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Original Research

Comparative evaluation of influence of working length determined with three different electronic apex locators on the apical extrusion of debris following the instrumentation with rotary Ni- Ti instrumentation system

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ABSTRACT:

Background: The present study was conducted to evaluate influence of working length determined with three different electronic apex locators on the apical extrusion of debris using ProTaper Universal (PTU), ProTaper Next (PTN) and Wave One (WO) Ni Ti system. **Materials & Methods:** The present study was conducted among 60 extracted human permanent molars with mature apices. Electronic working length measurements were taken before and after preparation of the mesiobuccal canal with Root ZX, ProPex II and Endex apex locator using various irrigants. In group I, root canals were prepared with ProTaper Universal (PTU) to size F4/0.06, in group II with ProTaper Next (PTN) to size X4/0.06 and in group III with (Wave One) WO to size 40/0.08. **Results:** The mean difference in actual and final length was 0.191. Electronic length before preparation (EAL1) and after preparation (EAL2) was -0.21 in group I, in group II was -0.104 and in group III was -0.106. The mean difference in actual and final length was 0.194. Electronic length before preparation (EAL1) and after preparation (EAL2) was 0.208 in group I, in group II was -0.192 and in group III was 0.236. The mean difference in actual and final length was 0.198. Electronic length before preparation (EAL1) and after preparation (EAL2) was 0.201 in group I, in group II was -0.199 and in group III was 0.235. **Conclusion:** Authors found that the usage of apex locator to determine the WL decreased the amount of apically extruded debris. PTN caused less apical debris extrusion after determination WL with/without apex locator.

Key words: Apex locator, ProTaper Universal, Working length.

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INTRODUCTION

The establishment of appropriate working length is one of the most critical steps in endodontic therapy. Cleansing, shaping, and obturation of the root canal system cannot be accomplished perfectly unless the working length is determined precisely.¹ Working length is the distance from a coronal reference point to a point at which the canal preparation and obturation should terminate.² It is generally accepted that root canal procedures should be limited to the confines of the root canal system for which an accurate working length is of paramount importance.³

One of the main steps of the root canal treatment is to provide the suitable conditions for periapical tissues to heal up by biomechanical instrumentation of the root canal system. During the instrumentation, necrotic debris, residual pulp tissue, microorganisms, dentin chips, or irrigation solutions could be forced through the apical terminus to the periapical area.⁴ This situation may cause an inflammatory reaction and postoperative pain which is known as “flare-up.” Flare-up is a complication which occurs as a result of swelling/pain of oral mucosa or soft tissues on face around the area of the tooth within a few hours or days after treatment. This may result in an early visit to a healthcare institute from the patient since clinical symptoms are so intense.⁵ Electronic apex locators have been introduced to determine the working length and form an important adjunct to radiography. Fourth generation apex locators take resistance and capacitance measurements separately to compare them with a database to

determine the distance to the apex of the root canal.⁶ The present study was conducted to evaluate influence of working length determined with three different electronic apex locators on the apical extrusion of debris using ProTaper Universal (PTU), ProTaper Next (PTN) and Wave One (WO) Ni Ti system.

MATERIALS & METHODS

The present study was conducted among 60 extracted human permanent molars with mature apices in the department of Endodontics. The study was approved from institutional ethical committee. All were informed regarding the study and their consent was obtained.

The teeth were cleaned of calculus, soft tissues, and debris with hand instrumentation and stored in distilled water until used. The crown of each tooth was sectioned at the cemento-enamel junction using a diamond disk revolving at a conventional speed in order to simplify access to the root canal and establish a level surface to serve as a stable reference for all measurements. Access cavity was prepared and mesiobuccal canal orifice was located. Electronic working length measurements were taken before and after preparation of the mesiobuccal canal with Root ZX, ProPex II and Endex apex locator using various irrigants.

In group I, root canals were prepared with ProTaper Universal (PTU) to size F4/0.06, in group II with ProTaper Next (PTN) to size X4/0.06 and in group III with (Wave One) WO to size 40/0.08. Results were tabulated and subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Efficacy of Root Zx apex locator

Mean differences			
		Mean	P value
Root canal length	AL	0.191	0.02
	FL		
Group I	EAL1	-0.21	0.03
	EAL2		
Group II	EAL1	-0.104	0.01
	EAL2		
Group III	EAL1	-0.106	0.04
	EAL2		

Table I shows that mean difference in actual and final length was 0.191. Electronic length before preparation (EAL1) and after preparation (EAL2) was -0.21 in group I, in group II was -0.104 and in group III was -0.106. There was significant difference seen with all (P< 0.05).

Table II Efficacy of ProPex II apex locator

Mean differences			
		Mean	P value
Root canal length	AL	0.194	0.05
	FL		
Group I	EAL1	0.208	0.01

	EAL2		
Group II	EAL1	0.192	0.02
	EAL2		
Group III	EAL1	0.236	0.01
	EAL2		

Table II shows that mean difference in actual and final length was 0.194. Electronic length before preparation (EAL1) and after preparation (EAL2) was 0.208 in group I, in group II was -0.192 and in group III was 0.236. There was significant difference seen with all ($P < 0.05$).

