

Effect of Apical Limit of Instrumentation and Obturation on Short Term Success of Root Canal Treatment: An in-Vivo Study

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ABSTRACT

OBJECTIVE: To determine the effect of two apical limit of instrumentation and obturation in root canal treatment on short term success of root canal treatment.

STUDY DESIGN: Comparative Randomized Clinical Trial

PLACE AND DURATION: Department of Operative Dentistry Isra Dental College from 19th Feb 2014 to 18th Feb 2016

METHODOLOGY: Total hundred patients of either gender who were diagnosed for pulp necrosis of single rooted teeth and required root canal treatment were selected. Hundred patients were divided into two groups by randomization. In Group-A, instrumentation and obturations were done upto apical constriction and in Group-B upto apical terminus. The patients were recalled at 4, 8 and 12 months follow up after root canal treatment to assess the short term success of the treatment.

RESULTS: Group A at follow-ups showed that 32% cases reported as complete success, 68% partially successful, 0% case failure at 4 months, 36% as complete success, 60% partially successful, 2% failure at 8 months and 36% as complete success, 60% partially successful, 2% failure at 12 months. Similarly, Group B at follow-up showed that 40% reported as complete success, 60% partially successful, 0% failure at 4 months, 72% as complete success, 24% partially successful, 4% failure at 8 months and 88% as complete success, 6% partially successful and 2% failure at 12 months. There was a non-significant difference ($P= 0.53$) of short term success between Group A and Group B at 4th month but found significant difference ($P= 0.001$ and $P= 0.018$ P) at 8th and 12th months.

CONCLUSION: There was a no difference in short term outcome at 4th month but there was difference in outcome at 8th and 12th months follow ups between the two apical limits.

KEYWORDS: Endodontics, Obturation, Apical constriction, Apical terminus, Root canal treatment outcome

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INTRODUCTION

Root canal therapies are one of the most common procedures to preserve teeth, that are intended to give a three dimensional seal with relief of patient's pain as well as to make

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favorable condition for healing of peri-apical tissues¹. The quality of canal preparation along with its filling followed ultimately by coronal seal with a definitive restoration are important factors to get high success rates. Many of previous studies have concluded the hypothesis that success of root canal therapy is dependent on the quality of obturation. General agreement is that the apical limit of instrumentation and obturation holds an important position in successful healing of an endodontically treated tooth².

For many years, the said issue has undergone tremendous research but is still a debatable topic for endodontists regarding apical limit of instrumentation and obturation³. Concept of cleaning and shaping of the root canal system is documented in many local and international research; however, apical limit are areas where consensus is yet to be established according to findings of clinical research⁴.

Traditionally, the canal preparation and obturation is achieved at the apical constriction (AC) which is the narrowest part of canal system⁵. Kuttler⁶ trusted apical limit should be the apical constriction, so did Seltzer et al⁷, Walton and Torabinejad⁵. Anatomical details and variations of the apical region are central to the success of any endodontic procedure. With the introduction of rotary instrumentation and advanced

mechanisms of WL determination, another school of thought in endodontology has arose that suggests to complete instrumentation of the canal till the apical terminus⁸. Schilder advocated the cleaning and filling be carried out till the radiographic peak⁹. There are advocates of the contemporary approach as well that boasts the best long-term results be achieved when the instrumentation and obturation is performed beyond the AC and up to the apical terminus.

Abundant reports are found in literatures that have discussed the factors affecting long-term results of endodontic treatment. Mostly the results suggest that eradication of bacteria while root canal instrumentation and hermetic obturation of the root canal system, 0-2 mm short of the apical foramen, is beneficial for better prognosis and healing of the peri-apical tissues¹⁰. According to Sjogren et al¹¹. in their study on the reasons that affect the long-term prognosis of root canal procedure with instrumentation up to the AC, success rate was 98% for roots with pulpal necrosis but without preoperative peri-apical lesions as they showed normal radiological features at follow-ups.

The study of endo-outcomes shows permeation of peri-apical micro-flora into not fully obturated canal as a prominent cause of failure². The another research also reported no failed cases amongst completely filled canals in which the gutta percha was extended slightly short of the apex, while 3.85% of failed cases were linked to filling beyond the apical foramen¹². No long-term results on the outcome of root canal treatment have been found previously in the literature that specifically focus on the effect of apical extent of instrumentation and obturation till the apical terminus.

