VOLUME - 11, ISSUE - 01, JANUARY - 2022 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Dentistry

EVALUATE THE EFFECT OF GLIDE PATH AND PREPARATION SIZE ON THE INCIDENCE OF APICAL CRACKS USING FOUR DIFFERENT ROOT CANAL PREPARATION SYSTEMS: A STEREOMICROSCOPIC STUDY

Harshitha S K Sharma

V Vasundhara

Sarmishtha boruah

Arka das

KEYWORDS :

INTRODUCTION

Biomechanical preparation is considered to be one of the most important stages in determining the success of root canal treatment.[1] Therefore the main aim of endodontic treatment is to eliminate the microorganisms, hard and soft tissue debris from the root canal, so as to provide a root canal with larger diameter, smooth walls and optimal apical size to aid in proper irrigation and 3-dimensional obturation.[2]

Nickel titanium rotary instruments were introduced to dentistry to aid in an improved root canal preparation. However, under clinical circumstances, these instruments showed a higher risk of instrument separation and fracture within the root canal, which is believed to be the result of high flexural (fatigue fracture) and torsional (shear fracture) stresses.[3] Root canal curvature is proven to be the major risk factor for causing flexural stresses on the rotary files. Therefore, coronal enlargement and pre flaring when creating a glide path is considered to be the first step in safer use of nickel-titanium rotary instruments as it prevents taper locks, instrument fractures and shaping aberrations.[4,5]

Endodontic glide path is defined as a smooth, though narrow tunnel or passage from the canal orifice to the apical terminus or electronically determined portal of exit.[6] It prevents the tip of the file from getting locked in the canal as it moves apically by making it free of debris or blockage that could cause iatrogenic effects. If this smooth passage is reproducible by files successively in the canal, it indicates the maintenance of a glide path.[7] By the achievement of glide path before the use of nickel titanium instruments of greater taper, the canal diameter becomes at least equal to the file tip used for shaping so that the apical end of the file acts as a pilot reducing the torsional stress, binding, structural fatigue and rate of failure thereby improving the efficacy and safety of cleaning and shaping procedures especially in curved root canals.[5] Glide path preserves the pathway of the entire working length and avoids excessive binding in the canal and makes it easier for the Ni-Ti files of greater taper to reach the entire working length of the canal resulting in the decrease of crack formations.[8]

Various hand and rotary instruments have been introduced for achieving a proper glide path during root canal preparation. However, the use of hand files may be difficult and time consuming, particularly in teeth with constricted and/or severely curved root canals.[9]

In contrast, preparation of glide path with nickel titanium rotary instruments is faster with better maintenance of the canal anatomy, less modification of canal curvature, fewer canal aberrations and lower prevalence of post-operative pain when compared with manual glide path performed with hand instruments.[10]. Therefore, the aim of this in vitro study was to evaluate the effect of creating a glide path and final apical preparation size on the incidence of apical cracks during canal preparation with Reciproc, WaveOne Gold, ProTaper Next, and HyFlex CM NiTi systems in mandibular s molars with curved root canals.

MATERIALS AND METHODS

160 freshly extracted mandibular molars were collected from the Department of Oral & Maxillofacial Surgery. All the teeth were examined under 16 X magnification under a dental operating microscope to check for external cracks. Teeth with patent roots, fully formed apices and separate canals with separate apical foramina were included in the study. Teeth with external defects or deviated apical foramen were excluded from the study.

The crowns of all the teeth were removed at 3mm above the proximal cementoenamel junction to ensure standardization and straight-line access. The resulting coronal surface provided a reference plane that was parallel to the apical polished surface. A size 10 K-file was introduced into the canal until the file tip was observed at the apical plane. This measurement was determined and recorded as the working length (WL). The distal roots were cut using a diamond disc. The mesial roots were covered using a silicone impression material to stimulate the periodontal ligament space. The teeth were then embedded in a tube filled with acrylic resin. The apical 4mm of the root was exposed to allow intraoperative imaging. The apical portion was then polished at a plane perpendicular to the long axis of the tooth with a 1,000 grit and 2,000 grit sand paper to reduce the fine scratches and obtain highly magnified, clear images. The apical portion was immersed in water during the whole preparation to avoid dehydration. A baseline image of the apical portion of each tooth was captured using a digital camera attached to a stereomicroscope at 20X magnification.

