ORIGINAL ARTICLE

ASSESSMENT OF ROOT CANAL WORKING LENGTH EMPLOYING MANUAL AND ROTARY INSTRUMENTATION TECHNIQUE. AN IN VITRO STUDY

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ABSTRACT

Background: The objective of root canal treatment is to eliminate infection and irritants from the root canal system.Working length determination and maintenance are essential for the success of treatment. To determine changes in root canal working length after preparation with manual or rotary instrumentation technique.

Methods: This In vitro Quasi Experimental study was carried out over a period of six months. Mandibular molars, extracted due to caries or periodontal reasons and mesiobuccal canals, with curvature between 20-400 were included.In Group A preparation was carried out with ProTaper instruments and in group B with manual Nickel Titanium files. An ISO #15 NiTi file was placed in the canal and radiograph taken to determine working length.Upon completion of preparation, radiograph with #30 NiTi file was taken and working length assessed. Changes in working length were assessed by comparing preoperative and postoperative values. Data analysis was done withPaired and Independent sample ttests using Statistical Package for the Social Sciences (SPSS) version 20.0 available at university campus. P-value < 0.005 was taken as statistically significant.

Results: Working length was better maintained in ProTaper group as compared to group prepared with Manual Ni-Ti instruments.

Conclusion: ProTaper instrumentation technique maintained working length better than manual instrumentation technique.

KEYWORDS: Pulpectomy, Root Canal Therapy, Tooth apex.

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INTRODUCTION

Root canal treatment is the removal of microorganisms and irritants from the root canal system, followed by root canal preparation and obturation. What is removed from the canals is more important then what is placed during obturation. Success of endodontic therapy depends on understanding the morphology of root canal system and maintaining proper curvature and working length. [1, 2]

Working length is the space in which chemo mechanical preparation of the root canal system is done.3It is the distance from the coronal reference point to the apical constriction.

Root canal prognosis is affected by apical limit of instrumentation and obturation. Proper working length determination and its maintainence during root canal treatment is challenging for the operator.Challenges faced could be due to tooth

position, indirect vision, limited mouth opening and varied root canal anatomy.[4, 5]

The working length should be limited to apical constriction not apical foramen which is 0.5-1 mm short of the major apical foramen. [6]

The apical foramina are not identifiable on radiograph, therefore radiographic apex should be considered during treatment. When treatment is limited short of the radiographic apex higher success rate is observed. The most commonly accepted working length is 0.5-1 mm short of radiographic apex. [7, 8]

Improper working length could result in under-instrumentation or over-instrumentation of root canals.[4, 5] Under-instrumentation results in less elimination of irritants and microorganisms.Over instrumentation results in trauma to apical area and post operative pain.

There have been advancements in dental technology and instruments, especially development of the NiTi (Nickel Titanium) alloy for endodontic instruments. Over the past years rotary NiTi instruments have revolutionised endodontic therapy. They produce a more rounded and tapered canal with less transportation and ledge formation.They have made root canal treatment simpler and less time consuming. [4, 9-11]

There is limited information about working length maintainence by manual and rotray instrumentation technique Thus, the purpose of this study was to compare the accuracy of working length determined and maintainence by manual and rotary instrumentation techniques.

METHODS

This In Vitro Quasi experimental study was carried over a period of six months. Total sample size was sixty extracted molar teeth. The inclusion criteria for the study were human mandibular molars, extracted due to caries or periodontal reasons and mesiobuccal canal of mandibular molars, with curvature between 20-40 degrees as measured by Schneider's method.[15]

Teeth with calcified canals, internal or external resorption and with less than 200curvature or severely curved canals with more than 400curvature as measured by Schneider's method were excluded from the study. Teeth were randomly distributed into two boxes thirty teeth in each box, labeled 'A' and 'B'. Each group was assigned an instrumentation technique. This was done by a draw performed by a colleague, who was not related to the study. Group A: Prepared with rotary (ProTaper/ Dentsply) instruments. Group B: Prepared with manual instruments (Ni-Ti Files/ Dentsply).

Access cavities were prepared and occlusal surfaces reduced to solid flat reference points in both the groups. An ISO #15 Ni-Ti file was placed in the canal and radiograph was taken. Radiographs were taken with the help of standardized XCP (Henry Schein) in mesiodistal direction using paralleling technique. In group A instrumentation with rotary instruments was carried out according to manufacturer's instructions. In group B instrumentation with manual technique was carried out with NiTi files using step back technique. Upon completion of root canal preparation in both the groups, post interventional radiograph with #30 NiTi master apical file was taken and working length determined.

