Canal preparation of the MB2 canal with the R25 RECIPROC® instrument without prior hand filing or glide path.

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NOTE TO THE READER: For a better understanding of the present article, the author recommends prior reading of the article titled "Canal preparation with only one reciprocating instrument without prior hand filing: A new concept".

Introduction

The canal preparation of the MB2 canal in a maxillary molar is challenging (Ibarrola et al. 1997) considering the complexity of the canal anatomy (Verma & Love 2011) and the presence of calcifications (McCabe & Dummer 2012) mainly in the coronal third of the canal.

Usually, small hand files are used to establish patency and create a glide path. However, these files lack rigidity for the negotiation of narrow spaces and are prone to fracture. Therefore, hand path-finding files with an enhanced rigidity (e.g. C-PILOT®, VDW Dentsply, Germany, and C+ Files, Maillefer Dentsply, Switzerland) were introduced (Allen et al. 2007). However, the efficacy of these files remains questionable (Allen et al. 2007). Moreover, another concern associated with the use of hand files for glide path is the possible occurrence of iatrogenic complications and canal transportation regardless of the proficiency of the clinician (Berutti et al. 2009).

Engine-driven files such as the PathFile™ instruments (Maillefer/Dentsply, Switzerland) and Mtwo® 10/.04 instrument (VDW, Germany) have been introduced for the glide path management. Studies have shown that the incidence of canal transportation associated with engine-driven files used for glide path management is lower compared to small hand instruments (Berutti et al. 2009). However, the management of the glide path with these engine-driven instruments requires the use of additional instruments, 1 to 3 instruments depending on the system. Also, recent studies have shown the increased incidence of buckling associated with these instruments (Lopes et al. 2012a). Moreover, patency of the canal with a small hand file has to be established prior to the use of the PathFile™ instruments for the management of a glide path; therefore, the possible complications resulting from the use of small hand files in narrow spaces are still a concern. Also, the engine-driven instruments used for the management of a glide path are used in a continuous rotation; therefore, there is an increased risk of fracture from binding (Alves Vide et al. 2012) especially in a narrow canal with a complicated anatomy such as the MB2 canal in a maxillary molar.

In many cases, the use of the engine-driven instruments may not be possible at the beginning of the canal preparation procedure due to the obliteration of the canal at its orifice and/or in its coronal third with calcifications; the use of very small hand files may also not be possible. In similar situations, the clinician will typically use fine ultrasonic tips to remove the calcifications and to reach a level in the canal where the use of small hand or engine-driven instruments for glide path will become possible. The use of ultrasonic tips for the removal of calcifications can cause canal blockages and ledges resulting in a more complicated procedure.

The objective of the present article is to present a new concept for the preparation of an MB2 canal without a glide path, thus eliminating the concerns associated with the use of small path-finding hand and engine-driven files.

Clinical procedure

Guidelines have already been established for the use of RECIPROC® instruments for the initial canal preparation; they include the forward and reverse angles, speed settings on the motor, the pressure applied on the instrument, the pecking and brushing motion with the instrument, the canal preparation without establishing a glide path and the need for establishing a glide path in some cases (www://endodonticcourses.com/literature). One major benefit of the RECIPROC® system is its simplicity regardless of the nature of the procedure and the degree of canal calcification and curvature. The guidelines for using the RECIPROC® instruments for initial endodontic treatments in canals with different degrees of calcification and curvature as well as in MB2 canals are the same.

The access cavity preparation, the straight-line access guidelines as well as the irrigation protocol remain unchanged, similar to a standard initial treatment procedure. The orifice of the MB2 canal has to be located before using the RECIPROC® instrument. The use of fine ultrasonic tips may be required for this purpose. The RECIPROC® instrument is not used to locate the orifice.

An R25 RECIPROC® instrument is used for the management of an MB2 canal in a maxillary molar. Before commencing preparation, the length of the root canal is estimated with the help of an adequately exposed and angulated pre-operative radiograph. The silicone stopper is set on the R25 instrument at 2/3 of that length.

In this new concept, obtaining patency of the MB2 canal and creating a glide path will never be attempted prior to using the R25 instrument. The tip of the R25 instrument will be placed at the orifice of the canal; the clinician will feel that the tip is catching in the orifice. The R25 is then activated in reciprocation to advance into the coronal third of the MB2 canal. Depending on the severity of the calcification and the width of the orifice of the canal, the advancement of the R25 may be slow; however, it will be progressive. The R25 will always be able to advance into the coronal third of the canal regardless of the width of the canal and the severity of the calcification at the orifice of the canal or in its coronal third. The R25 will act as an orifice opener due to its increased cutting ability and the relative strength at its tip.

Once the calcification at the orifice and the coronal third of the MB2 canal is overcome, the R25 will advance easily in the canal in an apical direction. The RECIPROC® instrument is used in the canal with a slow in-and-out pecking motion without pulling the instrument completely out of the canal. The amplitude of the in-and-out movements should not exceed 3-4 mm. Only very light pressure should be applied. The instrument will continue advancing easily in an apical direction. After 3 in-and-out movements, when more pressure is needed to make the instrument advance further in the canal or when resistance is encountered, the instrument is pulled out of the canal to clean the flutes. A size 10 file is used to check patency to 2/3 of the estimated working length. The canal is copiously irrigated.