160 samples were randomly divided into two main groups with eighty samples in each group. The grouping was based on the glide path preparation and non-glide path preparation.

- **Group A: With Glide Path Preparation**
- Subgroup I: ProTaper Next
- Subgroup II: HyFlex CM
- Subgroup III: WaveOne Gold
- Subgroup IV: Reciproc

- **Group B : Without Glide Path Preparation**
- Subgroup I: ProTaper Next
- Subgroup II: HyFlex CM
- Subgroup III: WaveOne Gold
- Subgroup IV: Reciproc

Biomechanical Preparation

Group A

A rotary glide path was created in all the eighty samples in the experimental group A using a PathFile (ProGlider, Dentsply Maillefer, Ballaigues, Switzerland) instrument of size 16 with 0.02 taper.

Group B

It consisted of eighty samples. No glide path preparation was done in any of the samples under the experimental groups under group B.

Subgroup I: biomechanical preparation was done in both the mesial canals using protaper gold file system according to the manufacturer's instructions upto apical size 25. 2.5% NaOCl was used as irrigation in between biomechanical preparation.

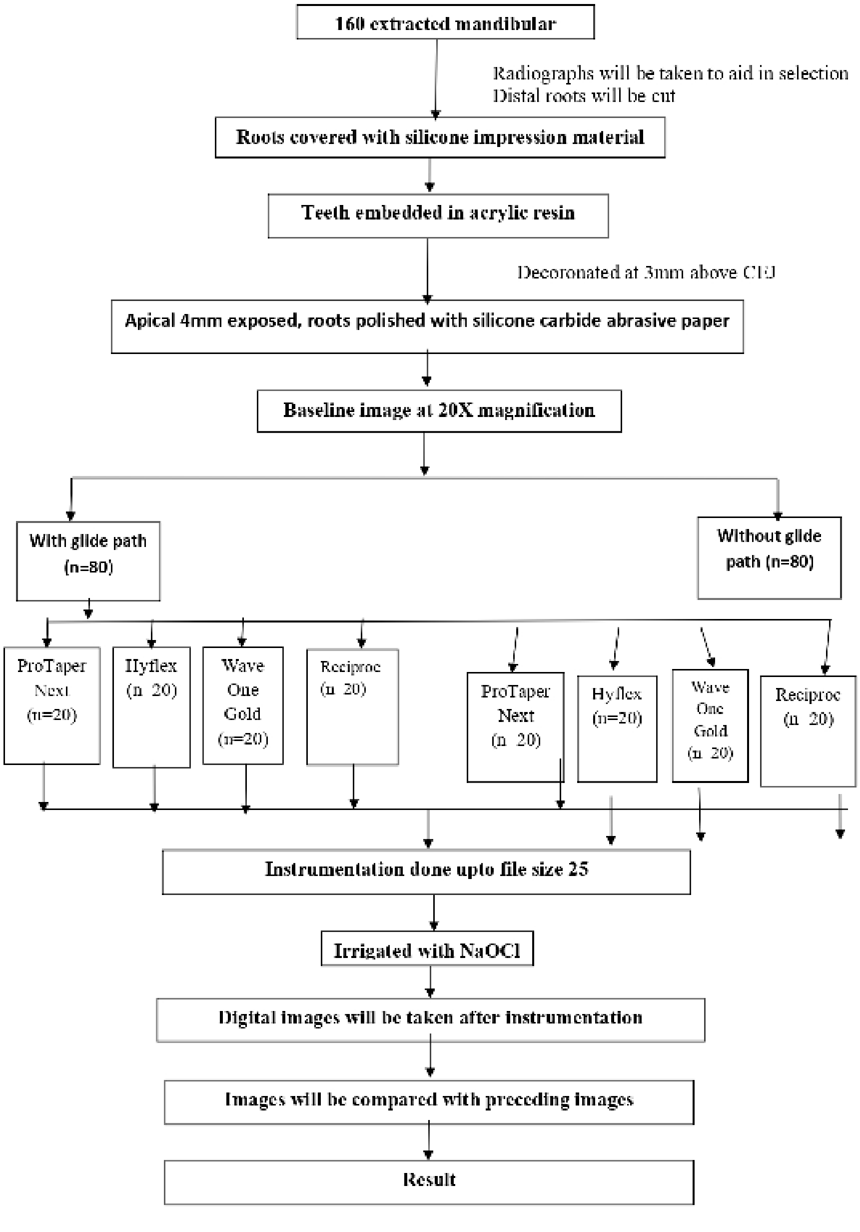
Subgroup Ii: Biomechanical preparation was done in both mesial canals using HyFlex CM file system upto apical size 25 according to the manufacturer's instructions. 2.5% NaOCl was used as irrigant in between biomechanical preparation