After extensive search of literature it was found that the comparison of short term success between the two preparations and obturation limits in root canal treatment has not been extensively studied internationally and local data is close to none. So there is need of a standardized research in this matter since the previous studies often lead to confusion for clinicians searching for proper directions based on scientific facts and prognostic results than only opinions. Therefore, the present study will help in developing a consensus for dental practitioner in selecting the choice of apical extension of instrumentation and obturation in routine RCT procedures in order to reduce the discomfort to the patient as well as increase the successful outcome of root canal procedure. So the objective of this study is to determine the effect of two apical limit of instrumentation and obturation in root canal treatment on short term success of root canal treatment.

METHODOLOGY

The comparative randomized clinical study was conducted at the Department of Operative Dentistry/College of Dentistry Isra University; Hyderabad Pakistan from 19th February 2014 to 18th February 2016. Local ethical committee approval was obtained before the study start from the local research ethical committee, Isra University Hyderabad.

Total hundred patients of either gender who were diagnosed for pulp necrosis of single rooted anteriors and posteriors teeth

without apical periodontitis or apical radiolucency and required root canal treatment were selected. The patients of aged 20 to 65 years were included. The patients that presented with perforation and/or internal resorption in teeth, resorbed and or open apices of teeth and previous root canal treated teeth were excluded. An informed consent was taken from every patient. Hundred patients were divided into two groups by randomization using odd and even patients' hospital ID number. Group-A, 50 patients in which apical limit of instrumentation and obturation was planed upto apical constriction and in Group-B, 50 patients in which apical limit of instrumentation and obturation was planed upto apical terminus. Apical constriction was just 0.5 short of apical end of root canal determined by apex locator. Apical terminus was the end point of apical end of root canal determined by apex locator.

In group A, clinical examination, radiographic examination and sensibility testing were performed to fulfilling the inclusion criteria. Patients were given local anesthesia (2% Lignocaine with 1:100,000 Adrenaline, Septodont, UK), and isolation of teeth with rubber dam was done. Access cavity was prepared by a diamond round bur. The access was refined and finished by an access cavity preparation carbide bur (Endo Z, Dentsply International) in a high-speed hand-piece. The working length was determined by a 4th generation electronic apex locator (Root ZX mini, J. Morita, Japan.) up-to the apical constriction and this was reconfirmed with a digital peri-apical radiograph (DIGORA Optime, Sorerdex, Finland). Following the manufacturer's instructions, canal instrumentation was performed with a rotary endo-motor (X-Smart, Dentsply International) using a Ni-Ti file system (Pro-taper Universal, Dentsply, Maillefer; Ballaigues, Switzerland). Between each file change, 2 ml. of 3% NaOCl (Clorox, Pakistan) were used for irrigation. The canal system was then dried by the corresponding sterile paper points (Pro-taper Universal Dentsply International). A try-in with the corresponding master gutta percha point (Pro-Taper, Dentsply International) was made to check for proper seal and tug-bag. A resin based sealer (AH-Plus, Dentsply Maillefer; Tulsa, OK, USA) was then applied by lentulo-spirals of the appropriate size and obturation were made by the cold single cone technique by the placement of the master gutta percha point (Pro-Taper, Dentsply International) After the obturation, an intra-oral digital imaging plate system (DIGORA Optime, Sorerdex, Finland) was used to develop a digital radiograph and check the obturation. The tooth was then restored with a composite restorative material (Z100, 3M ESPE)

In group B, all the standardized protocols followed for Group-A were repeated for this group as well except that the instrumentation and obturation was done till the terminus of the root located by the electronic apex locator (Root ZX mini, J. Morita, Japan) and reconfirmed and by a peri-apical radiograph developed through an intra-oral digital imaging plate system (DIGORA Optime, Sorerdex, Finland).

The patients were called at 4, 8 and 12 months follow up after root canal treatment to assess the short term success of the endodontic treatment based on all clinical and radiographic

findings according to the following modified criteria; (Fonzar F. et al, 2009)¹³. All patients gave 100% compliance by doing telephonic call for follow up appointment.

- Complete success: asymptomatic tooth showing no radiographic change/pathology
- Partial Success: asymptomatic tooth showing any radiographic changes
- Failure: symptomatic tooth showing radiographic change and/or development of a pathology

Data Analysis: Statistical package for social sciences (SPSS 20) was used to calculate the mean age, frequency of gender and teeth distribution. Frequency of short term success (Complete success, Partial Success, Failure) of the endodontic treatment based on all clinical and radiographic findings in each group was calculated. Chi-square test was used to compare short term success between groups with p-value (0.05) at 95% level of significance.

