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Research Article

SIMULATED ACRYLIC DECIDUOUS TEETH WITH PULP SPACE– A NOVEL EDUCATIONAL TOOL TO STUDY THE EFFICIENCY OF ENDODONTIC PROCEDURES

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A B S T R A C T

Introduction: Since decades, studies on pulpal space of deciduous teeth for anatomic and endodontic purposes has yielded limited results. Deciduous teeth having good canal system is scant and practically unavailable for students to practise the procedure. One of the reasons being that it cannot be extracted for any purpose except otherwise indicated, hence there is a need for simulated deciduous teeth. **Aim:** To check the competence of custom made simulated deciduous teeth with pulpal space by comparison of endodontic preparation and obturation to that of natural deciduous teeth. Hence in this study we generated 3D outer anatomy of the tooth with inner pulp space so that one can proceed with training and evaluating the endodontic efficiency. **Methods:** A total of 10 canals in each group; custom made simulated deciduous teeth and natural deciduous teeth were used in the study. Access cavity was prepared and BMP upto size 35 K file with frequent irrigation using hot water was done. Later all teeth were obturated with Zinc oxide Eugenol. The pre and post operative radiographs were taken and radiographs were assessed using Image J software for each group. The data was statistically analysed using unpaired t test. **Results:** Simulated model provided more favorable results in terms of root length and percentage of obturated area was 97.42 more than the natural deciduous teeth with mean POA to be 83.77 percent, the result was statistically significant (P Value< 0.001). **Conclusion:** The study shows that simulated tooth model is an effective tool for training and visualization of 3D obturation in deciduous teeth.

INTRODUCTION

Since decades studies on pulpal space of deciduous teeth for anatomic and endodontic purposes has yielded limited results. Several techniques have been tried in the past to prepare three dimensional anatomy of teeth with varied success. Natural deciduous teeth having good canal system is scant and practically unavailable for students to practise the procedure. One of the reasons for this is that they cannot be extracted for any purpose unless otherwise indicated, like in cases of trauma or interceptive orthodontic treatment. Even so, complete root canal system is hard to find in extracted deciduous teeth due to physiologic resorption. Improper oral hygiene practises and morphological variations make deciduous dentition more prone to dental caries leading to early involvement of pulp[1]. Hence there is a need for simulated deciduous teeth with inner pulp space so that one can proceed with training and evaluation of endodontic efficiency.

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For obturation of primary teeth commonly used materials are Zinc oxide eugenol, Iodoform paste, Calcium hydroxide or a combination of above.[2] Zinc oxide and eugenol paste was the first root canal filling material to be recommended for primary teeth, as described by Sweet in 1930. An ideal filling technique should assure complete filling of the canal without overfill and with minimal or no void. Both in vitro and in vivo studies have been done by several investigators on the quality of different obturating materials and techniques.

The aim of the present study was to check the competence of custom made simulated deciduous teeth with pulpal space by comparison of endodontic preparation and obturation to that of natural deciduous teeth and to evaluate the completeness of obturation in terms of linear totality of the root canal fill in using Radiovisiography (RVG) in simulated acrylic deciduous teeth and natural deciduous teeth.

METHODS

Specimen preparation, collection and pre operative scanning

Prior to the start of the study, ethical clearance was obtained from Institutional Ethical Committee and the present study was

conducted in the Department of Pedodontics and Preventive Dentistry, JSS Dental College and Hospital, Mysuru. The study was conducted on 10 simulated acrylic deciduous teeth and 10 natural deciduous teeth. A total of 10 simulated acrylic deciduous teeth were fabricated in house in the Department of Pedodontics and Preventive Dentistry, JSS Dental College and Hospital, Mysuru using 90% acrylic and 10% barium sulphate mixed by weight. The accuracy of the specimen was evaluated by two independent experts.

Primary teeth extracted due to reasons such as gross caries or over retention were collected from out-patient of Department of Pedodontics and Preventive Dentistry, JSS Dental College and Hospital, Mysuru. After extraction, the teeth were placed in formalin. Out of the teeth collected 10 were included in the study. While preparing the samples, the teeth were placed on paper towels to allow air drying. When completely dried, the apical parts of the root of simulated model of natural deciduous teeth were then covered by a ball of modeling wax approximately 2–4 mm in diameter to create a halo anatomical apical space around each root apex to serve as a collection area for any extruded canal filling material. This technique of creating peri-apical space around the root apices allowed simulation of identical environment as *in-vivo* conditions and also to show over obturated material. A customized jig was prepared to facilitate uniform fabrication of study samples with dimension of 1 * 1cm. In the centre of the jig, needle was placed to help in the uniform positioning and to eliminate the wax which was placed in the apex of the sample. The acrylic base for each sample was prepared, pouring cold cure acrylic into the jig by sprinkle on technique. Similarly 20 specimens were prepared. Teeth specimens were numbered 1 to 10 in each group.

