ORIGINAL RESEARCH

Clinicoradiographic Comparison of Carrier-based Obturation Technique and Lateral Compaction Obturation Technique

Sandeep S Reyal[1], Vijaya K Rajamani[2]

Abstract

Aim and objective: This *in vivo* longitudinal study aimed to do a comparative analysis of the efficacy of carrier-based obturation (CBO) technique and lateral compaction (LC) technique in patients undergoing root canal therapy.

Materials and methods: A total of 40 patients scheduled to undergo root canal therapy were enrolled based on inclusion and exclusion criteria. The patients were assessed using periapical digital radiographs. All the patients were broadly divided into two study groups based on the type of obturation technique used as follows: Group I—patients in which CBO technique with Thermafill carriers (30/0.04) (Dentsply Maillefer) with EndoSequence BC Sealer (Brassler, USA) was used and group II—patients in which LC technique with 30, 0.02 taper GP cone (Dentsply Maillefer) with EndoSequence BC Sealer (Brassler, USA) was used. All the root canal procedures were performed by two skilled and experienced endodontists. Clinical and radiographic evaluation of all the patients was done for assessing gutta-percha-filled area (GPFA) and the prognosis.

Results: Clinical and radiographic success was seen in 90% of the patients of group I while it was seen in 95% of the patients of group II. Statistically, nonsignificant results were obtained in the comparison of the efficacy of both the obturation techniques.

Conclusion: Within the limitations of this study, it can be opined that in patients undergoing root canal therapy, both the obturation techniques can be used with equal effectiveness.

Clinical significance: The present study helps us in envisaging the preferable obturation technique out of lateral condensation technique and CBO technique when the influence of treatment variables is also instituted. This study enhances the scope of obturation techniques in the discipline of endodontics.

Keywords: Endodontics, Obturation, Root canal therapy.

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Introduction

The main goal of endodontic therapy is resolution and/or prevention of apical periodontitis, which can be achieved by thorough cleaning, disinfection, and filling in the three-dimensional context of the root canal system. Failure to locate all canals, incomplete instrumentation, ledge, perforation, and overfilling of the teeth during treatment can cause endodontic failure. Seltzer[1] analyzed local and systemic factors that might affect the endodontic repair process and suggested that often endodontic failures may be beyond the dentist's control. The success of endodontic treatment is typically determined by careful evaluation of radiographic findings and clinical signs and/or symptoms of the treated tooth; however, histological evaluation can also be used.[1–4]

A key to successful endodontics and a major goal of contemporary nonsurgical root canal treatment is to seal completely, both the apical and coronal avenues of potential leakage and maintain the disinfected status reached by the chemical or mechanical cleaning, to prevent reinfection and percolation of bacterial substrates, allowing the periodontium to maintain its integrity and to achieve healing.[5–8] Amidst numerous authors/researchers have said that lateral compaction (LC) of GP is the gold standard practice.[6–9]

The inception of carrier-based obturation (CBO) was first defined in 1978 and thermoplasticized GP varnished endodontic files were explained[10] and nowadays it is being advocated by some of the researchers as the alternative to the LC of the GP technique. Over the years, various modalities of evaluation of obturation techniques have been presented.[7] The American Association of Endodontist (AAE) has defined radiographic success classifications as "healed" or "healing".[8] Russel's periodontal index, 1956 has been used to evaluate the clinical success. This *in vivo* longitudinal study aimed to do a comparative analysis of the efficacy of the CBO technique and LC technique in patients undergoing root canal therapy. The present study helps us in envisaging the preferable obturation technique when the influence of treatment variables is also instituted.

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Materials and Methods

This study was carried out in the Department of Dental Surgery, Armed Forces Medical College, Pune over a period of 1 year from February 2019 to February 2020. A total of 40 patients scheduled

to undergo root canal therapy were enrolled based on inclusion and exclusion criteria. The inclusion criteria for patients included: (1) Patient volunteering to participate in the study, (2) Patients age is 18 years or above, and (3) Noncontributory medical history. The exclusion criteria included: (1) Contributory medical history, (2) Mobility greater than grade I, (3) Radiographic presence of resorptive processes, and (4) Evidence of a preexisting vertical root fracture. Written informed consent was taken from all the patients after explaining in detail the entire research protocol. The study was approved by the Institutional Ethical Committee. Complete demographic and clinical details of all the patients were obtained. Assessment of periapical radiographs was done. Diagnosis of irreversible pulpitis was arrived in all the patients after performing clinical and radiographical evaluation including pulp testing procedures. All the patients were randomly divided into two study groups consisting of 20 patients each based on the type of obturation technique used as follows:

