Effect on Working Length in Curved Canals after Coronal Flaring Using Hand Stainless Steel and Rotary Ni-ti Files: An in vitro study

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ABSTRACT

Context: Maintaining the uniformity of working length measurement throughout the course of endodontic treatment is crucial to achieve the desired outcome of endodontic treatment and its long term success; in spite of various methods available to establish the correct working length. This is particularly critical in the instrumentation of curved canals.

Aims: Assessment of effect on working length in curved canals after the coronal flaring using hand stainless steel and rotary Ni-ti files.

Material and Methods: 40 extracted human maxillary and mandibular; first and second molar teeth were selected of which only the mesial root of mandibular molars and the mesiobuccal root of the maxillary molars were considered for the study. All the specimens were ranked by degree of maximum canal curvature and divided into two groups ranging from 20-45°. The roots demonstrating the smallest curve were assigned to group 1, the next smaller curve roots were assigned to group 2. The conditions compared were combinations of (a) early coronal flaring(flaring completed before WL determination) and late coronal flaring (flaring completed after WL determination) and (b) stainless steel hand files_Gates Glidden drills (SS) and nickel titanium rotary files (Ni-Ti).

Results: Results indicated that WL decreased for all canals as a result of canal preparation. The mean decrease in WL was significantly greater for the Stainless steel group than for the Ni-Ti groups. Less change in WL occurred in all groups when initial WL was determined after CF.

Conclusions: Results concludes that Ni-Ti rotary files can be expected to consistently produce a small decrease in WL, whereas the combination of G. G. Drills and stainless steel files causes more than twice as much decrease in WL.

Keywords: coronal flaring, protapers, rotary files, root canal preparation, working length

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INTRODUCTION

The precise determination of working length and the utilization of this measurement while cleaning, shaping, disinfecting, and obturating the root canals significantly influence the treatment success.[1] In spite of the various methods available to establish the appropriate WL, maintaining consistency of that measurement throughout the course of endodontic treatment is crucial to achieve the desired outcome of endodontic treatment and its long term success.[2] This is predominantly true in the instrumentation of curved canals [3] and hence the working length should not be changed during the entire course of the treatment. Study was done for the evaluation of effect of early coronal flaring (CF) and late CF on the working length (WL) in curved root canals. Instrumentation techniques are advocated for coronal flaring of the root canals.[4] Flaring of the coronal portion of canal has been established to facilitate the placement of files into the apical portion of curved root canals.[5] Working length determination after the initial coronal flaring of the root canal and before apical preparation, will curtail the change in working length that occurs during the instrumentation of curved canals.[6]

The principle of this study was to compare pre and post instrumentation WL in curved root canals prepared by (a) using early CF (flaring completed before WL determination) versus late CF (flaring completed after WL determination); and (b) using either stainless steel and nickel-titanium (Ni-Ti) instruments.

MATERIALS AND METHODS:

This *in vitro study was carried out in the Department Of* Conservative Dentistry and Endodontics, in Yashwantrao chavan Dental College and Hospital, Ahmednagar. 40 extracted human maxillary and mandibular, 1st and 2nd molar teeth were selected for the study. Teeth which are having normal pulp chambers, without any noticeable defect or abnormal root morphology, patent root canals, completely formed root apices without any sign of resorption, similar canal curvature (20-45°) were included in the study. Only the mesial root of mandibular molars and the mesiobuccal root of the maxillary molars were considered for the study.

Preparation of samples:

Coronal access cavity preparation was made in each specimen by using a carbide bur #10 and #14 using a high speed

air rotor hand piece. Canals were located and #10 K-file was placed in the designated canal and through the apical foramen to verify patency. The appropriate reference cusp and root tip were then flattened to facilitate reproducible, accurate measurements.

(A) (B) (C)

Canals were located and #10 K-file was placed in the designated canal and through the apical foramen to verify patency. (A) Sample 1; (B) Sample 2; (C) Sample 3

Measurement of canal angulation: The canal curvature of the mesial root was determined by using the Schneider's method.[6] Teeth Roots with mesial-distal curvature between 20° and 45° were selected for this study.

Measurement of non-flared Working length:

The occlusal surfaces of each tooth were flattened on a model trimmer to provide a consistent reference point for WL determination. A coronal access preparation was made in each specimen by using a carbide bur in a high-speed air-rotor hand piece. A #10 K file was introduced into the mesiobuccal canal of each specimen. With the help of a flat diamond abrasive disk, the root end was resected at or slightly coronal to the level of the apical foramen. The root end was positioned against a flat barrier made up of glass. A file was inserted into the canal until it reached the apical glass barrier. WL measurement was determined with the help of a digital caliper in micrometers using the fattened coronal surface as a reference point. This measurement was designated as non-flared WL. This measurement was recorded three times in succession for each canal, and a mean value for WL calculated.

Division of samples:

All the 40 specimens were ranked by degree of maximum canal curvature and divided into two groups ranging from 20-45°. The

roots demonstrating the smallest curve were assigned to group [1]; the next smaller curve roots were assigned to group [2] .The mean canal curvature per group was calculated and compared to verify similarities in curvature.