Before initiating the preparation a standard pre operative intraoral periapical radiograph (IOPA) radiograph was taken of each specimen in both the groups using the same Radioviography RVG (SCHICK P/N B22501000, GENDEX(DENTSPLY) 140millisec, kilovolts(60kv), milliamperes (6mA) (Fig 1) so that radiographic errors were minimized and radiographs were scanned, pre obturated area (X) and estimation of root length of simulated acrylic deciduous teeth and natural teeth was analyzed using image J software v1.51k.

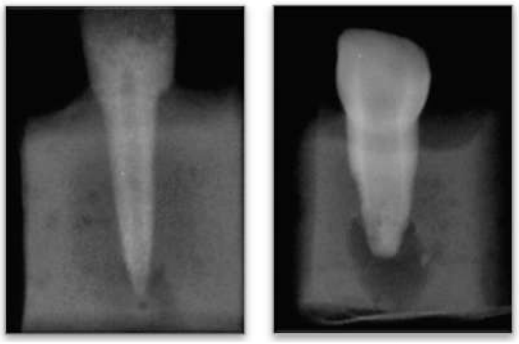


Fig 1 Pre-operative radiograph of simulated acrylic deciduous teeth with pulp space and natural deciduous teeth

Preparation of teeth specimen and working length determination A standard coronal access cavity preparation with round bur was done using low speed micro-motor. Working length estimation was done using 15 # k file with rubber stop and length of the canal was recorded as length of initial file at the apical foramen -1mm. Root canals were instrumented till file number 30-35 # k file and the canals were irrigated and once the preparation was done ,they were dried using absorbent paper points.

Obturation and post obturation scanning Root canals were obturated with zinc-oxide Eugenol mixing zinc oxide powder with eugenol into thick mix by mixing one volume unit of powder and one volume unit of liquid by weight on a dry glass slab for 45 seconds using stainless steel spatula in circular motion. An endodontic plugger, with rubber stopper, was used to place a thick mix of zinc oxide eugenol paste into the canal orifice. Approximately three or four additional increments were added to fill the canal orifice. Finally over the orifice more material was pressed and compressed using wet cotton.

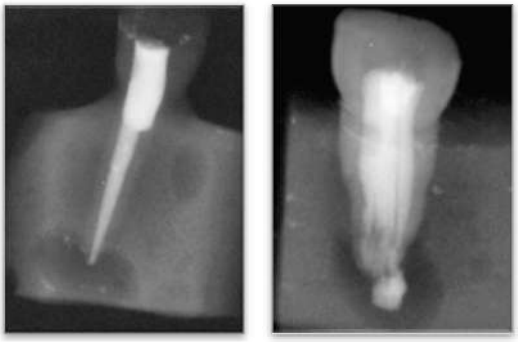


Fig 2 Post-operative radiograph of simulated acrylic deciduous teeth and natural deciduous teeth

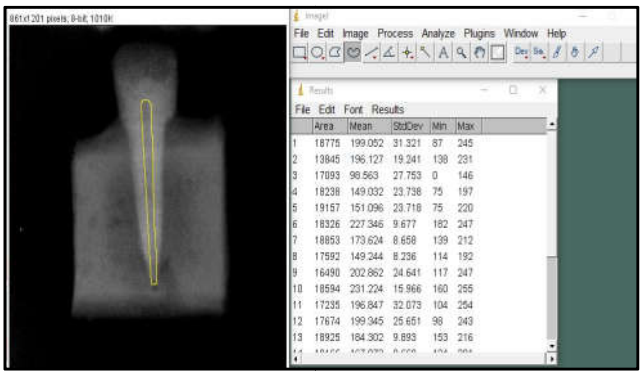


Fig 3 Analysing of radiograph using image J software

Post obturation intraoral periapical radiograph (IOPA) radiographs were taken of each specimen in both the groups using same Radioviography RVG (SCHICK P/N B22501000,GENDEX(DENTSPLY) 140millisec, kilovolts (60kv), milliamperes (6mA) (Fig 2) so that radiographic errors were minimized and radiographs were scanned, post obturated area(Y) was analyzed using image J software v1.51k(Fig 3) and finally percentage of obturated area (POA) was calculated using the formula Y/X*100.

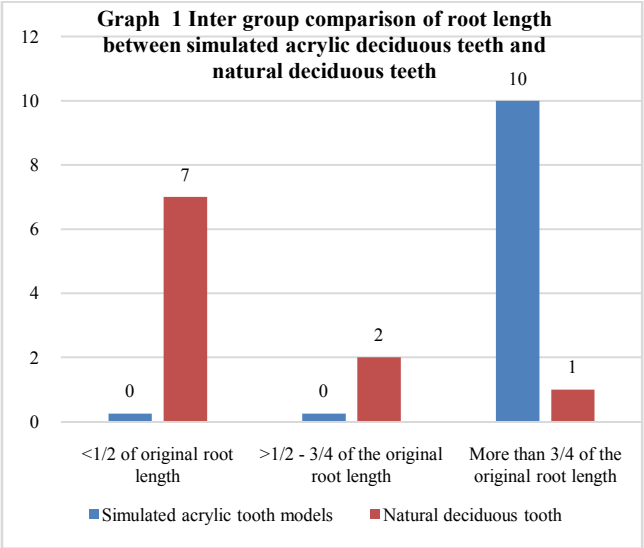
RESULTS

The results of the present study have been discussed under the following headings