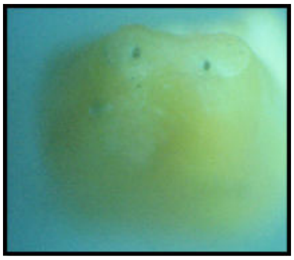
Subgroup Iii: Biomechanical preparation was done in both mesial canals using primary size WaveOne Gold file system in reciprocation motion according to the manufacturer's instructions. 2.5% NaOCl was used as an irrigant in between the biomechanical preparation.

Subgroup Iv: Biomechanical preparation was done in both the mesial canals using R25 file of Reciproc file system in reciprocation motion according to the manufacturers instructions. 2.5% NaOCl was used as an irrigant in between biomechanical preparation.

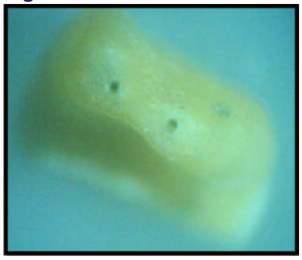
Stereomicroscopic Observation Of The Apical End

- A baseline image of the apical portion of each tooth was captured using a digital camera attached to a stereomicroscope at 20X magnification before canal instrumentation.
- Second image of the apical portion of each tooth was captured using a digital camera attached to a stereomicroscope at 20X magnification after canal preparation.
- The images were evaluated by two separate calibrated examiners who were blinded to the group assignment.
- Each image was compared with the preceding image, and any visible crack line on the apical surface that was not present in the preceding image was defined as a crack



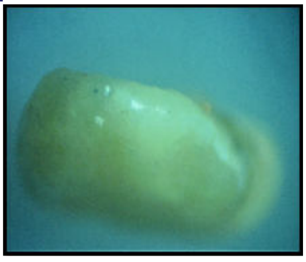


A. Baseline Image



B. Postinstrumentation With #25 File

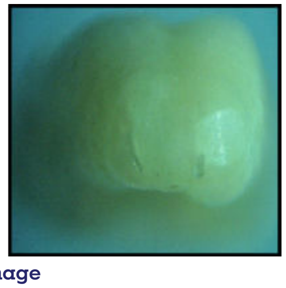
Fig 18: Stereomicroscopic Images Of Hyflex Cm Without Glide Path Preparation



