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CBCT Evaluation Of Glidepath Preparation By Different Rotary Nickel Titanium Glide Path Instruments, V Glide Path 2 And Pathfiles In Root Canals Of Maxillary First Premolars- An Ex Vivo Study

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Abstract: *Endodontic glide path is secret to radicular safety and marks the path of modern endodontics. The present study aimed to evalaute the different rotary glide pathe systems for various parameters viz- time taken, change in angle of curvature, transportation, remaining dentin thickness,change in area and centric ratio.*
Keywords*:Glide path, Path files, VGlide path 2*

I. Introduction

The goal of root canal instrumentation is to obtain a continuous tapering preparation along with maintaining the original shape of the canal from the coronal access to the apex (1). The concept of Glide Path was introduced to prevent the risk of instrument fracture. Endodontic GlidePath is the secret to radicular safety and marks the path of modern endodontics (2).West defined GlidePath as a smooth radicular tunnel from the canal orifice to the physiologic terminus of the root canal. Various file systems have been introduced for glide path preparation (3). The aim of the present study is to evaluate the glide path prepared by the different rotary glide path instrument systems: V Glide Path 2 (SS White Technologies UK, Inc.) and the PathFiles (Dentsply Maillefer, Ballaigues, Switzerland).

II. MaterialsAnd Method

20 human maxillary premolars were collected and stored in 10% formalin solution. They were then cleaned to remove adherent hard and soft tissues. Access was done using the Endo access and Endo Z bur (Dentsply Maillefer, Ballaigues, Switzerland). Subsequently, canal length and patency was determined using size 10- K file (Dentsply Maillefer, Ballaigues, Switzerland) and radiographs. Working length was established 0.5 mm shorter than the radiographic apex.The specimens were then assigned to two different groups consisting of 20 teeth each.

Group 1: Pathfiles (Dentsply Maillefer, Ballaigues, Switzerland)
Group 2: V GlidePath 2 (SS White Technologies UK, Inc.)

Teeth were then embedded in acrylic blocks and in each block six teeth were placed. All teeth were scanned by Cone Beam Computed Tomography (CBCT) (Carestream Dental, US). Cross-sectional images were studied at distances of 0, 1, 2, 3, 5 and 7 mm from the most apical part of each specimen.

The teeth were then prepared using the two different file systems in the following way: Group 1:The GlidePath was prepared using Nickel Titanium Rotary system, PathFiles (Dentsply Maillefer, Ballaigues, Switzerland) using Endoprep- RC (Anabond Stedman) as the lubricating agent. Pathfile # 1 was used using an endodontic torque control motor with 16:1 contra angle at the suggested settings (300 rpm on display, 5 Ncm) upto the working length. This was followed by PathFile # 2 and # 3 along with copious irrigation**.**Group 2: (V GlidePath 2) (SS White Technologies UK, Inc.).Initially manual GlidePath was made using # 10 K File. Then mechanical GlidePath was prepared using file 13 (V03) and 17 (V04) Nickel titanium rotary file systems. Endoprep- RC (Anabond Stedman) was used as a lubricating agent. Roots were embedded into acrylic at the same position as done preoperatively in the high resolution dental mode (i.e. 90 micron resolution). The settings for the CBCT scanner were 84 kVp and 5 mA. All the scans were analyzed using the imaging software CS3D (Carestream Dental, US). Study images were reconstructed from the volumetric dataset, in planes perpendicular to the selected tooth axes. The transportation, Centric ability, Change in cross sectional area, Remaining dentin thickness and Root canal curvature were evaluated at 0.0, 1.0, 2.0, 3.0, 5.0, and 7.0 mm intervals. The pre and

post instrumentation scans were superimposed using On Demand Software (Cybermed Inc., Korea Version 1.0). The two systems were evaluated for the following parameters:
Working time: The time for canal preparation was recorded and Included instrumentation, the change of instruments, irrigation and cleaning of the instruments.

Root canal curvature: It was calculated using the CS3D (Carestream Dental, US) software. The degree of canal curvature was defined as the angle between the long axis of the canal and a line from the point of initial curvature to the apical foramen (Figure 2).

Measurement of canal transportation: The pre- and post-instrumentation scans were superimposed using the On Demand Software (Cybermed Inc.., Korea Version 1.0). Shortest distance from the edge of the uninstrumented canal to the edge of the tooth in both mesial (X1) and distal (Y1) directions were measured and then compared with the values measured from prepared canals (X2 and Y2). The following formula was used for the calculation of transportation: (X1-X2) - (Y1-Y2). A result of zero indicated negligible canal transportation; a positive result indicated transportation towards the furcal (distal) aspect of the root; and a negative result towards the mesial aspect of the root (Figure 3).