Group I—Twenty patients were included in whom the CBO technique was used and obturations were performed using Thermafill carriers (30/0.04) (Dentsply Maillefer) with EndoSequence BC Sealer (Brassler, USA) which had been thermoplasticized in the ThermaPrep oven (Dentsply Maillefer, Ballaigues, Switzerland). After the obturation, the carrier was cut with a round bur at the orifice entrance, and then the excess of gutta-percha was removed.

Group II—Twenty patients were included in whom LC technique was used in which size 30, 0.02 taper GP cone (Dentsply Maillefer) with tug back was selected. In this technique, the master cone was coated with sealer EndoSequence BC Sealer (Brassler, USA) and placed into the canal. A size 20 endodontic finger spreader (Dentsply Maillefer) was inserted 2 mm short of the working length. Accessory gutta-percha cones of size 20, 0.02 taper (Dentsply Maillefer) were inserted until the entire length of the root canal was filled. The cones were sectioned with a heated instrument at the level of the canal orifice and compacted with a plugger.

All the root canal procedures were performed under the hands of two skilled and experienced endodontists. Clinical examination was done immediately after obturations and after 1 month of root canal therapy. Radiographic evaluation of all the patients was done immediately after the obturations for assessing the prognosis and the patient was followed up for 1-month post-luting of the crown of the RCT-treated tooth. Patients were asked to report to the dental office if they experience any subjective symptoms like pain or swelling even after 1 month of the treatment.

Clinical Examination

Patient responses were documented after examining them for palpation and percussion tests. Periodontal status recording of adjacent tissues was carried out as per Russell's periodontal index, 1956. The principles for clinical success were demarcated as no tenderness on palpation or percussion with no evidence of mobility and also no account of coexisting soft tissue pathosis.

Radiographic Examination

The patient's automated archives were used to attain digitalized preoperative radiographs. With the assistance of a film holder and a digital sensor postoperative digital periapical radiographs were acquired using a paralleling cone technique. Digital radiographs were taken using a charge-coupled device sensor [plate size + 2 (3 × 4 cm) effective resolution (lp/mm)–22 (1100 dpi)] Vista Scan Mini Easy, DBSWIN and VistaEasy Imaging Software (ver-5.15.1, Dürr Dental AG, Germany) and a standard dental X-ray unit (Intraskan DC Xray unit, Skanray technologies, Pvt. Ltd., Mysore, India) with the exposure parameters of tube housing set to 70 kV, 8 mA, and 0.10 seconds.

A beam aiming device cataloged with Skanray technologies, Pvt. Ltd. was used to obtain straight and angled views. Individual follow-up digital radiograph was analyzed for the length of fill, voids, and periapical status. Length of fill was classified as "acceptable" (0–2 mm from the radiographic apex), "short" (>2 mm from the radiographic apex), or "long" (beyond radiographic apex). Voids were classified subject to their position within the root canal system (none, coronal third, middle third, apical third). If a gap was present between a post and obturation material, it was encompassed as a void.

For easiness, if teeth with multiple canals had voids in more than one canal, the most apical void was the location documented for that particular tooth. Periapical status was documented established on assessment with preoperative radiographs and classified as one of the undermentioned: healed (normal or slightly widened PDL), healing [reduction in the size of periapical radiolucency (PARL)], or nonhealing (PARL unchanged, increasing in size or new PARL).[11,12]

Radiographic success was demarcated as classifications of "healed" or "healing" according to the AAE descriptions for gauging outcomes.[13] A classification of "nonhealing" was regarded as a radiographic failure. Overall therapeutic opinions were demarcated as both radiographic and clinical success and failure.

All the results were recorded in a Microsoft excel sheet and were analyzed by SPSS software. Data were presented as numbers and percentages. Chi-square test and Fisher's exact test (FET) were used for assessment of the level of significance.

