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Volumetric analysis of three different obturation techniques in primary teeth using CBCT: An *in vitro* study

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Abstract

Background and Objective: Varied morphology of primary teeth makes it difficult to provide complete three-dimensional obturation of the canal with hermetic seal. 3-dimensional volume measurements of quality of obturation with the help of cone beam computer tomography (CBCT) is the possibility without sectioning the specimens. CBCT is a new tool which gives accuracy of 3 dimensional view of quality of images. There is paucity in literature about the analysis Of Three Different Obturation Techniques in Primary Teeth Using CBCT. Hence this study undertaken to evaluate the efficiency of 3 different obturation techniques; Motor driven lentulo spirals, Hand held Lentulo spiral, Endodontic pressure syringe in primary teeth using CBCT.

Materials and Methods: 60 primary anterior and posterior teeth were obturated using three different obturation techniques; Motor driven lentulospiral, Hand held lentulospiral and Endodontic pressure syringe and volumetric analysis of obturation was done using CBCT. The results obtained were subjected to Pearson's, chi-square test, Kruskal Wallis & Mann Whitney u test.

Results: Motor driven Lentulo spiral group led to better quality of filling resulting in 92% post obturation volume in anterior teeth and 85.5% in posterior compared to Hand held Lentulo spiral group showed 85.5% in anterior teeth and 81.5% in posterior teeth and

Conclusion: In our study Motor driven Lentulo spiral has better quality of filling than Hand held lentulospiral and Endodontic pressure syringe. Further studies are required to support our observations.

Keywords: Primary teeth, pulpectomy, obturation techniques, CBCT

Introduction

One of the keys to successful pulpectomy therapy is to obturate adequately the prepared root canal space. Due to the varied morphology of primary teeth like, thin ribbon shaped canals, lateral branching, apical ramifications, and connecting fibrils and sometimes fusion of canals, it is very difficult to provide complete three-dimensional obturation of the canal with a hermetic seal^[1-4]. Analysis of proper obturation in primary teeth requires a better device. Cone Beam Computer Tomography (CBCT) is one such device recently used for 3dimensional view of object. A novel technology in the dent maxillofacial imaging is the use of CBCT; a non-destructive technology provides 3D interpretation of the specimen. CBCT has various advantages such as lower effective radiation doses, lower cost, less space requirement, easier image acquisition with an interactive display mode such as multi planar reconstruction. 3-dimensional volume measurements are possible without sectioning the specimens and, thus, avoiding the loss of tooth material, which would mimic voids. The specimens also can be used for further research^[5].

There is paucity in literature about the analysis Of Three Different Obturation Techniques in Primary Teeth Using CBCT. Hence this study was undertaken to comparatively evaluate the quality of fill using motor driven Lentulo spirals, Hand Lentulo spiral, and Endodontic pressure syringe in primary teeth by a newer advanced Cone Beam Computerized Tomography.

Material and Methods

Ethical clearance was obtained from the institutional ethical committee. Sixty extracted primary teeth with at least two-thirds of intact roots, without internal or external root resorption and canal calcifications were included in the study. The teeth were collected and placed in 0.9% normal saline. Then the teeth are thoroughly cleaned with pumice slurry, rinsed with water and stored in normal saline. Teeth were taken from saline and placed on paper to air dry. Caries excavation was done using spoon excavator. Then the access was gained using #4 round carbide bur. Coronal pulp remnants were removed with the round carbide bur itself and the radicular pulp remnants are removed using barbed broaches. The chamber was then irrigated with normal saline. 15 size K- file was inserted into the root canal and radiograph was taken working length was established by subtracting 1mm from the total canal length. Canals were enlarged up to 25 size K-files and final finishing was done using 4% Hero shaper file system. Irrigation of canals was done using sodium hypochlorite and normal saline and dried using sterile paper points, and divided into three groups of 20 teeth each.

Group I: Motor driven Lentulo spiral,

Group II: Hand held Lentulo spiral and

Group III: Endodontic pressure syringe group

These groups were further divided into anterior teeth (subgroup A) and posterior teeth (sub group B) containing ten teeth each.

These teeth were mounted on a thermocol sheet and six individual scans were done using CBCT (New Tom Giano, USA) and pre- obturation volume (X) was analyzed.