Measurement of Centric ability: This ratio was calculated for each section using the following formula: (X1 - X2) / (Y1-Y2). Gambill *et al*. (1996) defined centring ratio as the measurement of the ability of the instrument to stay centred in the canal. The numerator for this formula was the smaller of the two numbers, if these numbers were unequal. A result of one indicated perfect centring ability; the closer the result is to zero, the worse the ability is of the instrument to remain centred.

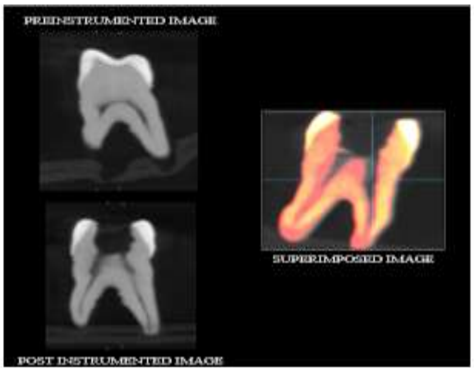


Figure 1: Superimposition of the Preinstrumented and the Post instrumented CBCT image

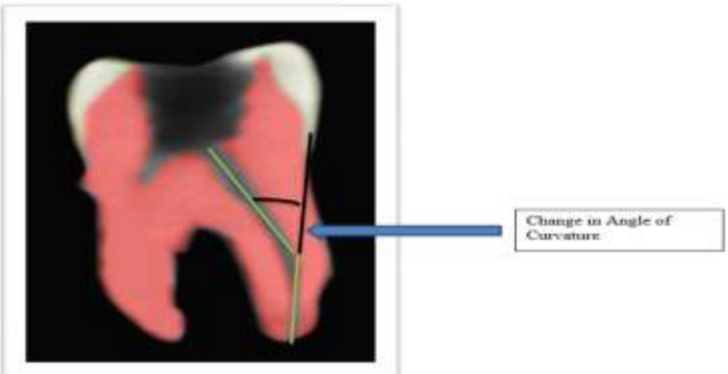


Figure 2: Schneider’s Method for measuring Change in angle of Curvature

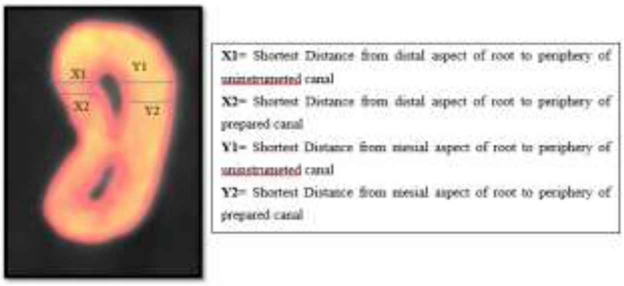


Figure 3: Measurement of Transpotation and Centric Ability

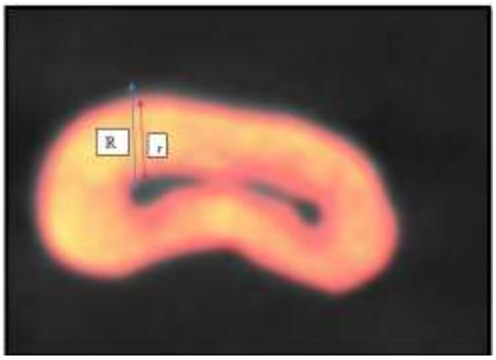
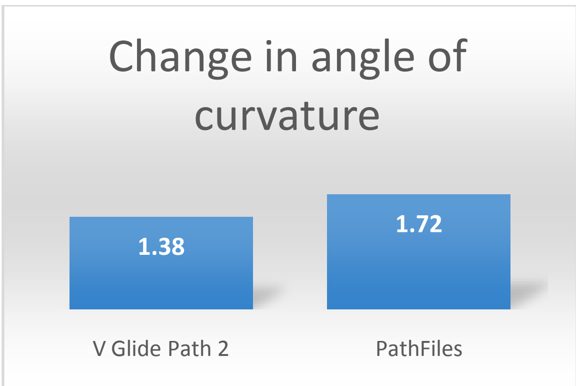
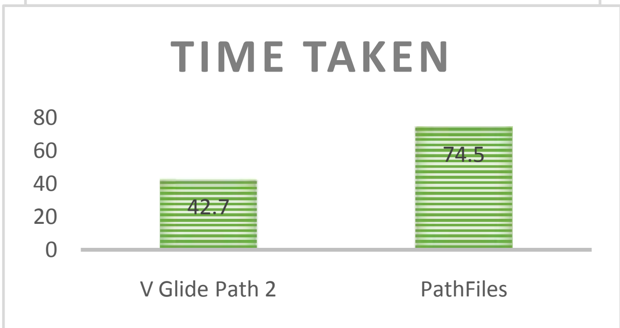