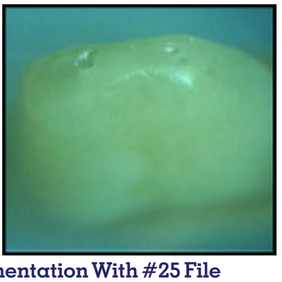
A. Baseline Image

B. Post Instrumentation With #25 File

Fig 19: Stereomicroscopic Images Of Hyflex Cm With Glide Path Preparation

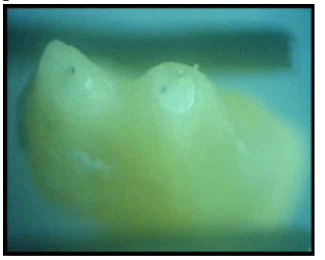


A. Baseline Image

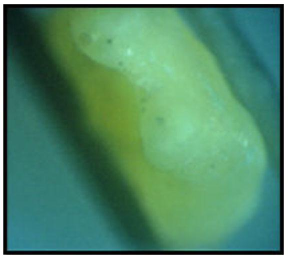


B. Post Instrumentation With #25 File

Fig 20: Stereomicroscopic Images Of Protaper Next Without Glide Path Preparation

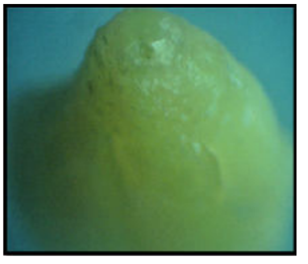


A. Baseline Image

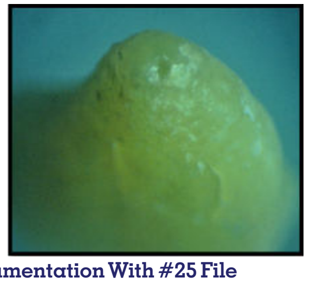


B. Post Instrumentation With #25 File

Fig 21: Stereomicroscopic Images Of Protaper Next With Glide Path Preparation

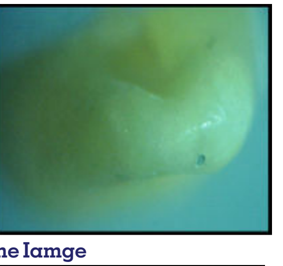


A. Baseline Image

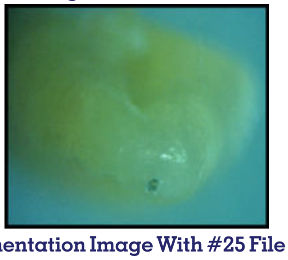


B. Post Instrumentation With #25 File

Fig 22: Stereomicroscopic Images Of Waveone Gold Without Glide Path Preparation



A. Baseline Iamge



B. Post Instrumentation Image With #25 File

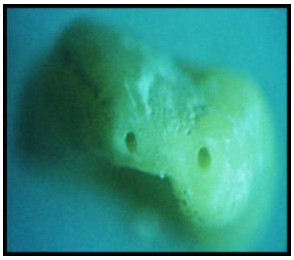
Fig 23: Stereomicroscopic Images Of Waveone Gold With Glide Path Preparation

A. Baseline Image

B. Post Instrumentation With #25 File

Fig 24: Stereomicroscopic Images Of Reciproc Without Glide Path Preparation

A. Baseline Image



B. Post Instrumentation With #25 File

Fig 25: Stereomicroscopic Images Of Reciproc With Glide Path Preparation

Statistical Analysis:

The following methods of statistical analysis have been used in this study. The data was retrieved from pre-coded survey proforma to a computer. The Excel and SPSS (SPSS INC, CHICAGO, VERSION 21.0) SOFTWARE packages were used for data entry and analysis. Descriptive statistics for each parameter that included numbers and percentages for discrete or categorical data and averaged (mean + standard deviation) for continuous data are presented in the form of Tables and Figures. Significance for all statistical tests

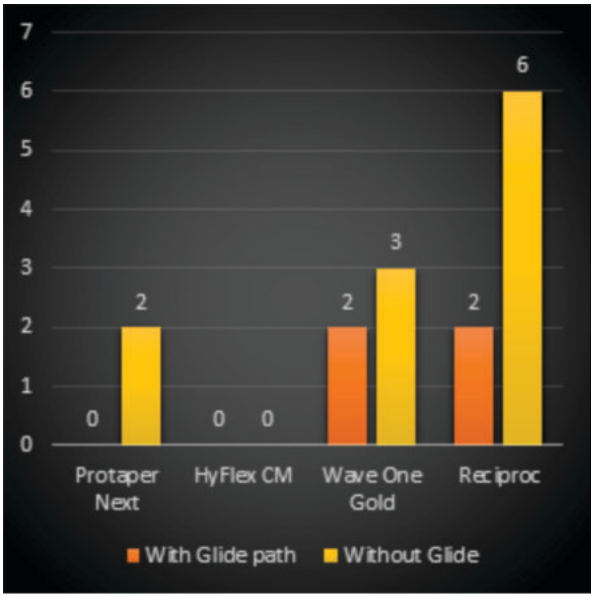
Mean scores and standard deviations were calculated in each group and subjected to statistical analysis.