The RECIPROC® instrument is used until it has reached 2/3 of the estimated working length as indicated by the stopper on the instrument. The instrument is then removed from the canal, the canal is irrigated and a size 10 file is used to determine the length. The RECIPROC® instrument is then re-used in the same manner until the working length has been reached. Upon reaching working length, the RECIPROC® instrument is withdrawn from the canal. The RECIPROC® instrument can also be used in a brushing motion against the lateral walls.

Creating a glide path during the use of the RECIPROC® instruments: indication and management

A glide path may also have to be created in some MB2 canals when the R25 stops advancing in the canal or if advancement becomes difficult. In this case, pressure should not be exerted on the R25. The instrument should be removed from the canal and the canal irrigated. If the R25 still advances with difficulty or if it does not advance, it should be removed from the canal and the canal irrigated once again. At this point, hand files sizes 10 and 15 should be used to create a glide path to the working length. The R25 would then be used until the working length has been reached. If, however, the progress of the R25 instrument were still difficult or not possible, the canal preparation would need to be completed with hand files.

Using hand files to finish the apical canal preparation

In some canals, the size 10 file used for the working length determination (after the R25 has reached 2/3 of the estimated working length) has to be pre-curved, otherwise it cannot reach working length. This indicates the presence of an abrupt apical curvature (Fig. 1). The use of the R25 is contra-indicated in this instance. The canal preparation has to be finished with hand files. However, in most of the cases, the size 10 file used for the working length determination will reach that length without being pre-curved (indicating the presence of a gradual curvature) (Fig. 2). The R25 will be used to working length to complete the preparation.

Fig. 1a

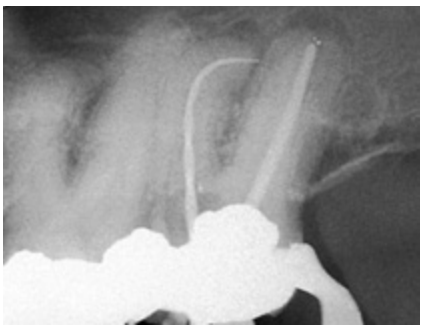

Fig. 1b

Fig. 2

Discussion

The glide path management can be a challenging and complicated procedure that requires the combined use of different manual stainless steel and engine-driven nickel-titanium instruments in order to be accomplished safely (Lopes et al. 2012b).

One major benefit of the RECIPROC® system is its simplicity regardless of the nature of the procedure the degree of canal calcification and curvature. The guidelines for using the RECIPROC® instruments for initial endodontic treatments in canals with different degrees of calcification and curvature as well as in MB2 canals are the same.
The author has been using the described technique for the management of MB2 canals for almost 4 years from the date of publication of this article.

The first main challenge in the management of an MB2 canal is the progress of the instrument in the coronal third of the canal. This challenge is caused by the presence of calcifications at the orifice of the canal and its coronal third. As a general rule, the pulp calcification process occurs in a corono-apical direction (Mccabe & Dummer 2012). Once these calcifications are removed, the instruments will advance easily towards the apical third of the canal (Amir et al. 2001).

According to an evaluation of MB2 canals treated by the author, once the canal orifice was located (the tip of a fine endodontic explorer will catch in the orifice), obtaining of canal patency and the creation of a glide path are not required to allow the progress of the R25 into the coronal third of MB2 canals regardless of the degree of calcification at the orifice of the canal and/or in its coronal third. Interestingly, despite the dimensions of the R25 (a diameter of 0.25 mm at the tip and a 0.08 mm/mm taper on the apical 3 millimeters) and despite the severe narrowness of the MB2 canal in some situations, the R25 will consistently remove the canal calcification at the orifice of the canal and in its coronal third. It will advance into the middle third of the canal without the need to use ultrasonic tips or orifice opener instruments. In similar situations, the use of small hand or engine-driven pathfinding files will not be possible until the removal of the coronal calcificationis accomplished with an ultrasonic tip. The use of ultrasonic tips can result in more complications such as canal blockages, canal ledges or root perforations.

The efficiency of the R25 in the management of the coronal third of MB2 canals in a safe and consistent manner can be explained by the following reasons.

1. The R25 instrument is very efficient in cutting dentine. The R25 instrument has a design similar to Mtwo® instruments, which have been shown to cut dentin very efficiently compared to other rotary instruments.

2. The tip of the R25, due to its diameter and the taper, is advantageously more rigid than the tip of the existing rotary path-finding files. The tip of the R25 will not buckle when confronted with canal narrowness and calcification in contrast to the rotary path-finding instruments.

