

三维自调节根管预备锉

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[摘要] 镍钛旋转器械预备后的根管横切面为圆形, 普遍存在近远中壁过度预备, 颊舌侧壁和靠近峡区的泪滴状区域及峡区未被清理等问题, 而三维自调节锉(SAF)则可解决上述问题。SAF由中空可压缩的薄镍钛网丝制作而成, 不仅在纵向上能顺应根管弯曲方向, 在横断面上亦能适应根管形态, 自动调整为圆形、扁形或椭圆形等对根管壁牙本质进行均匀的往复式切削。SAF连接冲洗系统VATEA后以持续低压传递冲洗液至根管深处, 收到机械预备和化学预备同期进行的效果, 有利于去除涂层, 遗留的未预备面积较旋转器械少, 但其去除根管内感染物质的能力尚存争议: SAF较旋转器械更容易清除椭圆形根管中的细菌, 但却不能有效地预备根尖段, 冲洗液也难以传递至根尖区域, 导致其不能有效去除根管壁碎屑、涂层, 亦不能有效地清除根尖的感染细菌。SAF的通畅能力较弱, 在再治疗中主要起辅助冲洗的作用, 可以去除更多的牙胶残留物。SAF不易出现器械完全分离, 偶尔网状镍钛丝的一端分离, 另一端仍与器械主体相连, 不会出现分离端遗留根管内造成根管堵塞。以SAF联合用手用锉预备根管, 牙本质壁则几乎无任何微裂纹。简而言之, SAF的出现对于进一步研发和改良器械, 提高根管预备效率, 减少并发症具有重要的意义。

[关键词] 三维自调节锉; 根管预备; 镍钛器械

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Self-adjusting file for root canal preparation Liu Zhaohui, Ling Junqi. (Dept. of Conservative Dentistry and Endodontics, Guanghua School of Stomatology, Hospital of Stomatology, Sun Yat-sen University, Guangdong Provincial Key Laboratory of Stomatology, Guangzhou 510055, China)

[Abstract] All current rotary files cut the root canal into a form that has a round cross section. Substantial untouched areas may be left on the buccal and lingual sides of a flat root canal or on the side facing the isthmus in tear-shaped root canals. However, the self-adjusting file(SAF) can address these problems. SAF is a hollow file designed as a compressible, thin-walled, pointed cylinder composed of a nickel-titanium lattice. When inserted into a root canal, SAF adapts itself to the canal's shape both longitudinally and along the cross section and removes a relatively uniform dentin layer with a reciprocating movement. A special irrigation device, VATEA, is connected to SAF to provide a continuous flow of irrigation into the recess of the canal at low pressure. Debris and the smear layer can be removed efficiently during the simultaneously mechanical and chemical preparations. Compared with popular rotary instruments, SAF can cut more of the root canal area. However, its efficiency in eliminating viable bacteria is debatable. SAF can easily remove bacteria in oval root canals. However, insufficient apical preparation and inadequate apical irrigation has also been reported. Hence, the removal of debris, smear layer, and bacteria in the apical region of the root canal is difficult for SAF. Furthermore, SAF plays only an additional flushing role in root canal retreatment because of its poor negotiation ability. The use of SAF with rotary instruments results in a significant reduction in the amount of filling residual. SAF cannot be totally separated, and the detachment of one of the arches at either of its ends is a common mechanical failure. Furthermore, the damaged file

can easily be retrieved from the canal. The combination of SAF and hand instruments rarely results in dentinal microcracks. In conclusion, the emergence of SAF is important for the further improvement of the instruments that enhance the efficiency of root canal preparation as

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well as for reducing complications.

[Key words] self-adjusting file; root canal preparation; nickel titanium instrument

根管预备指对根管系统三维结构的成形和彻底清理,是根管治疗的关键。目前,种类繁多的机动镍钛旋转预备器械通过改变横截面、锥度,尖端设计、螺纹设计等使其各具优势,具有良好的切割性能和弹性,在高效清除根管内感染物质的同时,能够最大限度地维持根管系统走向,减少根管偏移和台阶的产生;然而,随着微型计算机X线断层摄影术(micro-computer tomography, mCT)技术在口腔领域的应用,人们对复杂根管系统的解剖形态和预备评价进行了深入的研究,发现镍钛旋转器械预备后的根管横切面为圆形,普遍存在近远中壁过度预备,颊舌侧壁和靠近峡区的泪滴状区域及峡区未被清理等问题^[1-4]。2010年, Metzger等^[5-7]设计的新型三维自调节锉(self-adjusting file, SAF)的问世,有望解决目前根管预备过程中面临的部分问题。

1 三维自调节锉的特征

SAF与其他机械预备器械由核心加螺旋形切割刃组成截然不同,它是由中空可压缩的薄镍钛丝网制作而成的,不仅跟常规镍钛锉一样在纵向上能顺应根管弯曲方向,在横断面上亦能适应根管形态,自动调整为圆形、扁形或椭圆形等。SAF的直径分别为1.5 mm和2 mm两种规格,单支锉即可完成整个根管预备,其中SAF-1.5用于已扩大至20号的根管,SAF-2用于已扩大至30号的根管。SAF由特定的往复运动(振幅0.4 mm)机头RDT3驱动,后者连接于兼容的Kavo GENTL Epower或相似的低速手机,转速为5 000 r·min⁻¹。当锉置于根管内后,其弹性回复力对根管壁施加连续轻微压力,在往复运动作用下,自调节根管的三维形态,对根管壁牙本质进行均匀的切削。SAF为一次性根管锉,推荐每一根根管预备时间4 mm,切削根管壁60~75 μm厚。

