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Respecting the Root Canal Anatomy Three Dimensionally Using Self Adjusting File (SAF) - A Novel Approach

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Abstract

Root canals often have hard-to-reach areas that are practically inaccessible to current mechanical preparation technologies. The goal of cleaning and shaping may be easily and reproducibly achieved with rotary files as far a relatively straight and narrow root canals but not attainable in flat oval and curved canals. The new self-adjusting file (SAF) represents a totally different approach in endodontic file design and mode of operation that was specially designed to overcome this problem. The aim of this present paper is to discuss the three dimensional shaping ability and characteristic features of self-adjusting file with a review of literature.

Keywords: Endodontic files; Canal preparation; Root canal treatment; Self adjusting file

Introduction

Endodontic therapy success depends on canal preparation which determines the efficacy of all subsequent procedures and includes mechanical debridement, creation of space for medicament delivery, and optimized canal geometries for adequate obturation. The intricacies of dental anatomy per se reveal themselves early in procedure when canal orifices of entire canals may be overlooked [1]. Cleaning and shaping of root canals successfully require the presence of irrigating solutions that can only be applied to the apical third of root canal only after Enlargement with instruments [2]. Nickel Titanium rotary instruments have become major adjunct for root canal shaping, but perform poorly in flat oval and curved canals [3]. A systemic and comprehensive study by Wu et al. has shown that oval or flat root canal morphology can be expected in 25% to 50% of cases [4]. The buccal and lingual areas of such flat root canals and the area facing the isthmus in tear shaped ones cannot be adequately prepared by current rotary files. This led to the introduction of a new self-adjusting file (SAF) which not only adapts longitudinally but also to the cross section of the canal [5]. The aim of present paper is to discuss the unique parameters of self-adjusting file over rotary NiTi files with review of literature.

Review of Literature

Fauchard the founder of modern dentistry, described instruments for trephination of teeth, preparation of root canals and cauterization of pulps but the exact systemic description of root canal preparation was not mentioned in the literature. At the end of 18th Century, only primitive hand instruments, excavators, iron cautery instruments, very few thin and flexible instruments for endodontic treatment had been available. Edward Maynard developed the first endodontic instruments by notching round watch springs for extirpation of pulp spaces [6,7].

In the middle of 19th century, broaches with three or four sided were recommended to enlarge the canal with that of the fang. Though Gates glidden drill was introduced in 1885 and K-files in 1915, but the standardization of instruments was proposed only in 1929 by Trebitsch and again in 1958 by Ingle [8]. The use of fine needles with rectangular cross section mounted on to a dental handpiece was described by Oltamare and advocated its use in curved root canals to avoid instrument fracture. In 1889, William H. Robins developed first endodontic hand piece for automated root canal preparation with specially designed needles mounted on to dental hand piece with 360° rotation. The Cursor contra angle handpiece introduced in 1928 combined rotational and vertical motion of the file. Later, Racer hand piece using vertical motion and Giromatic hand piece with reciprocal 90° rotation became popular in 1964 [6].

The dentist could only influence the rotational speed and vertical amplitude of the file by moving the hand piece, which was all rigid made from stainless steel. The Canal Finder system was a modified endodontic hand piece with partially flexible 90° rotational motion depending on the rotary speed and resistance of the file inside the canal space. In 1970's and 1980's lateral oscillating as well as upward filing motion developed with Excalibur and Endoplaner handpiece and also devices ranging from ultrasonic to laser were all attempted for root canal preparation and disinfection [6,9].

Nickel Titanium rotary instruments have been a great step forward in modern endodontics were first described by Walia et al. adequately cleaned and shaped the simple, narrow, straight canals with round cross section with its 3600 rotation at low speed [10]. The buccal and lingual areas of flat root canals and the area facing the isthmus in tear shaped ones could not be adequately prepared by current rotary files leading to Obturation failures [11,12]. Another inherent problem with rotary files is apical canal transportation in curved root canals which is a critical point as the inner side of curvature remains untouched, full of debris and might lead to ledging apically [13,14]. Accurate length measurement was an essential prerequisite for any rotary file which sometimes accidentally passes the apical foramen soon lacerates or zips the apical foramen. Unexpected separation of the files was also a major drawback with NiTi files [5,15]. Nevertheless to overcome, these inherent problems, self-adjusting file was developed. Self-adjusting file (SAF): A novel approach.

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Biological Adaptation

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 that can be inserted into any canal previously prepared or negotiated with #20 and #30 K-file respectively. When introduced into root canal space, it not only adapts longitudinally but also along its cross-section.

In a round canal, it will attain a round cross-section, whereas in an oval or flat canal it will adapt according to its cross-section, thereby 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 [16,17].

The SAF is operated with Trans line (in and out) vibrating hand pieces with 3,000-5,000 vibrations per minute and amplitude of 0.4 mm. Such a hand piece may be the KaVo GENTLE power or equivalent combined with either a 3LDSY head (3600 free rotation; Kavo, Biberach Riss Germany) or MK-Dent head (3600 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). When the SAF is used to enlarge the canal it does not impose its shape on the canal space but rather complies with its original shape keeping the apical part of curved canals closer to its original thus reducing chances of apical transportation [5].

Cul De Sac Portion of Root Canal Space

Every available file system generates smear layer and leaves debris in the apical third of root canal. The cul de sac portion of the root canal presents a distinct challenge for any irrigation method. Inserting an irrigation needle deep into the root canal coupled with the application of positive pressure may enhance the risk for injecting the irrigation solution beyond the apex, potentially causing a "sodium hypochlorite accident" [18-20].

This unmet challenge resulted in a new branching point in the "evolution tree" of endodontic which aims for simultaneous 3D shaping, debridement and disinfection of the root canal space [21]. The SAF file is operated with continuous irrigation provided by a special device (VATEA). The chosen irrigation fluid enters the file through a free-rotating hub and is continuously replaced throughout the procedure, thus providing a fresh, fully active, supply of sodium hypochlorite and chelator solution ethylene diamine tetraacetic acid. The operator has a choice of which of the two solutions to use at a given moment and at what flow rate to infuse the canal. No positive pressure can develop in the root canal because the solution can always easily escape through openings in the lattice of the file. In addition to effectively replacing the irrigant from the apical portion of the root canal and the simple activation of the irrigant through the creation of turbulence, the SAF file also induces a scrubbing motion on the canal walls that must have obviously contributed to the exceptionally clean surface that resulted even in the cul de sac portion of the canal [19].

Root Canal obscuration

Many obstructing methods used today aim at good adaptation of the root canal filling material to the canal walls, thus ensuring an adequate seal that will prevent bacterial contamination/re-contamination of the root canal system.

Lateral compaction using chloroform-dipped customized master cone technique is expected to provide a intimate seal to the canal walls prepared with SAF system [5]. A micro-CT-based quantitative three-dimensional method for analysis of root canal filling adaptation to the canal walls presented that the SAF allowed not only better cleaning and shaping but also better adaptation of the root canal filling than those by rotary file [22]. The efficacy of two stage retreatment method in which the SAF is used to remove root canal filling residue left in the Curved canals of mandibular molars resulted in significant reduction when compared with that of rotary instruments [23].

Conclusion

Self-adjusting file system although a novice user is advised to advance slowly along the learning curve from simpler to more complicated canals providing a practical solution for the thus far unsolved problems of mechanized cleaning and shaping of canal space with oval, oval-flat cross-sections.

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