RESULTS

There were 100 patients selected for this study among them 25 (50%) male and 25 (50%) female in Group A while there were 28 (56%) male and 22 (44%) female in Group B. (Fig-1) The mean age of the patients was 32.42 ± 9.9 in Group A and 31.42 ± 10.6 years in Group B. There was no significant difference of age between the two groups (P=0.62 P > 0.05). A total of 100 single rooted anteriors and posteriors teeth were included in the study. Out of the 100 teeth included in the study, thirty eight (38%) were incisors, twenty (20%) were canines and forty two (42%) were premolars.

The results of clinical assessment of this study for Group A at follow-ups showed that zero (0%) case reported with pain, tenderness to palpation and tenderness to percussion at 4 months, one (2%) case reported with pain, tenderness to palpation and tenderness to percussion at 8 months and two (4%) cases reported with pain, tenderness to palpation and tenderness to percussion at 12 months respectively. Similarly the clinical outcome for Group B at follow-ups showed that zero (0%) case reported with pain, tenderness to palpation and tenderness to percussion at 4 months, two (4%) cases reported with pain, tenderness to palpation and tenderness to percussion at 8 months and one (2%) case reported with pain,

tenderness to palpation and tenderness to percussion at 12 months respectively.

The results of radiographic assessment of this study for Group A at follow-up showed that sixteen (32%) cases reported as complete success, thirty four (68%) cases as partially successful and the zero (0%) case as failure at 4 months, nineteen (36%) cases as complete success, thirty (60%) cases as partially successful and one (2%) case as failure at 8 months and nineteen (36%) cases as complete success, thirty (60%) cases as partially successful and one (2%) case as failure at 12 months follow-up. Similarly the results of radiographic assessment of this study for Group B at follow-up showed that that twenty (40%) cases reported as complete success, thirty (60%) cases as partially successful and the zero (0%) case as failure at 4 months, thirty six (72%) cases reported as complete success, twelve (24%) cases as partially successful and 2 (4%) cases as failure at 8 months and forty four (88%) cases reported as complete success, three (6%) cases as partially successful and one (2%) cases as failure at 12 months follow-up as shown in Table-I

The chi-square test was applied which showed a non-significant difference (P= 0.53 P>0.05) of successful, partially successful and failure cases between Group A and Group B at 4th month follow-up but significant difference (P= 0.001 P<0.05 and P= 0.018 P<0.05) between Group A and Group B at 8th and 12th months follow-up respectively. (Table-I)

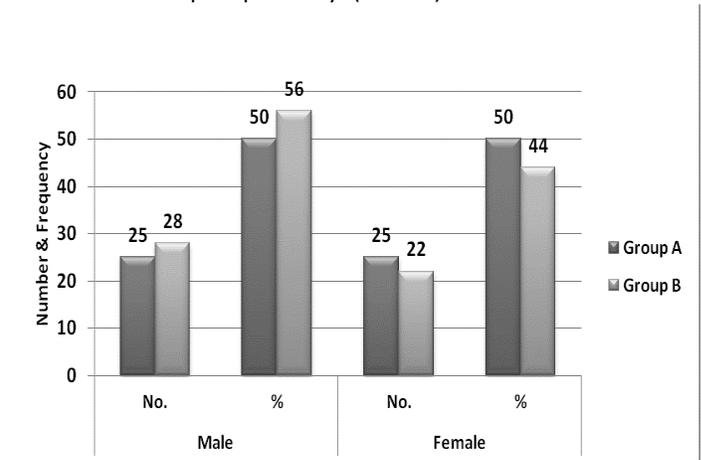


Fig-1: Frequency of Gender distribution (N=100)

Table-I: Comparison of short term outcome between group-a and group-b at 4 months, 8 months and 12 months follow-up (N=100)

Follow Up	Groups	Long Term Outcome				
		Successful	Partially Successful	Failure	X ² -value	p- value (0.05)
4 months	Group A (n=50)	16 (32%)	34 (68%)	0 (0%)	0.694	0.53
	Group B (n=50)	20 (40%)	30 (60%)	0 (0%)		
8 months	Group A (n=50)	19 (38%)	30 (60%)	1 (2%)	13.302	0.001
	Group B (n=50)	36 (72%)	12 (24%)	2 (4%)		
12 months	Group A (n=49)	34 (68%)	13 (26%)	2 (4%)	8.077	0.018
	Group B (n=48)	44 (88%)	3 (6%)	1 (2%)		

DISCUSSION

The ultimate objective of root canal therapy is removal of all bacteria and debris from the entirety of the canal system and then filling the cleaned space completely in three dimensions. In light of this objective, there are advocates of the approach that boast the best long-term results be achieved when the instrumentation and obturation is performed beyond the AC and up to the apical terminus^{12,13}. Schilder⁹ recommendation was to clean, prepare and to fill to the apex and to obturate lateral canals and apical ramifications for successful outcome in root canal treatment.