Table III Efficacy of Endex apex locator

Mean differences			
		Mean	P value
Root canal length	AL	0.198	0.03
	FL		
Group I	EAL1	0.201	0.02
	EAL2		
Group II	EAL1	0.199	0.01
	EAL2		
Group III	EAL1	0.235	0.04
	EAL2		

Table III shows that mean difference in actual and final length was 0.198. Electronic length before preparation (EAL1) and after preparation (EAL2) was 0.201 in group I, in group II was -0.199 and in group III was 0.235. There was significant difference seen with all ($P < 0.05$).

Table IV Actual and final length and electronic lengths for both apex locators before and after preparation in different groups

Paired difference		
	Mean	P value
AL- group I	-0.021	0.12
AL- group II	-0.0023	0.41
AL- Group III	-0.051	0.81

Table IV shows that results were statistically insignificant ($P > 0.05$). Group II showed best results out of all.

DISCUSSION

Establishment of the correct working length is an important stage in root canal treatment, because sufficient evidence suggests that instrumentation either beyond or too short of apex can adversely affect success.⁷ Various schools of thought exist for the termination of the root canal working length. Though the importance of staying inside the root canal with the obturation and avoiding extrusion of material into the periapical tissues in order to obtain a higher success rate was stated by various research workers.⁸ It has been regarded that it is not possible to prevent some of debris to be pushed out to the apical tissues, and no method has been found yet that does so. According to the results of detailed researches, it is not possible for

practitioners to decrease the qualitative extrusion of debris, but it seems likely to keep a quantitative amount under control using techniques such as crown-down to reach apical terminus.⁹ The present study was conducted to evaluate influence of working length determined with three different electronic apex locators on the apical extrusion of debris using ProTaper Universal (PTU), ProTaper Next (PTN) and Wave One (WO) Ni Ti system.

In this study, In group I, root canals were prepared with ProTaper Universal (PTU) to size F4/0.06, in group II with ProTaper Next (PTN) to size X4/0.06 and in group III with (Wave One) WO to size 40/0.08. Electronic working length measurements were taken before and

after preparation of the mesiobuccal canal with Root ZX, ProPex II and Endex apex locator.

We found that mean difference in actual and final length was 0.191. Electronic length before preparation (EAL1) and after preparation (EAL2) was -0.21 in group I, in group II was -0.104 and in group III was -0.106. Cicek et al¹⁰ in their study seventy-two teeth were selected. The WL determination was performed with root ZX. The teeth were divided into six experimental groups, randomly. In groups, root canals were prepared with PTU to size F4/0.06, with PTN to size X4/0.06, with WO to size 40/0.08, with TF to size 40/0.04, with MT to size 40/0.06, and with RS to size AS40/0.06. After preparations were completed, final irrigation was performed with 2 mL distilled water, and a total of 10 mL of distilled water was used in each tooth. Tubes were stored in an incubator at 68°C for 5 days to evaporate the distilled water before weighing the dry debris. The RS group led to the highest amount of extruded debris, however, WO led to the least amount of extruded debris.

We found that mean difference in actual and final length was 0.194. Electronic length before preparation (EAL1) and after preparation (EAL2) was 0.208 in group I, in group II was -0.192 and in group III was 0.236. Jain et al¹¹ compare the efficacy of electronic apex locators after cleansing and shaping of the root canals and whether there was any alteration in accuracy when used in the presence of irrigants. Seventy extracted human permanent molars with mature apices were selected. Equal number of maxillary and mandibular permanent molars (35 each) was sectioned at the cemento-enamel junction. Access opening was done and only the mesiobuccal root canal was studied for the purpose of standardization. Electronic working length measurements were taken before and after preparation of the mesiobuccal canal with Root ZX and ProPex II using various irrigants. P-values for actual and final canal lengths for Root ZX employing NaOCl (0.001), CHX (0.006), LA (0.020) and for ProPex II was (0.001) respectively. When the data were compared, results were statistically significant ($P < 0.05$). Cicek et al¹² in their study forty-eight extracted mandibular incisor teeth divided into four groups were used in this study. In Groups 1 and 2, a 10 K-file was progressed until it was just visible at the major apical foramen and WL was recorded as 1 mm short. In Groups 3 and 4, the WL was determined with the Root ZX (sensitivity of 0.1) using a 10 K-file. During the instrumentation, the PTN was used to X2 in groups 1 and 3, and the HyFlex CM was used to 25/.06 in groups 2 and 4. Distilled water was used as an irrigant. Debris was collected in tubes then stored in an incubator at 68°C for 5 days to evaporate the distilled water. The

Eppendorf tubes, including the extruded debris, were weighed to obtain final weights. The amount of extruded debris was calculated by subtracting the weight of the empty tube from the weight of the dry tube. Less apically extruded debris was obtained in Group 3, with a significant difference compared to Group 1 and Group 2 ($P < 0.05$).

CONCLUSION

Authors found that the usage of apex locator to determine the WL decreased the amount of apically extruded debris. PTN caused less apical debris extrusion after determination WL with/without apex locator.

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