Canal instrumentation and measurements in each group:

Group 1-Stainless steel group: Specimens in group 1 were treated as follows: The root canal was flooded with a solution of 5.25% sodium hypochlorite. Apical patency was verified using a #10 K file. The canal was irrigated with 1 ml of 5.25% sodium hypochlorite, and G. G. Drill no. 3, 2, and 1 were used for coronal flaring. The canal was irrigated and the distance to the apical glass barrier was determined. This length was designated the Group 1 flared WL.

Group 2-Ni-Ti rotary ProTaper group:

Each specimen in group 2 was instrumented using rotary ProTaper systems. Once coronal portion of the canal was prepared with SX and S1, the canal was irrigated, and the distance to the apical glass barrier was determined as described previously. This length was designated as group 2 flared WL.

RESULTS:

Two working length (WL) readings were noted for each sample:

(1) Non-flared WL (WL before CF preparation).

(2) Flared WL (WL after CF preparation).

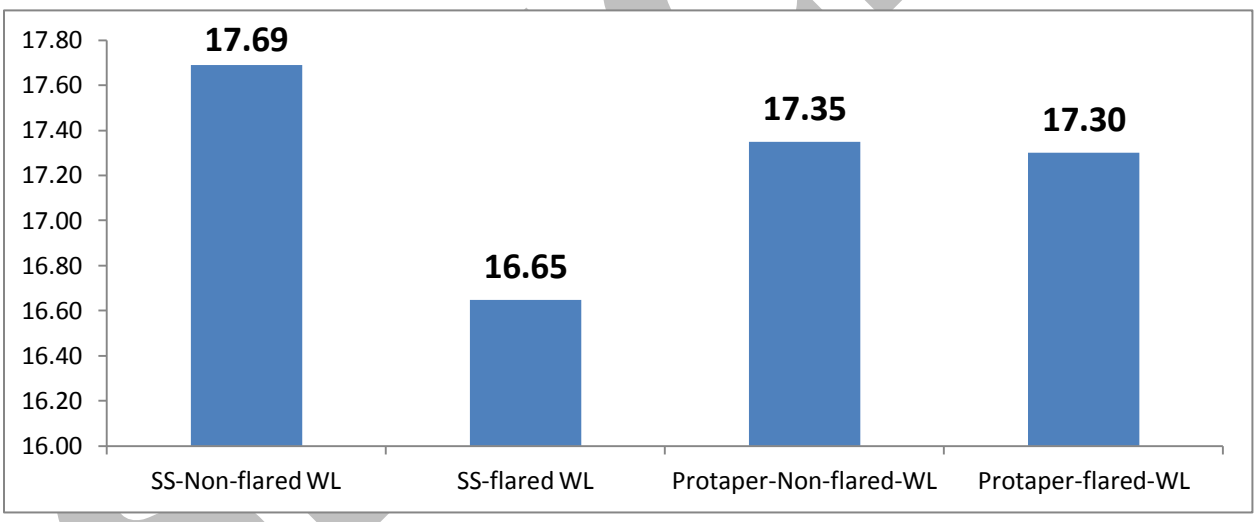
Mean canal curvature and non-flared WL values were compared between groups by using one way analysis of variance (ANOVA) test. One-way ANOVA test was used to verify similarity between mean canal angulations of all the groups. No significant difference *was found between mean canal* angulation. For each specimen, differences between the non-flared WL and flared WL were calculated in [Table 1].

Mean and standard deviation (SD) of working length (WL; in mm) according to different groups with non-flared WL, flared WL

TABLE 1:

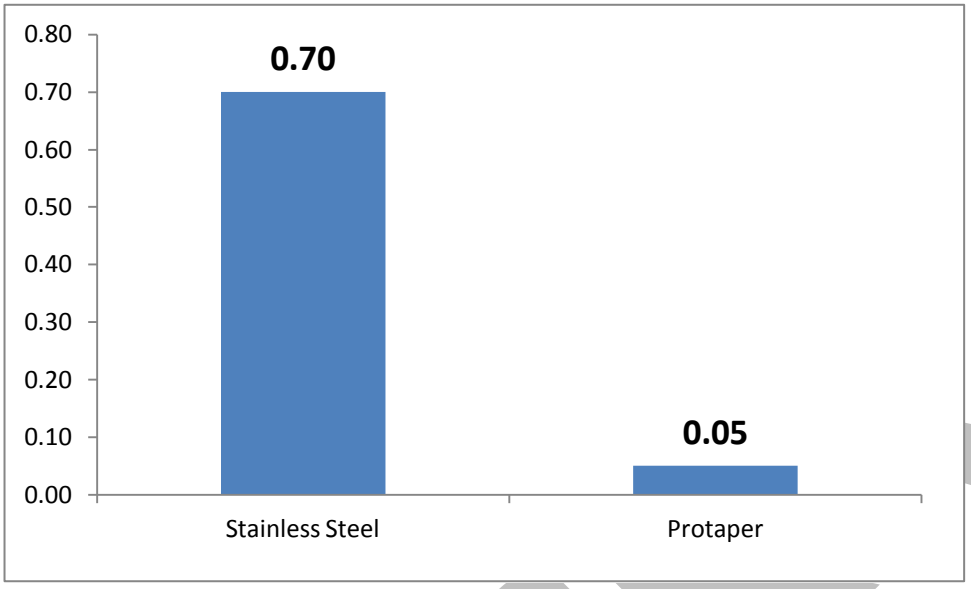
GROUPS	Non-flared WL		Flared WL	
	MEANS	SD	MEANS	SD
STAINLESS STEEL	17.69	0.98	16.65	1.01
PROTAPER	17.35	1.33	17.30	1.34