Inter group comparison was done using Fisher exact test, Student t test and chi square test at $p<0.05$.

Table 1: Incidence Of Crack Propagation Among The Study Groups

GROUPS		BASELINE IMAGES	SIZE 25 FILE
GROUP 1	ProTaper Next + GLIDE PATH	0/20	0
GROUP 2	HYFLEX CM + GLIDE PATH	0/20	0
GROUP 3	WaveOne Gold + GLIDE PATH	0/20	2
GROUP 4	RECIPROC+GLIDE PATH	0/20	2
GROUP 5	ProTaper Next	0/20	2
GROUP 6	HYFLEX CM	0/20	0
GROUP 7	WaveOne Gold	0/20	3
GROUP 8	RECIPROC	0/20	6
P=0.654			

Table 1 shows the incidence of crack initiation at the apical level with different file systems and with and without glide path preparation. The values were subjected to Fisher exact test and the significance value was set at $p<0.05$. It was observed that the $p=0.654$.It shows that there is no statistically significant difference between the groups prepared with glide path and without glide path, i.e., incidence of cracks were seen in all the groups independent of glide path preparation



Graph 1: Comparison Of Crack Initiation Within Each Subgroup

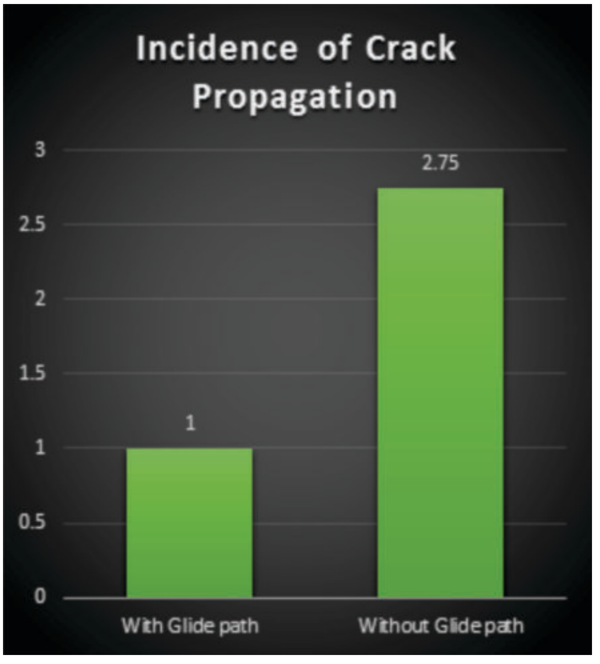
Table 2: Comparison Of Crack Initiation Within Each Subgroup

		GROUP I With Glide Path			GROUP II Without Glide Path	
	N	Chi-Square	p-value	N	Chi-Square	p-value
Protaper Next	0	4.000	0.261	2	12.000	0.213
HyFlex CM	0			0		
Wave One Gold	2			3		
Reciproc	2			6		

Chi-square test applied, *p-value significant at $p<0.05$

Table 2 shows the influence of glide path preparation within each subgroup. The results were subjected to chi-square test and the significance value was calculated. The significance value was set at $p<0.05$. It was seen that in all the samples within GROUP A each subgroup i.e., ProTaper Next, HyFlex CM, WaveOne Gold and Reciproc file systems with glide path the significance value was $p=0.261$ and in all the samples within GROUP B, within each subgroup i.e. ProTaper Next, HyFlex CM, WaveOne Gold and Reciproc file systems without glide path, the significance value was $p=0.213$. This shows that crack initiation occurred independent of glide path preparation.