3. Histological studies have shown that canal patency (natural path of least resistance) exists regardless of the degree of canal calcification and despite the fact that canals may appear completely calcified visually or radiographically (Patersson & Mitchell 1965, Schindler & Gullickson 1988, Torneck 1990, Kuyk & Walton 1990). Being very efficient in cutting especially in the absence of buckling, the tip of the instrument, unlike the existing path-finding instruments, will engage the canal orifice and will start cutting and advancing even if the canal appears to be completely calcified. The R25 will follow the natural path of least resistance, the existing canal space, regardless of the severity of the calcification at the orifice or in the coronal third of the canal.

4. The R25 combines 2 features, which greatly contribute when used together to the maintenance of the canal curvature. First, the R25 is made from an M-Wire® NiTi alloy, which confers to the instrument a relative flexibility. Second, the use of a reciprocation movement, which has been shown to be favourable to the maintenance of the canal curvature.

5. It should be obvious to the reader, from points 1 - 4, that the R25 will force its way into the natural path of least resistance. Despite the narrowness of the MB2 canal and the presence of severe calcifications, the R25 will safely advance in the coronal third of the canal. The risk of instrument fracture is greatly reduced as the forward and reverse angles set on the motor for the reciprocating movement are lower than the angle of fracture of the instrument. Even if the instrument binds in the narrow canal space, it will not fracture because the motor will reverse the rotation when the angle set on the motor is reached; the angle at fracture will not be reached. In addition, the incidence of instrument binding is reduced (Varela-Patiño et al. 2010). This can be explained by the combination of the pecking movement, an incomplete forward rotation and the reverse rotational movement, which disengages the tip.

6. The safety in using the R25 for the management of MB2 canals is also the result of a reduced torsional fatigue. When an engine-driven instrument is used in a canal it will engage the canal walls and cut dentine. This will subject the instrument to stresses in torsion. The repeated stresses on the instrument from the repeated cutting procedure will cause changes in the metal. The changes in the metal can be either reversible or irreversible (leading to fatigue and fracture) depending on the degree of rotation of the instrument when it is engaging the canal walls. The changes will be irreversible (fatigue will develop and fracture will ultimately occur) when the angle of rotation is greater than the angle at which the elastic limit (elastic angle) of the instrument is reached. In single file reciprocation, the forward and reverse angles used are not only lower than the angle of fracture of the instrument; they are also lower than the elastic angle. Therefore, torsial fatigue is greatly reduced despite the repeated engagement of the canal walls by the R25 when used for the preparation of a calcified MB2 canal.

Once the R25 has prepared the coronal third of the MB2 canal, a second challenge may be encountered due to the complex anatomy of the MB2 (Verma & love 2011). In this situation, the R25 will stop from advancing in the canal or its advancement may become difficult. The R25 is immediately removed from the canal. Patency has to be checked and a glide path is created (see the section on "*Creating a glide path during the use of the RECIPROC® instruments: indication and management*").
The management of the MB2 canal with the R25 in this situation is similar to the management of any other calcified canal. The only difference is that the incidence of complex anatomy encountered is probably greater in the MB2 canal. Based on an evaluation of MB2 canals treated by the author, a glide path is required in almost 7 % of the MB2 canals once the coronal third is prepared to allow the R25 to advance further apically in the canal. An additional 13 % (i.e. total of 20 %) of the canals require a glide path before the R25 reaches the 0.5 mark on the Root ZX apex locator, and 5 % (i.e. total 25 %) will require a glide path before the R25 reaches the Apex mark on the Root ZX apex locator.

Acknowledgement
Prof. Ghassan Yared is the inventor of single file reciprocation and was involved in the development, field testing and research of RECIPROC®. He serves as a consultant to the RECIPROC® product range.

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Curriculum Vitae

Prof. Ghassan Yared is an endodontist practicing in Ontario, Canada. He completed his endodontic specialty training at University Paris VII (Paris, France) in 1987 and obtained his MSc from the Lebanese University (Beirut, Lebanon) in 1994.

Prof. Yared has been extensively involved in teaching. He joined the Faculty of Dentistry at the Lebanese University in Beirut, Lebanon in 1988 and became Professor and Head of the Department of Endodontics; he also created and chaired the Department of Research. He joined the Department of Endodontics at the University of Toronto, Canada in 1999 for a full-time position as Assistant Head of the Department of Endodontics and Director of the Endodontic Undergraduate Programme. He remained at that position as Associate Professor until summer 2004. He was Acting Head of the Department of Endodontics for 2003 and 2004. Prof. Yared was elected for four consecutive years as the “Best Teacher of the Year”, and received the “Master Bruce Howard Award for Excellence in Teaching”, the highest teaching award at the Faculty of Dentistry, University of Toronto.

Prof. Yared has supervised the research projects of graduate endodontic students at the University of Toronto and has published extensively in peer-reviewed international endodontic journals. He has also given numerous lectures and continuous education courses worldwide.

Prof. Yared is a reviewer for the International Endodontic Journal, the Journal of Endodontics, Endodontic Topics, and for Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontics. He is also a member of the Canadian Academy of Endodontology and the American Association of Endodontists.

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Rev. 0/02.04.13