MEAN WL (mm) ; flared and non flared with stainless steel and protaper



Non-flared WL to Flared WL

Comparison of groups stainless steel-glates glidden and ProTaper with respect to non-flared working length (WL) & Mean reduction in WL.



Non-flared WL to Flared WL

Variable	Source of variation	Degrees of freedom	Sum of squares	F Value	P Value
Non-flared WL	Between groups	1	1.166223	0.856796	0.360478
	Within groups	38	51.72348		
	Total	39			
Flared WL	Between groups	1	6.520562		0.045466
	Within groups	38	1.524237		
	Total	39			

Comparison of two groups (stainless steel and ProTaper with respect to non-flared WL, flared WL by one way ANOVA.

DISCUSSION

The objectives of root canal preparation are removal of organic substrate from the canal system by chemo-mechanical methods and the three dimensional shaping of the root canal system while maintaining the original outline form of the canal.[1] Studies have shown that changes in Working

length commonly occur during the cleaning and shaping of curved root canals. Weine et al. found that changes in WL were produced by straightening of the canal during the course of treatment.[7,8] It has been suggested that this straightening of the canal result in a decrease in canal length. Therefore, straight line access and CF should be performed before WL Determination.[5]

It has been observed that straightening of canal results in a decrease in canal length; therefore, CF should be performed before WL determination.[9] Goerig *et al advocated shaping the coronal aspect of a* root canal first before apical instrumentation is commenced.[10] Sadeghi and Doago and Ibarrola *et al., compared WL* changes after SLA and different CF methods. They found that it is better to establish WL after SLA. Least changes in WL occurred with Ni-Ti rotary orifice shapers after Coronal Flaring.[11,12]

In the study by Davis *et al., similar results were obtained* wherein mean decrease in WL was significantly greater for stainless steel group (−0.48 ± 0.32 mm) than for the Ni-Ti group (−0.22 ± 0.26 mm).[9] This supposition is also supported by the findings of both Dummer and Thompson[10] and Bryant *et al.*[11]*,who reported that Ni-Ti* rotary files caused minimal change in canal configuration. In a clinical study, Farber and Bernstein evaluated WL change that occurred during instrumentation. They found that 30% of the curved canals decreased in length by 1 mm or more and two canals were shortened by 2 mm.[13] In the present study, CF in the stainless steel group was accomplished with Gates Glidden (G. G.) drills and in the Ni-Ti ProTaper group S1 and Sx.

In this study; group [1] and [2] differed in the relative amounts of WL change that occurred as a result of coronal flaring. In group [1], initial CF had a major influence on length change. Of the overall 0.70 mm mean decrease in canal length occurred during initial coronal flaring. While in group 2, only 0.05 mm decrease in canal length occurred during initial coronal flaring. Change in WL due to preparation of coronal portion of the canal was significantly more by stainless steel instruments (*P values < 0.05).*

The relatively large length change produced by the G. G. drills in group 1 may be due to the removal of the cervical bulge of dentin. CF with G. G. drills tends to create a straight line access to the mid root canal. Flaring in group 2 with ProTaper S1

and Sx and tended to follow the original canal contour and did not create the same type of straight-line access to the midroot canal. The results of this study indicate that Ni-Ti rotary files can be expected to consistently produce a small decrease in WL, whereas the combination of G. G. drills and stainless steel files causes more than twice as much decrease in WL. In group 1 lost at least 1 mm of length, seems to indicate significant potential for over instrumentation and overfilling of curved canals, when WL is determined before flaring. None of the canals in group 2 lost 1 mm or more of length, indicating significantly less risk of over-instrumentation and overfilling, regardless of whether flaring is completed before or after WL determination.[14,15]

CONCLUSION

Working length in curved canals is consistently decreased during the course of instrumentation. WL is decreased significantly more when a regimen of G. G. drills and stainless steel hand files are used compared to Ni-Ti rotary files. When rotary Ni-Ti files were used the reduction in WL was much smaller. CF before WL determination significantly reduces change in WL that occurs after instrumentation in curved canals, especially for stainless steel group. When rotary Ni-Ti files were used, the reduction in WL, although statistically significant, was much smaller. The clinician should know that the WL subsequently decreases during canal instrumentation. Keeping this factor in mind the cleaning and shaping should be done so as to provide better treatment outcome.

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