crozeta BM *et al.*, 2016). In one of their studies, *De-Deus et al.* found that the M-Wire Reciproc and Reciproc Blue (*VDW, Munich, Germany*) instruments were equally effective in removing filling materials from straight oval-shaped straight (De-Deus G *et al.*, 2019).

Zuolo AS *et al.* compared the efficacy of the rotary TRUShape system (*Dentsply Tulsa Dental Specialties, Tulsa, OK*) with the Reciproc file in removing filling material from oval canals filled with two different sealers. According to their findings, no statistical difference was observed in terms of the percentage of remaining filling material (Zuolo AS *et al.*, 2016). Similar are the findings of *Kaloustian MK et al.*, who compared the performance of Reciproc and the rotary 2Shape system (*Micro-Mega, Besançon France*) (Kaloustian MK *et al.*, 2019).

Another current study stated that Reciproc removed more filling materials than ProTaper Universal Retreatment (*Dentsply, Ballaigues, Switzerland*) and hand files (Elsherief SM *et al.*, 2018). Other investigators, such as *Crozeta BM et al.*, came to an opposite conclusion. They compared the efficacy of ProTaper Universal Retreatment, Reciproc and TF Adaptive (*Kerr, Orange, CA, USA*). The authors noted that the reciprocating instrument was the least effective at removing filling remnants from the canal walls, followed by the continuous or adaptive motion systems (Crozeta BM *et al.*, 2016). Although the reciprocating file showed less effectiveness than the other systems tested, it appeared to perform faster than NiTi instruments with continuous rotation, as it was found in the work of *Zuolo AS et al.* (Zuolo AS *et al.*, 2016), *Alakabani TF et al.*, (Alakabani TF *et al.*, 2018) and *Iriboz E et al.*, as well. (Iriboz E *et al.*, 2019). Furthermore, in a research of Rivera-Peña ME *et al.*, the use of Reciproc as a supplementary file after the ClearSonic tip resulted in the lowest percentage of residuals throughout the whole root canal and in its apical third (Rivera-Peña ME *et al.*, 2018).

The recently developed innovative files XP Endo Shaper and XP Endo Finisher (*FKG Dentaire, La Chaux de Fonds, Switzerland*) have shown sufficient results for optimized removal of filling remnants from oval-shaped root canals (Iriboz E *et al.*, 2019; Özyürek T *et al.*, 2016). In a current study of *De-Deus et al.*, the authors registered that the XP-endo Shaper instrument, driven in a continuous rotation, displayed higher cleaning ability compared to Reciproc and Reciproc Blue (De-Deus G *et al.*, 2019). *Azim AA et al.* came to the conclusion that тхе XP Endo Shaper was the most efficient in gutta-percha removal, compared to WaveOne Gold and HyFlex EDM when operated at a higher speed (Azim AA *et al.*, 2018). These findings are supported by the statements of another study in which XP-Endo Shaper and XP-Endo Finisher R groups were statistically more effective than hand files and ProTaper Retreat System in removing the filling material (Iriboz E *et al.*, 2019). Additionally, XP Shaper instrument has been reported to improve retreatment effectiveness when used as a supplementary instrument (Dhaimy S *et al.*, 2021).

The XP Endo Finisher is also aimed at improving root canal cleaning when used as an additional cleaning tool compared to Endo Activator, passive ultrasonic irrigation (PUI) and conventional needle irrigation (Özyürek T *et al.*, 2016). In some studies, it appears to be equally effective with XP Endo Finisher R in removing filling materials from oval-shaped canals (Hassan E *et al.*, 2022; Silva EJNL *et al.*, 2018).

The novel specially designed for retreatment XP Endo Finisher R (*FKG Dentaire, La Chaux de Fonds, Switzerland*) with a near-zero taper is manufactured from superflexible NiTi MaxWire (Martensite-Austenite Electropolish FleX alloy). The file acquires a “spoon-like” shape, in the 10 mm segment of the tip when exposed to body temperature, allowing the instrument to reach the anatomical irregularities more easily than conventional NiTi instruments (Baranwal HC *et al.*, 2020; Tsenova-Ilieva I *et al.*, 2022). The file maximizes the cleaning and disinfection of the complex oval-shaped canal anatomy

and is currently preferred as a supplementary tool in the retreatment process (Siqueira, JF *et al.*, 2011).