Results

In the present study, a total of 40 patients were analyzed and were broadly divided into two study groups: group I and group II. The mean age of the patients of group I and group II was found to be 29.8 standard deviation (SD) and 28.4 SD years, respectively. There were 13 males and 7 females in group I and 11 males and 9 females in group II (Fig. 1). A total of 2 teeth were classified as failures in the CBO group and 1 in the LC group. The success and failure of the treatment associated with different variables, i.e., presence of restoration, tooth type, presence of post, number of canals, length of obturation, preoperative pulpal status, preoperative apical periodontitis were calibrated by FET and all had p value >0.05 and thus were not significantly associated with the outcome of treatment. However, overall comparison in terms of the success of the treatment showed the presence of voids only in the apical area was significantly influencing the outcome of treatment ($p = 0.04$) whereas voids in the middle and coronal third were nonsignificant. Clinical and radiographic success between the two groups was non-significant ($p = 0.54$), though a larger number of patients in group II (95%) as compared to group I (90%) had clinical and radiological success (Table 1 and Fig. 2).

The effect of various treatment variables on the outcome is depicted in Table 2.

Discussion

The success of endodontic treatment can be attributed to the root canal preparation associated with chemical irrigation and the endodontic filling providing a tight seal, which is the only way to

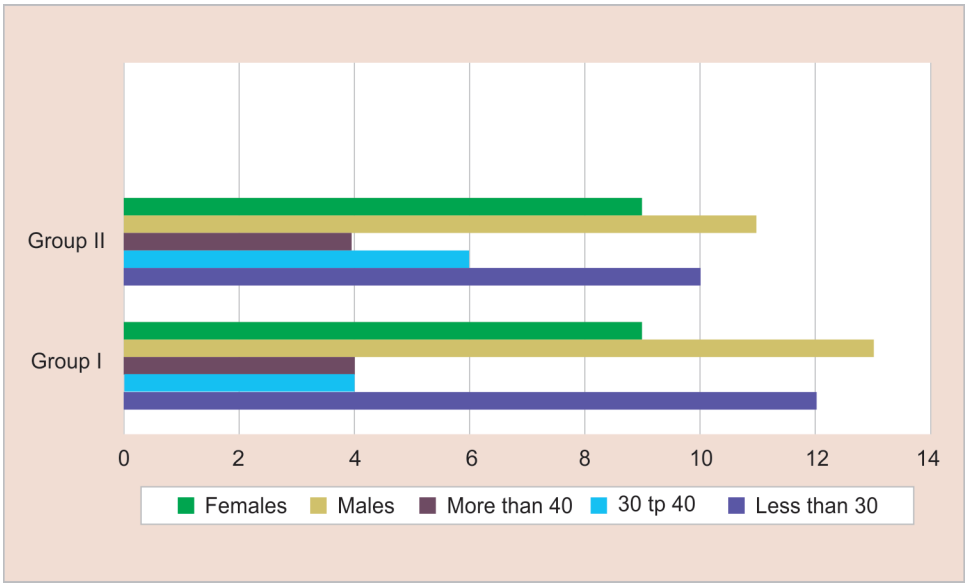

Fig. 1: Age-wise and gender-wise distribution of patients

Table 1: Clinical and radiographic status of treated teeth at recall

Parameter	*Success/ failure*	*Group I (n = 20)*	*Group II (n = 20)*	*p value*
Clinical	Success	18 (90%)	19 (95%)	$X^2 = 0.36$
	Failure	2 (10%)	1 (5%)	$p = 0.54$
Radiographic	Success	18 (90%)	19 (95%)	$X^2 = 0.36$
	Failure	2 (10%)	1 (5%)	$p = 0.54$

ensure a long-lasting result. The hermeticity of the root canal filling plays a key role in promoting the healing process.[7–11] Improper obturation of root canal leads to postoperative complications failing endodontic therapy. The root canal space is sealed perfectly by the three-dimensional obturation of the root canal system.[14] It prevents penetration of bacteria and their products into the periradicular tissues and creates a favorable biological environment for the healing of periapical tissues.

Different types of obturating systems can influence the quality of obturation.[15] Hence, the present study was undertaken for comparing the efficacy of the CBO technique and LC technique in patients undergoing root canal therapy.

In the present study, a total of 40 patients were analyzed and were broadly divided into two study groups; group I and group II. Complete data of all the patients were obtained. The mean age of the patients of group I and group II was found to be 29.8 and 28.4 years, respectively (Fig. 1).