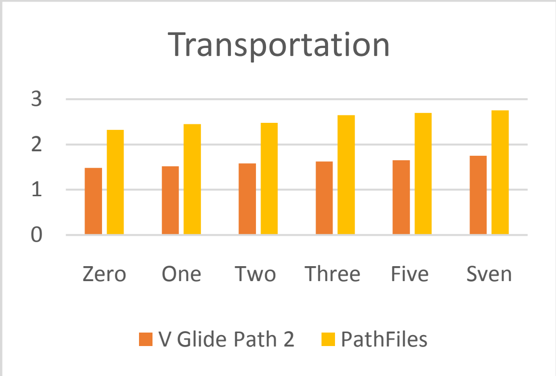
Figure 4: Change in Cross sectional Area and remaining Dentin thickness measured using a superimposed CBCT scan

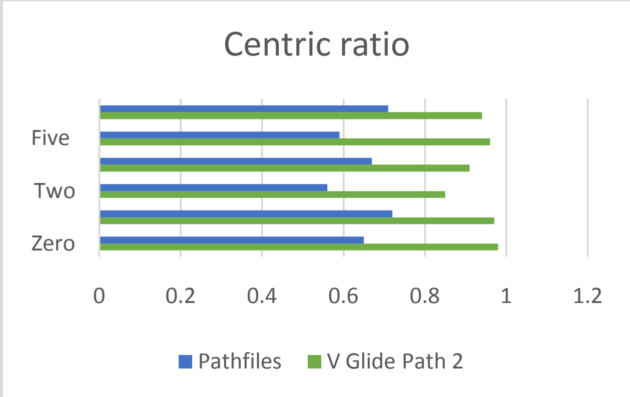
III. Results

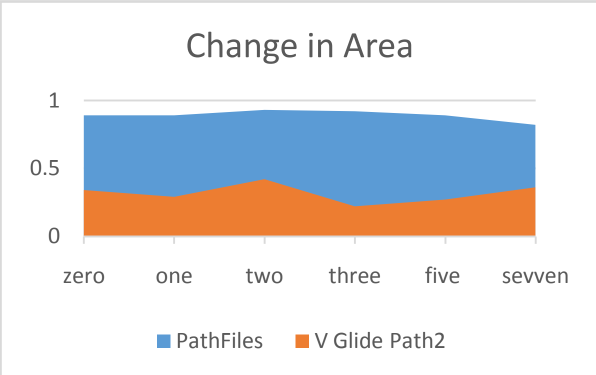
Change in angle of curvature for V Glide path 2 was less (1.38°) as compared to PathFiles (1.72°). The time taken for glide path preparation by PathFiles was 74.5 seconds as compared to 42.7 seconds taken by V Glide Path 2 (Graph 2). V Glide parh 2 caused less transportation then PathFiles at all levels 0,1,2,3,5,and 7 mm(Graph 3). Centric ratio for V Glide path 2 was more towards one as compared to path Files at all levels (Graph 4). V Glide path 2 removed less dentin (Graph 5)and there is less change in area of cross section (Graph 6) at all levels.

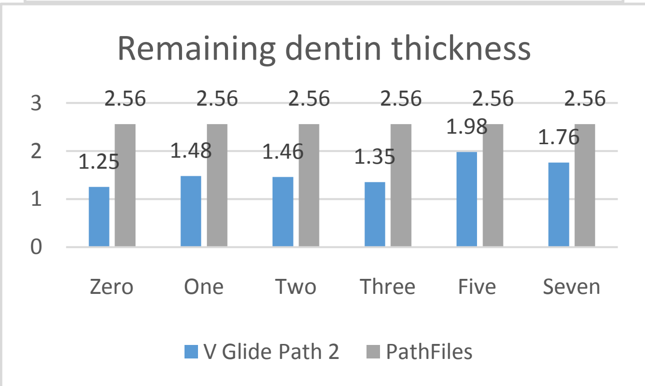












Graph 1: Change in angle of curvature, Graph 2: Time taken, Graph 3: transportation, Graph 4: Centric ratio, Graph 5: Change in Area, Graph 6: Remaining Dentin thickness.