In this present study the short term success rate based on clinical outcome for Group A and Group B at 4 months follow-up showed that no (0%) case reported with pain, tenderness to palpation and percussion, one case (2%) from Group A and two cases (4%) from Group B at 8 months follow-up reported with pain, tenderness to palpation and percussion and two cases (4%) from Group A and one case (2%) from Group B at 12 months follow-up reported with pain, tenderness to palpation and percussion. After thorough search of the previous literature, it was found that comparison of short and long term clinical outcome in context to the apical limit of root canal treatment procedures has not been published and therefore direct comparisons can't be made.

In this present study the short term success rate was 100 %, 98%, and 96% respectively at 4, 8 and 12 months follow up in group A (instrumentation upto apical constriction). In the previous study by Gill et al¹⁴ on healing out come after root canal treatment success rate was 76.19%. The findings of our study are in contrast with this previous study as we found a total of 96% success rate (68% complete success and 26% partial success) for Group A at the end of our study. The results of our study are also in contrast to previous study by Peters et al¹⁵ on healing outcome after root canal treatment as they reported 81% success that is less compared to our results of 96% (68% complete success and 26% partial success) for Group A. Another previous study by Penesis et al¹⁶ on healing outcome after root canal treatment reported 67% success rate. The results of complete successful cases (68%) of our study are in agreement with this previous study. The results of our study are also in agreement with the previous study by Molander et al¹⁷ on healing outcome after root canal treatment. They reported 65% success rate that is similar to our results of 68% complete success rate at the final follow-up at 12 months.

Previous studies^{11,18} have also evaluated long term outcome of RCT. According to Sjogren et al¹¹ in their study on the factors affecting the long-term results of endodontic therapy with instrumentation up to the AC, success rate was 98% for roots with pulpal necrosis. The findings are in concordance with the present study that shows an overall success rate of 96% (68% complete success and 26% partial success) for Group A. In a study by Kerekes¹⁸ there was a successful outcome of 71% and 88% when instrumentation and obturation was done to the AC by general practitioners and students respectively. This in

accordance to the present study when instrumentation and obturation was done to the AC with a complete success rate of 68% cases.

In this present study the short term success rate was 100 %, 96%, and 94% respectively at 4, 8 and 12 months follow up in group B (instrumentation up to apical terminus). The findings of this study is similar to previous study by Kerekes¹⁸ on long-term results of endodontic treatment, there was a successful outcome of 93% when instrumentation and obturation was done to the radiographic apex in necrotic pulps which is in agreement with this study where the successful outcome for group B at the end of the study was 94% (88% complete success & 6% partial success). We did not find any further previous local and international studies in relation to the apical limit of instrumentation and obturation upto the apical terminus, so further comparison can't be made.

According to a couple of previous studies^{19,20} the length to which the obturating material extends might affect the outcome of endodontic treatment although prognoses are poor when there is overfill or under-fill of >3mm from the radiographic terminus. In the present study there was no statistically significant difference between the outcome of both group A and B at 4th month follow-up ($p=0.001$, $p<0.05$) but we found statistically significant difference between the outcomes of both group A and B at 8th and 12th month follow-ups ($p=0.001$, $p<0.05$) ($p=0.018$, $p<0.05$). The findings of present study reveal that instrumentation and obturation till root terminus shows better short term outcome compared to instrumentation and obturation till apical constriction. In contrast to the present study, Hoskinson et al²¹ found no statistically significant difference on outcome in relation to the apical extent of root filling. ($p=0.270$, $p>0.05$). We did not find further local and international studies on comparison on long-term success and healing outcome in relation to the apical limit of instrumentation and obturation so further comparison can't be made.

The instrumentation and obturation till terminus shows better long term outcome compared to instrumentation and obturation till apical constriction and this apical limit is recommended for the dental surgeons. However, further large scale studies with controlled confounding factors and a longer follow-up are advised to validate the findings.

The limitations of study: is smaller number of sample size because of a strict exclusion criteria and confounding factors that can affect short term outcome could not be controlled. To further affirm the results of this study, histological tests are recommended after RCT so that the histological changes should be examined and matched with the clinical and radiographic findings in successful or failure cases.

CONCLUSION

There was a no difference in short term outcome at 4th month but there was difference in outcome at 8th and 12th month's follow-ups between the two apical limits.

CONTRIBUTION OF AUTHORS

Iqbal Z: Conceived idea, Designed methodology, Manuscript writing.

Khan TA: Data collection, Literature review, Data analysis.

Critical analysis

Disclaimer: None.

Conflict of Interest: None.

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