Group I: In group I sub group A and B were obturated with a 21mm Lentulo spiral which was mounted on a slow speed contra angle hand piece (1,000 rpm) to deliver the zinc oxide Eugenol into root canals. A rubber stopper was used to keep Lentulo spiral 1mm short of the working length, based on the pre-operative radiograph. The Lentulo spiral was smeared with cement, inserted into the canal and rotated in clockwise direction and withdrawn from the canal while still rotating. The process was repeated until the canal orifice appeared to be filled with the cement. The Motor driven Lentulo spirals were changed for every 5 samples.

Group II: Sub group A and B was obturated with a 21mm Hand held Lentulo spiral of size 20. Lentulo spiral is held by hand it is inserted into the canal with clockwise rotation, accompanied by a vibratory motion to allow the material to reach the apex, and then withdrawn from the canal, while simultaneously continuing the clockwise rotary motion. The Hand held Lentulo spirals were changed for every 5 samples.

Group III: Sub group A and B were obturated with a 30-gauge needle is slowly inserted into the root canal and using a slow, withdrawing-type of motion the needle is withdrawn in 3mm intervals with each quarter turn of the screw until the canal is visibly filled with orifice.

After the completion of obturation again the samples were scanned for post obturation volume (Y) and the presence or absence of the voids were analyzed for obtaining the quality of fill and evaluating the homogeneity of the obturation.

$Y/X*100$ formula was used to calculate the post obturation volume percentage. The obtained results were subjected to volumetric analysis. Obtained results were subjected to Pearson's, chi-square test, Kruskal Wallis & Mann Whitney u

test.

Results

The comparison of means among Group IA, Group II A and Group III A. Statistical Analysis was done using Independent sample t test. The mean in group IA was found to be 92.70 ± 4.01 , in group II A was found to be 83.35 ± 7.47 and in group III A was found to be 90.91 ± 2.15 . F value was found to be 5.75 and p value was found to be 0.008 (statistically significant). (Table 1)

Table 1: Mean comparison of post obturation volume percentage of groups in anterior teeth.

Groups	Mean	SD	F value	P value
Group i	92.7	4.01	5.758	0.008 S
Group ii	85.35	7.47		
Group iii	90.91	2.15		

Statistical Analysis: Independent sample t test. Statistically significant if $P < 0.05$

The comparison of means between Group IA and Group II A, Group IA and Group III A and between Group II A and Group III A. Statistical Analysis was done using Independent sample t test. The mean in group IA was found to be 92.70 ± 4.01 and in group II A was found to be 83.35 ± 7.47 . The mean difference was found to be 7.35 ± 3.46 . P value was found to be 0.008 (statistically significant). The mean in group IA was found to be 92.70 ± 4.01 and in group III A was found to be 90.91 ± 2.15 . The mean difference was found to be 1.79 ± 1.86 . P value was found to be 0.23 (statistically non-significant). The mean in group II A was found to be 85.35 ± 7.47 and in group III A was found to be 90.91 ± 2.15 . The mean difference was found to be 5.56 ± 5.32 . P value was found to be 0.036 (statistically significant). (Table 2)

Table 2: Mean comparison of post obturation volume percentage among Groups in anterior teeth.

Groups	Mean	SD	Difference mean \pm SD	P value
Group i	92.70	4.01	7.35 ± 3.46	0.013 S
Group ii	85.35	7.47		
Group i	92.70	4.01	1.79 ± 1.86	0.230 Ns
Group iii	90.91	2.15		
Group ii	85.35	7.47	5.56 ± 5.32	0.036 S
Group iii	90.91	2.15		

Statistical Analysis: Independent sample t test. Statistically significant if $P < 0.05$

The comparison of means among Group I B, Group II B and Group III B. Statistical Analysis was done using Independent sample t test. The mean in group I B was found to be 85.55 ± 1.57 , in group II B was found to be 81.57 ± 5.48 and in group III B was found to be 75.37 ± 3.38 . F value was found to be 17.957 and p value was found to be 0.000 (statistically significant). (Table 3)

Table 3: Mean comparison of post obturation volume percentage between Groups in posterior teeth.

Groups	Mean	SD	F value	P value
Group i (b)	85.55	1.57	17.957	0.000 S
Group ii (b)	81.57	5.48		
Group iii (b)	75.37	3.38		

Statistical Analysis: Independent sample t test. Statistically significant if $P < 0.05$

The comparison of means between Group I B and Group II B, Group I B and Group III B and between Group II B and

Group III B. Statistical Analysis was done using Independent sample t test. The mean in group I B was found to be 85.55 ± 1.57 and in group II B was found to be 81.57 ± 5.48 . The mean difference was found to be 3.98 ± 3.91 . P value was found to be 0.041 (statistically significant). The mean in group I B was found to be 85.55 ± 1.57 and in group III B was found to be 75.37 ± 3.38 . The mean difference was found to be 10.18 ± 1.81 . P value was found to be 0.000 (statistically significant). The mean in group II B was found to be 81.57 ± 5.48 and in group III B was found to be 75.37 ± 3.38 . The mean difference was found to be 6.20 ± 2.10 . P value was found to be 0.007 (statistically significant). (Table 4)

Table 4: Mean comparison of post obturation volume percentage among groups in posterior teeth.