Difference in working length (millimeters) was determined by comparing postoperative values with preoperative values.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 20.0. The difference in the pre and post operative readings of working length was compared using Paired samples t-test (within the group comparison). Independent samples t-test (between the groups comparison) was used to compare the working length in the two groups. A p-value less than 0.05 were taken as statistically significant. Error graphs (Mean with 95% confidence intervals for mean) were also made for pre operative and post operative root canal working length. (Figure 1)

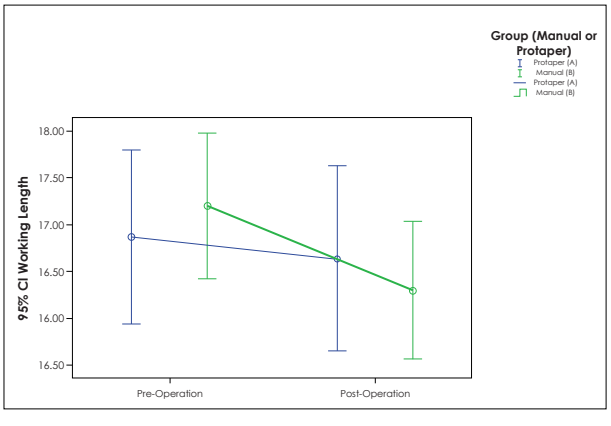

Figure 1: Mean Distribution (95% CI) of Pre and post working length by instrumentation Techniques

RESULTS

Working length in the group A prepared with Rotary (Protaper/ Denstply) instruments was better maintained as compared to the group B prepared with

Manual (Ni-Ti/ Denstply) instruments (Table 1). No significant difference was observed between the two groups before procedure for working length (p-value=0.576). The average difference of the working length in pre and post operation was found to be lower with Rotary (ProTaper) technique when compared with manual technique (p-value=0.007) (Table 2).

Table 1
Mean Distribution of Manual and Rotary (ProTaper) Instrumentation Techniques with 95 percent Confidence Interval for the Difference

Manual or Rotary (Protaper)	Pre-operation	Post-operation	95% Confidence Interval for the difference	p-value
	Mean (SD)			
Manual Working length	16.3 (1.97)		0.9 (0.47, 1.33)	<0.001
Rotary Working length	16.6 (2.65)		0.3 (0.02, 0.45)	0.032

Table 2
Mean Difference (Pre – Post) Distribution of Manual and Rotary (Protaper) Instrumentation Techniques with 95 percent Confidence Interval for the Difference

Working Length	Difference in pre-post Manual	Difference in pre-post Rotary (Protaper)	95% Confidence Interval for the difference	p-value
	Mean (SD)	Mean (SD)		
Working Length	0.90 (1.15)	-0.23 (0.57)	-0.67 (-1.14, -0.19)	0.007

DISCUSSION

The purpose of this study was to evaluate the accuracy of working length maintaining by manual NiTi files and ProTaper rotary system. Loss of working length can cause endodontic flare up due to areas left uninstrumented.[4]

Success of endodontic therapy depends on maintaining the canal anatomy, working length and three-dimensional obturation with complete coronal and apical seal. There have been studies on the apical limit of root canal preparation and obturation.The working length was taken 0.5-1 mm from radiographic apex, which corresponds to apical constriction.[5, 12-15]

Many studies have been carried out on the affects of different endodontic instruments on resin blocks or human teeth. Resin blocks can be softened by heat generated by instruments, [16] therefore we used extracted teeth in our study.

Working length can be determined by different methods like electronic apex locators, cone beam computed tomography and Periapical radiographs. Periapical radiographs are the mostly commonly used method for diagnosis, treatment planning, working length determination, obturation and post operative evaluation. In our study, like other studies also working length was assessed on Periapical radiographs.[16- 18]

Few studies [9,16,19- 22] have been carried out to compare working length maintaining by manual or rotary instrumentation technique the results showed that working length was maintained better with rotary instruments as compared to manual instruments, which coincides with our study too.

As compared to rotary instruments, good manual control and dexterity is required with manual instruments. Rotary instruments are made of NiTi, the instrument design [23] and flexibility of these instruments increases efficacy and decreases procedural errors. [24- 30]

In developing countries there is a trend towards saving and retaining teeth by doing endodontic therapy. This procedure has become quite common. There is also a rising trend in using Rotary endodontic instruments. ProTaper system is widely used therefore we carried out this study to assess the capabilities of this system in maintaining working length and our results prove that this system maintains working length better than manual Nickel Titanium instruments. This could be due to the design of the instrument, the sequence in which instruments are used and rotational speed. [4, 23]

LIMITATION

The results cannot be generalized as they were performed by one operator.One operator performed the procedure therefore Inter examiner reliability cannot be measured. Bias: Personal bias might have been introduced, due to single person examination, although precautions were taken.

CONCLUSION

Rotary (ProTaper) instrumentation technique maintained working length better than manual instrumentation technique.ProTaper instrumentsmaintained canal anatomy, taper and working length without procedural errors on extracted teeth.

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