According to *Da Silva V et al.*, significantly less material could be observed on the canal walls in the group with sequential use of Reciproc and XP-endo Finisher R compared to the instrumentation with Reciproc only (Da Silva V *et al.*, 2022). The same results were reported by *Karova E et al*. when the XP Endo Finisher R was used as an additional file after the D-Race (*FKG Dentaire, La Chaux-de-Fonds, Switzerland*) instrumentation (Karova E *et al.*, 2022). Used as a supplementary tool, it improves the removal of root canal obturation material, regardless of the filling technique (Zhang W *et al.*, 2022; Faus-Llácer V *et al.*, 2021) or the sealer used (Hassan E *et al.*, 2022; Silva EJNL *et al.*, 2018). Like the XP Endo Finisher, the XP Endo Finisher R has been reported to be superior to passive ultrasonic irrigation (PUI) in the study of *De-Deus et al*. (De-Deus G *et al.*, 2019). It has been shown to be more efficient than Endo Activator and PUI in other studies as well (Volponi A *et al.*, 2020; Tavares SJO *et al.*, 2021).

Self-Adjusting file (SAF) (*ReDent, Ra'anana, Israel*) is a rotary instrument designed for primary root canal shaping although, it can be used as an additional cleaning tool for retreatment of oval shaped canals. Due to its novel design, the SAF can expand and reach more of the canal irregularities than conventional center-orientated NiTi instruments (Alves FRF *et al.*, 2022). Its use as an adjunctive technique during retreatment of oval-shaped canals has resulted in better removal of filling material from the root canal walls (Keleş A *et al.*, 2014 May; Keleş A *et al.*, 2014).

Another commonly used additional approach is the passive ultrasonic irrigation of irrigants. Its impact is due to the acoustic streaming and cavitation caused by the vibration of an ultrasonic tip at a frequency ranging from 25 kHz to 30 kHz (Karova E *et al.*,). PUI has been noted to improve cleaning of filling material in oval-shaped root canals when used after mechanical instrumentation (Crozeta BM *et al.*, 2020). The same results were registered for the use of sonic irrigation in retreatment cases, although its performance was not superior to PUI (Jiang S *et al.*, 2016).

Lasers have also been considered as an available additional procedure for irrigant activation (Jiang S *et al.*, 2016) or filling material removal during retreatment of oval-shaped canals (Keleş A *et al.*, 2015; Alves FRF *et al.*, 2022). Both Nd:YAG and Er:YAG lasers have been investigated for filling removal, but the results for Er:YAG laser have been shown to be superior. It is also preferred for its lower thermal effect on the tooth structures and surrounding periodontium and the lower thermal trauma (Tachinami H *et al.*, 2010).

Some of the researchers investigated and compared the degree of removal of filling material at different levels of the root canal (Spinelli A *et al.*, 2022). The apical portion of the canal is generally considered critical for debridement. Some authors state that further enlargement of the apical third improves removal of root fillings (Ma J *et al.*, 2012; De-Deus G *et al.*, 2019). However, the additional apical instrumentation could weaken the mesial and distal walls which can lead to crack formation or fractures (Kunert GG *et al.*, 2010). Other authors, such as *Spinelly et al*., found that the remnants occupy a large portion of the middle third, especially in the buccal-lingual sides of the oval-shaped canals. They also noted that these canal contents were not visible on conventional X-ray examination, suggesting greater contamination of the canal than conventional observation methods can reveal (Spinelli A *et al.*, 2022).

CONCLUSION

The complex anatomy of oval-shaped root canals presents a major challenge for secondary endodontic retreatment. Despite the use of various retreatment techniques and the improvement of additional protocols, none of the above has yet succeeded in cleaning the entire root canal from filling residue. Further research should be done to improve the retreatment protocols of oval shaped canals.

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