VOLUME - 11, ISSUE - 01, JANUARY - 2022 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra



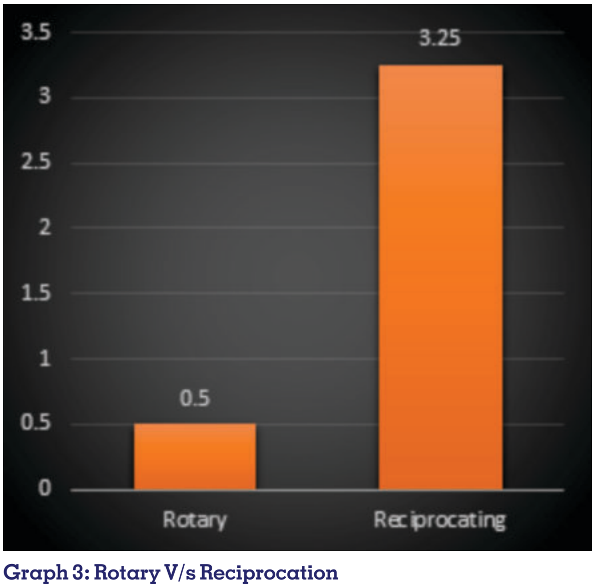
Graph 2: Intergroup Comparison Of Crack Incidence

Table 3: Intergroup Comparison Of Crack Incidence

System	Mean	S.D.	t	p-value
With Glide Path	1.00	1.155	-1.271	0.251
Without Glide Path	2.75	2.50		

Student t-test applied, *p-value significant at $p<0.05$

TABLE 3 shows the intergroup comparison between GROUPS A and B. The mean and standard deviation of all the groups were calculated and subjected to Student t test. The significance value was set at $p<0.05$. It was seen that there was no statistically significant difference between GROUP A and GROUP B ($p=0.251$). Crack initiation was not affected by glide path preparation.



Graph 3: Rotary V/s Reciprocation

Table 4: Rotary V/s Reciprocation

Systems	Mean	S.D.	t	p-value
Rotary	0.50	1.00	-2.569	0.042*
Reciprocating	3.25	1.89		

Student t-test applied, *p-value significant at $p<0.05$

Table 4 shows the incidence of crack formation between file systems operating with different rotary motion. SUBGROUP I AND II were file systems rotating at a continuous rotary motion and SUBGROUPS III AND IV were file systems rotating in a reciprocation motion.

The mean and standard deviation of all the values were calculated and subjected to student t test. The significance value was set at $p<0.05$. It was observed that the p value obtained from the statistical analysis was $p=0.042$. This shows that there was statistically significant difference in the crack initiation between the samples prepared with reciprocating systems and continuous rotation systems. The samples prepared with reciprocating file systems had a higher incidence of cracks formation than the samples prepared with full sequence rotary files at continuous rotation motion.

Therefore, the Mean deviation, Standard deviation and Statistical analysis using Fisher test, chi-square test and student-t test showed that there was no influence of prior glide path preparation on the incidence of crack formation when prepared with four different root canal preparation systems. However, there was a significantly higher incidence of crack formation when biomechanical preparation was done using reciprocating file systems compared to biomechanical preparation done with full sequence rotary file systems at the level of apical foramen.

DISCUSSION

Predictable success of endodontic treatment requires accurate diagnosis, three dimensional cleaning and shaping, and hermitically sealing the root canal space up to the physiologic terminus. Successful biomechanical preparation is the attainment of free access to the apical foramen, through the root canal, by mechanical means. Canal shaping is an essential step as it provides sufficient space for efficient disinfection with irrigating solutions and medicament. [9] Therefore the three main objectives of biomechanical preparation are:

1) Mechanical removal of pulp tissue and infected dentin
2) Proper cleaning and shaping of the root canal
3) Facilitation of Intra-canal medicament placement

Over the decades, it has clearly been established that, for a successful 3D obturation, root canal system has to be three dimensionally cleaned and shaped. One guiding strategy that has emerged as a critical part of endodontic success is the creation and maintenance of a glide path.[7] Creating a manual or mechanical glide path was shown to be the first step for safer use of nickel titanium (Ni-Ti) rotary instrumentation because this procedure prevents fracture, shaping aberrations, and torsion of instruments.[11] Additionally, creating a glide path is recommended to reduce the risk of taper lock and frictional forces to the canal walls especially in curved canals

Glide path acts as a guide for endodontic mechanics and confirms a sufficient existing space available for the next larger instrument for root canal preparation especially, when using rotary NiTi files, creation and maintenance of glide path are necessary because many available NiTi rotary instruments have non-end cutting tips and because of their extreme flexibility, they cannot initially negotiate the root canals.[7]