Groups	Mean	SD	Difference mean \pm SD	P value
Group i (b)	85.55	1.57	3.98 \pm 3.91	0.041 S
Group ii (b)	81.57	5.48		
Group i (b)	85.55	1.57	10.18 \pm 1.81	0.000 S
Group iii (b)	75.37	3.38		
Group ii (b)	81.57	5.48	6.20 \pm 2.10	0.007 S
Group iii (b)	75.37	3.38		

Statistical Analysis: Independent sample t test. Statistically significant if $P < 0.05$

Discussion

An acceptable obturation technique is the one which shows optimal filling along with least number of voids. Therefore, the present study was undertaken to compare efficiency of obturation in primary teeth by using Motor driven lentulospiral, Hand held lentulo spiral and Endodontic pressure syringe techniques using CBCT. The present study compared the efficiency of the Lentulo spiral group mounted on a slow-speed Hand piece [group I (a) & (b)], Hand-held Lentulo spiral [group II (a) & (b)] and Endodontic pressure syringe [group III (a) & (b)], The Lentulo spirals used in this study were smaller by two sizes from the last k- file used and was kept 1mm short of the working length there was enough space for the Lentulo spiral to rotate and, less chance of it getting engaged in the narrow root canal. Hence, there was no separation Lentulo spirals in this study. This is considered a key, for safe use of the Lentulo spiral in pediatric dentistry.

In this study Motor driven Lentulo spiral group led to better quality of filling resulting in 92% post obturation volume in anterior teeth and 85.5% in posterior teeth compared to Hand held Lentulo spiral group which showed 85.5% in anterior teeth and 81.5% in posterior teeth and endodontic pressure syringe showed 90.9% post obturation volume in anterior teeth and 75.3% in posterior teeth. In anterior teeth there was no significant difference between Motor driven Lentulo spiral group and Endodontic pressure syringe group, but Motor driven Lentulo spiral showed better quality of fill. In posterior teeth Motor driven Lentulo spiral group showed better quality of fill followed by Handheld Lentulo spiral group and Endodontic pressure syringe group. The reason could be that the design and flexibility of the Lentulo-spiral allow file to carry the paste uniformly throughout the curved, narrow canals of primary molars. In accordance to our study results Aylard and Johnson (1987) [6] and Dandashi *et al.* (1993) [7] reported that the Lentulo spiral mounted on a slow speed hand piece was superior in filling straight and curved root canals of primary teeth. Torres *et al.* (2004) [8] found that the Lentulo spiral delivered paste into the canals better than injection systems such as Navi Tip system. Asokan *et al.* (2012) [9] evaluated volumetric analysis of root canal fillings in primary

teeth using spiral computed tomography and found that Hand-used Lentulo spirals produced a less-dense fill when compared to motor driven Lentulo spirals. Memarpour *et al.* (2013) [10] Singh. R *et al.* (2015) [5], Pandranki *et al.* (2017) [11], Chandani *et al.* (2017) [12], Akhil (2018) [13] reported that Lentulo spiral technique led to more number of optimal fills, with fewer voids with superior quality of fill when compared to other techniques. A study by S Reddy *et al.* (1997) [14] Dandashi *et al.* (1993) [7] and Reddy *et al.* (2015) [15] stated that no significant differences were found between Lentulo spiral and endodontic plugger in obturation quality. T. walia *et al.* (2016) [16] found relatively fewer voids when the teeth were obturated with Hand held Lentulo spiral obturating technique which showed the maximum number of optimally filled canals. A contrasting result was seen in a study conducted by Gandhi *et al.* (2017) [17] and Kumar (2016) [18] where highest number of voids were seen in the teeth obturated with Lentulo spiral. The present study was limited to incisors with lesser sample size.

Conclusions

Within the limitations of the present study Motor driven Lentulo spiral has better quality of filling than Hand held lentulospiral and Endodontic pressure syringe. Further studies are required to evaluate the obturation quality by using different techniques with different materials with advanced diagnostic tools like CBCT.

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