IV. Discussion

Maintaining the original root canal anatomy is the basis for successful endodontic treatment. Many rotary instrument systems have been introduced so far with the aim of preparing root canals efficiently by preserving the original root canal anatomy of the tooth(4). During the preparation of curved canals a number of procedural errors like change in angle of curvature and apical transportation may take place. For preserving the root canal anatomyand to prevent instrument fracture, a GlidePath is a must(5). West defined GlidePath as a smooth radicular tunnel from the canal orifice to the physiologic terminus of the root canal.. A GlidePath is achieved when the file forming it can enter the orifice and follow the smooth canal walls uninterrupted to the terminus. This confirms that there is a pathway for instruments to passively move smoothly in the canal(6,7).

The aim of the study was to evaluate canal shaping by investigating the efficiency of two different nickel titanium rotary GlidePath instruments.Statistically, the standard deviation of observations may Increase when curved specimens are used. Ajuz et al recently showed on S-shaped Endo Training Blocks that rotary NiTi instruments appear to be suitable for adequate preparation of the GlidePath as they promoted significantly less deviation from the original canal anatomy(8).However, the benefit derived from testing file systems in the natural dentine of extracted teeth as more realistic conditions and outweighs the benefit derived from observing smaller standard deviations in artificial canals. Therefore natural teeth were used in the present study.

The evaluation of the changes in canal curvatures after instrumentation has been widely used to assess the tendency of a given technique or of the mechanical properties of a certain instrument to maintain the original anatomy of the canal or rectify its curvatures. Lesser the straightening of the canals, more efficiently the canal is prepared. The difference in the angle of curvature was used to evaluate the efficiency of a file (Schneider and Weine). Change in angle of curvature for Pathfiles (Dentsply Maillefer, Ballaigues, Switzerland) was 1.72 and 1.38 for V GlidePath 2 (SS White Technologies UK, Inc.). The small tip sizes and reduced tapers provide excellent flexibility and fatigue resistance and thus there is less straightening of canals. The results of the study showed that PathFiles (Dentsply-Maillefer, Ballaigues, Switzerland), produce more straightening as compared to V GlidePath 2 (SS White Technologies UK, Inc.).

Ideal canal preparation requires negligible canal transportation and perfectly centered preparations (9). It is seen that manual hand files produce less transportation as compared to rotary files. The search for efficient rotary systems that produce less transportation is in progress. V Glide Path 2 (SS White Technologies UK, Inc.) produced negligible or very less transportation. In particular cutting edges are pressed against the outer side of the curved canals (convexity) in the apical thirds and against the inner side at the middle or coronal thirds (concavity). The low .02 taper, the robust square cross section and the four cutting angles create a good combination of flexibility, strength and efficacy that allow a safe and fast use even in severely curved or calcified canals. It is less technique sensitive. The centric ability of V Glide Path 2 (SS White Technologies UK, Inc.)was more as compared to the PathFiles.

The amount of dentin removed is a measurement of the aggressiveness of the instrument (10). Despite the claim that nickel titanium files have a sharper cutting edge because of their triangular cross section, they did not remove a significantly greater amount of dentin from the root canal than stainless steel instruments (11). In the present study, PathFiles removed more dentin than V Glide Path 2. It has been demonstrated that minimal degree of canal transportation doesn't necessarily mean that the instrument is safe for preparing curved root canals (Cheung and Chan 1996). The ideal instrument should plane the whole perimeter of the canal without thinning the remaining the root dentin excessively (14).

The mean time taken to prepare root canals with V GlidePath 2 (SS White Technologies UK, Inc..) took 42.7 seconds whereas Pathfiles (Dentsply Maillefer, Ballaigues, Switzerland) took almost 74.5 seconds for GlidePath preparation as it is a three file system. If the time required for preparing the root canal is less, the operator gets more time for proper irrigation and recapitulation. This leads to a better and successful root canal treatment. The high cutting efficiency also reduces the shaping time in case of path files.

GlidePath instruments have small tip sizes (less than 20) and small tapers (2%) so they are extremely flexible. To Increase instrument torque strength, the cross-sections are square**,** thereby increasing the central core of the instrument.These GlidePath instruments are resistant to breakage because their fatigue limits are so high. Another reason they rarely separate is due to the fact that their small sizes prevent them from engaging much of the canal wall. The primary function of these instruments is not to shape the canal, but to remove tissue from the canal and create a GlidePath (9). In the study there was no Incidence of breakage of instrument among any of the four groups.Furthur studies are required to provide more information about the preparation techniques, the new instruments and methodologies used to evaluate the action of endodontic instruments inside the root canal.

V. Conclusion

In conclusion, within the limits of this study, V GlidePath 2 (SS White Technologies UK, Inc.)is an optimum file system for GlidePath Preparation. It exhibits negligible transportation and more centered preparations when compared toPathfiles (Dentsply-Maillefer, Ballaigues, Switzerland).The change in area and the amount of dentin removed was least for V Gilde Path 2.

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