SAF通过硅胶管与特定的冲洗系统VATEA连接,后者以1~10 mL·min⁻¹的速度连续低压传递冲洗液至SAF,通过中空的器械进入根管深处,收到机械预备与化学预备同期进行的效果,有利于去除涂层。冲洗系统VATEA和RDT3机头经特殊

处理,可耐受长时间暴露于次氯酸钠冲洗液中。

2 三维自调节锉的成形

目前,根据SAF具有的可压缩性和三维自调节性的特点,其成形能力研究主要集中于评估其在不同根管形态中未预备面积和根管偏移等变化方面。mCT以高精度微焦点X线球管进行的超高分辨率三维成像,可分辨根管细微结构,在分析软件下进行的三维重建及重合预备前后图像,可精确定量和比较根管体积、表面积、未预备面积和根管偏移等形态学变化^[8],是评价SAF成形能力的主要手段。

不同的根管形态,其未预备面积差异较大,但大多数SAF遗留的未预备面积较旋转器械少:预备效果最好的是上颌前牙单根管(圆直根管),SAF预备5 min后未预备面积仅占8.6%^[9]。预备下颌磨牙远中根管(长椭圆形根管),SAF未预备面积为23.5%,明显低于ProTaper组的59.6%^[10-11]。Peters等^[12]在利用ProTaper机动旋转系统预备上颌第一磨牙时发现,近颊、远颊和腭根管壁分别遗留43.0%、33.2%和49.0%的未预备面积,而SAF预备后未预备面积分别为25.8%、22.1%、25.2%。预备C形根管后遗留的未预备面积最高(41.0%),仍低于ProTaper组的66.0%^[13]。根管预备后的热牙胶充填,SAF组90.5%的充填率明显高于ProTaper组77.5%^[14]。亦有研究^[15]表明,SAF和旋转器械预备效果相当:以SAF预备下颌前牙扁根管,根管中下段与旋转器械K3相比较无明显差异,根管上段预备后,其根管体积和面积以及预备区域较K3明显增加,根管尖端相当于40号02锥度。Dietrich等^[16]亦认为,SAF、K3、WaveOne对根管的成形能力无明显差异;对峡区的预备,SAF和K3较WaveOne好,但SAF和K3无明显差异。

SAF的设计者认为,SAF不具有坚固内核,回弹力小,在弯曲根管时不致引起根管拉直或偏移。以SAF预备下颌磨牙远中根,根管上段偏移约106 μm,尖端偏移81 μm;在预备上颌磨牙根管时,根管偏移31~89 μm,低于旋转器械预备时根管偏移(120~135 μm)。

3 三维自调节锉的清洁性能

组织学切片^[17]显示,以SAF预备椭圆形根管,其颊舌侧遗留的牙髓组织较ProTaper组少;以SAF伴次氯酸钠冲洗预备下颌磨牙近中根管,峡区内碎屑明显少于ProTaper组,经乙二胺四乙酸(ethylene diamine tetraacetic acid, EDTA)再次冲洗后,碎屑进一步减少^[18];以SAF伴次氯酸钠和EDTA交替冲洗,单根管内无碎屑,根管冠部无涂层,中段无涂层区域为80.0%,尖端无涂层区域为65.0%。1.3%低质量分数的次氯酸钠和EDTA联合应用能有效去除涂层,避免过度腐蚀根管壁牙本质,次氯酸钠加混合物-四环素-异构体-酸-去污剂或加EDTA无明显差别^[19-20];然而在一个模拟的侧支根管试验中,啄击有利于冲洗液到达根管深处,但SAF不能同负压冲洗装置一样将冲洗液传递至整个工作长度,不能有效地清洁侧支根管^[21]。

在细菌清除方面,SAF较旋转器械BioRaCe更容易清除椭圆形根管中的细菌^[22],即以SAF冲洗2 min,细菌明显减少,冲洗6 min,效果最佳^[23];但是,Paranjpe等^[24]则发现,SAF不能有效地预备根尖段,冲洗液也难以传递至根尖区域,导致其不能有效去除根管壁碎屑、涂层,亦不能有效地清除感染细菌,其效果较ProTaper差。

4 三维自调节锉的再治疗性能

SAF的通畅能力较弱,在去除牙胶等充填物的过程中,主要以辅助冲洗的形式出现。采用ProTaper再治疗锉去除牙胶后以SAF辅助冲洗,残留的牙胶量明显减少,但却不能完全清除上颌磨牙或下颌磨牙弯曲根管中的牙胶^[25-26]。Solomonov等^[27]发现,Profile联合SAF预备,较ProTaper能更有效地去除下颌远中扁形根管残留牙胶。

5 三维自调节锉的安全性能

SAF的中空设计致其不易出现器械完全分离,偶尔网状镍钛丝的一端分离,另一端仍与器械主体相连,不会出现分离端遗留管内造成根管堵塞。设计者认为,其使用29 min后仍无镍钛丝分离,但30 min后其清洁功能降低40.0%;SAF不会引起冲洗液超过根尖孔,出现根尖急症。

有学者在预备弯曲半径为5 mm,弯曲度分别为45°和60°的人造根管中发现:预备4 min后,SAF开始出现镍钛丝分离,随着时间的延长分离进一步加重,特别是弯曲度为60°的根管;使用16 min内,以单侧镍钛丝分离为主,之后出现双侧镍钛丝分离,极易出现整体分离。他们建议使用多支SAF锉预备弯曲根管,以避免器械分离,但会因此增大经济成本。

研究显示:以HERO Shaper、Revo-S、Twisted File和ProTaper预备根管,牙本质壁均存在程度不同的微裂纹;而以SAF联合手用锉预备根管,牙本质壁则几乎无任何微裂纹。

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