During the literature review, a study done by Kandemir and Çalışkan[16] has shown that two commercially different systems thermafil (TF; Dentsply Maillefer) or the cold lateral condensation technique were both useful techniques of obturation. Our study results were also similar and we observed that under standardized RCT protocol the results obtained by either CBO or lateral condensation are similar. Numerous *in vitro* studies[9,14–16] have been reported on cold LC when compared to other obturation techniques literature; however, clinical studies are a few to number. The outcome of RCT is multifactorial which can be patient-related factors or practicing dental operators. While interpreting treatment outcomes, it is pertinent to validate the study design and patient data. This prospective study over 1 year had major advantages that clinical follow-up of the patient could be done directly evaluating the clinical parameters related to the patient like pain and periapical healing. The period covered in the study was of 1 year and every month endodontists were in constant touch with patients verbally and they were further asked to report any of the subjective signs and symptoms to the dental office if any.

Ansari et al.[17] opined that the cold lateral condensation technique to be the gold standard and compared the radiographic quality of obturation with thermoplasticized injectable gutta-percha techniques and found no statistical difference between the two systems. In our study, there was no significant difference observed in the clinical and radiographic parameters of either of the methods (Table 1). Even though the present study was over 1 year, in our next subsequent study a longer duration for selection of patients will be used to further establish the outcome of both techniques.

Kandaswamy et al.[18] performed a volumetric analysis of laterally condensed gutta-percha, vertically compacted thermoplastized gutta-percha (E and Q Plus system), and cold free-flow gutta-percha (GuttaFlow). Based on their *in vitro* study, it was found that the least volume of obturation was observed in the cold lateral condensation technique. However, in our study, we found that the lateral condensation technique can be as efficient as the CBO technique when evaluated clinicoradiographically.

Also, a study by Ruchi et al.[19] compared three different obturating techniques LC, thermafil, and calamus for filling area and voids using cone-beam computed tomography. In their *in vitro* study, it was found that though calamus is better in terms of obturation but carrier-based and lateral condensation are equally effective in 3D obturation. Our study also did not find any significant results in LC and CBO groups.

In the present study, though there was no statistical difference in both the obturating techniques but the success rate was more in the LC technique being 95% as compared to 90% in the CBO technique ($p = 0.3604$) with an overall success rate of 92.5%. Robert et al.[20] compared a retrospective clinical outcome of LC and CBO and while assessing success rates between cases obturated with LC or CBO there was no difference in success rates ($p = 0.802$); overall success rate was 83% and LC showing 81% and CBO showing 83%.