Berutti et al. recommended manual pre-flaring of the root canal to create a glide path before using NiTi rotary instrumentation and reported reduced torsional stress and increased the lifespan of rotary NiTi instruments.[5] Patino et al. also reported that the separation rate of the rotary NiTi instruments was significantly reduced when their use was preceded by glide path preparation.[8]

In 2006, West recommended using a K-file with an initial watch-winding motion to remove restricted dentin in very narrow canals, followed by a vertical in and out motion with a 1 mm amplitude and gradually increasing the amplitude as the dentin wall wears away and the file advances apically.[6] However, it has also been observed that because of the relative stiffness of stainless steel files, there is a risk of canal transportation, which may lead to perforation, ledging, or apical zipping.

Currently, there is no research dealing with the effect of glide path on preventing dentinal cracks (damage) during root canal preparation with rotary and reciprocating Ni-Ti instruments at the apical level. So the aim of this study was to evaluate the effect of glide path preparation on the incidence of apical cracks using four different root canal preparation systems and evaluated under a stereomicroscope.

The stereomicroscopic images of the prepared samples revealed that both rotary and reciprocating instrumentation lead to microcrack formations on the roots dentin.

Also, the preparation of a glide path before biomechanical preparation had no effect on the occurrence of apical cracks while using ProTaper Next, HyFlex CM, WaveOne Gold and Reciproc file systems. However, performing the apical preparation with RECIPROCATING FILE SYSTEMS (WaveOne and Reciproc) induced more crack formation in the apical third of the root canal when compared to full sequence ROTARY FILE SYSTEMS (ProTaper Next and HyFlex CM). Therefore, the null hypothesis was partially rejected as reciprocation systems created more apical cracks than full sequence rotary systems

Reciproc and WaveOne Gold require only one instrument to shape the root canal, while ProTaper Next and HyFlex CM require more number of instruments. It is possible that the use of more instruments may cause the formation of more apical cracks. But, the current study demonstrated that Reciproc and WaveOne Gold created more cracks than ProTaper Next and HyFlex CM at the apical level

CONCLUSION

within the limitations of the current study it can be concluded that, there was no influence of prior glide path preparation on the incidence of crack formation when prepared with four different root canal preparation systems. However, there was a significantly higher incidence of crack formation when biomechanical preparation was done using reciprocating file systems compared to biomechanical preparation done with full sequence rotary file systems at the level of apical forame

REFERENCES

1. Peters OA. Current challenges and concepts in the preparation of root canal systems: a review. JOE 2004; 30: 559-67
2. Yoldas O, Yilmaz S, Atakan G, et al. Dentinal microcrack formation during root canal preparation by different NiTi rotary instruments and the self-adjusting file. J Endod 2012; 38:232-5
3. Cheung GS, Peng B, Bian Z, Shen Y, et al. Defects in ProTaper S1 instruments after clincal
4. Berutti E, Paolina DS, Chiadussi G, et al. Root canal anatomy preservation of WaveOne reciprocating file with or without glide path. J Endod 2012; 38:101-104
5. Berutti E, Negro AR, Lendini M, et al. influence of manual preflaring and torque on the failure rate of ProTaper rotary instruments. J Endod 2004; 30:228-230
6. West J. Endodontic update 2006.J Esthet Restror Dent. 2006; 18: 280-300
7. Peters OA. Current developments in rotary root canal instrument technology and clinical use: a review. Quintessence int. 2010; 41: 479-88
8. Patino P, Biedma B, Liebana C, et al. The influence of a manual glide path on the separation rate of rotary NiTi rotary instruments. J Endod. 2005;31:114-6
9. Hulsmann M, Peters O, Dummer PHM, et al. Mechanical preparation of root canals: shaping golas, techniques and means. Endod Topics. 2005;10:30-76
10. Berutti E, Cantatore G, Catallucci A, et al. Use of Nickel Titanium rotary path file to create a glide path: comparison with manual preflaring in stimulated root canals. J Endod 2009;35: 408-12