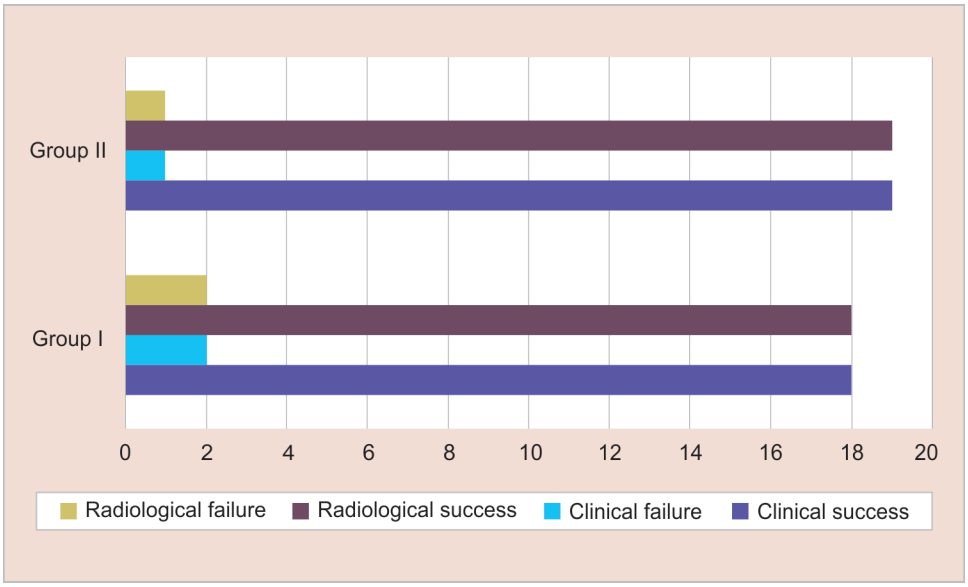

Fig. 2: Comparison of outcome in the two groups

Table 2: Effect of treatment variables on the outcome

	Treatment outcome		
	Success	*Failure*	*p value*
Obturation technique			
CBO	18	2	0.3604
Lateral compaction	19	1	
Tooth type			
Anterior	14	–	0.6143 (Fisher's exact test)
Premolar	10	1	
Molar	13	2	
Preoperative pulp status			
Vital	11	1	0.903495
Necrotic	26	2	
Preoperative apical periodontitis			
Yes	22	3	0.5406 (FET)
No	15	–	
Restoration			
Extracoronal	05	2	0.067 (FET)
Intracoronal	21	–	
Not present	11	1	
Number of canals			
Single	14	–	0.5394 (FET)
Multiple	2	3	
Post			
Yes	06	1	0.4966
No	31	2	
Length of obturation			
Acceptable	20	1	0.625 (FET)
(0–2 mm from apex)	01	–	
Long (beyond apex), short (>2 mm from apex)	16	2	
Presence of voids			
Apical	01	2	0.0403 (FET)
Middle	03	1	
Coronal	04	–	
None	29	–	

He suggested that molars had a significantly less success rate (53%) than premolar and anterior teeth (89%) ($p = 0.005$). In this study, the success rate was 86% in molars and 96% in premolars and anterior teeth ($p = 0.6143$).

The effect of various treatment variables on the outcome like tooth type, presence of post, number of canals, length of obturation, preoperative pulpal status, preoperative apical periodontitis, were not significantly associated with the outcome of treatment. However, the existence of restoration could not validate significant differences but it displayed inclinations on the way to significance ($p = 0.067$). The dearth of significant differences is probably owing to the small percentage of necrotic teeth and teeth with preoperative apical periodontitis accumulating to comparatively less sample size. Largely, studies in the endodontic research (including the present study) appraise prognostic aspects in terms of success/failure. This is in disparity to studies that gauge prognostic aspects in terms of survival. The latest study by Ng et al.[21] formulated that diverse influences may affect survival rates, comprising cuspal coverage, presence of proximal contacts, serving as an abutment tooth, type of tooth, and occurrence of preoperative pain.

In this study, out of all the treatment variables on outcome only one factor had marginal significance, i.e., the presence of voids in the apical and middle area where 7 were labeled as success and 3 as failure ($p = 0.0403$). The lateral compaction group had 1 failure and the CBO group had 2 as a failure. This can be postulated due to a lack of profound spreader penetration after master cone placement in the CBO group, thus barring accessory cones from being conspicuous at the apical 1–3 mm. In contrast, Allison et al.[22] have contemplated that dye leakage in his *in vitro* study is associated with the extent to which apical penetration of spreader occurs while obturating with LC. This can be regarded as operator technique sensitivity bias as a total number 37 out of 40 were regarded as successful treatment outcomes.

While reviewing the article by Wu et al.[23] limitation of the study was observed in regards to the consequence of root canal therapy. One foremost observation was the adoption of periapical radiographs for the assessment of success. The most frequently used criterion for healing is either reduced size of the lesion or normal periodontal ligamental space. Also, studies by Fernandez et al.[24] and Van der Borden et al.[25] radiographs were a two-dimensional representation and it had limitations for evaluation. It was suggested that three-dimensional radiographic methods increased the diagnostic value on treatment outcome.

Conclusion

Within the limitations of the study, it can be inferred that the CBO technique with a 90% success rate can be equally efficacious to the LC technique with a 95% success rate. The CBO technique can be advocated as a suitable replacement for lateral condensation technique though further studies with a larger sample size are recommended. The present study helps us in envisaging the preferable obturation technique when the influence of treatment variables is also instituted. This study enhances the scope of obturation techniques in the discipline of endodontics.

Contribution of Authors

Concept: Lt Col Vijaya Kumar R; Design: Lt Col Vijaya Kumar R, Maj Sandeep Singh Reyal; Definition of Intellectual content: Lt Col Vijaya Kumar R, Maj Sandeep Singh Reyal; Literature search, Clinical studies, Experimental studies: Lt Col Vijaya Kumar R, Maj Sandeep Singh Reyal; Manuscript preparation: Maj Sandeep Singh Reyal; Manuscript Editing: Lt Col Vijaya Kumar R, Maj Sandeep Singh Reyal; Manuscript Review: Lt Col Vijaya Kumar R.

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