Inter group comparison of root length between simulated acrylic deciduous teeth and natural deciduous teeth

Root length of simulated acrylic deciduous teeth and natural deciduous teeth was measured using image J software v1.51k and canal length were graded under < ½ of original root length, > ½ - ¾ of the original root length and more than ¾ of original root length. It was observed that 7 samples showed under < ½ of original root length, 2 showed > ½ - ¾ of the

original root length and 1 showed more than ¾ of original root length in case of natural deciduous teeth. On the contrary with simulated acrylic deciduous teeth, 10 showed more than ¾ of original root length (Graph1). Hence simulated model provided more favorable results in terms of root length.



Comparison of percentage of obturated area (POA) between Simulated acrylic deciduous teeth with pulp space and natural deciduous teeth

In two groups containing ten samples each RVG was taken and the area of the canal before obturation (X) and area of the canal after obturation(Y) was assessed using image J software v1.51k and percentage of POA was calculated using the formula Y/X*100. Mean POA simulated acrylic deciduous teeth was 97.42 more than the Natural deciduous teeth with mean POA to be 83.77 percent. The result was statistically significant P Value < 0.001.(Graph 2 and Table 1)

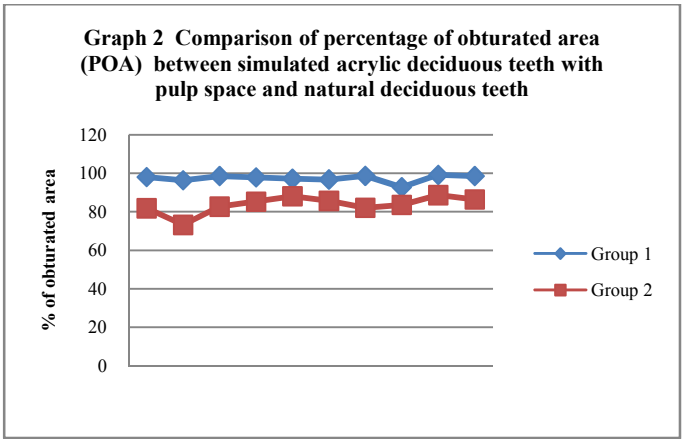


Table 1 Comparison of mean of percentage of obturated area (POA) between simulated acrylic deciduous teeth with pulp space and natural deciduous teeth

Groups	Sample size (N)	Mean POA(%)	t	P- value
Simulated acrylic tooth models	10	97.42	9.022	0.01
Natural deciduous teeth	10	83.77		

DISCUSSION

Despite of significant advances in preventive dentistry, dental caries continues to be one of the most common infectious oral health diseases in mankind[3]. Morphologic variations along with improper oral hygiene practices make deciduous dentition more prone to the vagaries of dental caries leading to early involvement of pulp[4]. Preservation of primary teeth helps in proper mastication, phonation, swallowing, esthetics, acts as a natural space maintainer and prevention of detrimental psychological effects and aberrant oral habits due to loss of teeth[5,6]. Untreated pulpally involved teeth may lead to toothache and swelling in the face or cheek due to abscess. The main objective of pulp therapy in primary dentition is to retain the primary tooth in a non-pathological state in dental arch until exfoliation and thereby giving a proper guidance to the eruption of permanent dentition[7]. Pulpectomy is defined as the complete removal of the necrotic pulp from the root canals of primary teeth and filling them with an inert resorbable material so as to maintain the tooth in the dental arch[8].

The commonly used root canal filling materials for primary teeth are zinc oxide eugenol paste (ZOE), calcium hydroxide pastes-$Ca(OH)_2$, iodoform or combination of these materials. However, none of them meets all the criteria for an ideal filling material[9,10]. Zinc oxide and eugenol paste was the first root canal filling material to be recommended for primary teeth, as described by Sweet in 1930.

Providing comprehensive knowledge of the anatomy of human teeth is one of the basic functions of dental education, because a thorough understanding of their internal structure is one of the prerequisites for any successful clinical intervention. Deciduous teeth having a good canal system is scanty and practically unavailable for the students to collect and practise on it as deciduous teeth cannot be extracted for any purposes except in case of trauma or as a part of any treatment modality. In such a situation training becomes difficult. Consequently, interactive 3D models and virtual training systems are becoming more widely used in the areas of medical and dental research. [11] Hence in the present study for standardization we generated3D outer anatomy of the tooth with inner pulp space so that one can proceed with training and evaluating the endodontic efficiency. Single obturating material ZOE was used because it is most commonly used root canal filling material and many investigators have assessed its performance.[12]

The innovation mentioned in the present study simulated deciduous tooth, is assessed for its efficiency in aiding training and its role as an educational tool in endodontic procedure for budding dentist. Root length of simulated acrylic deciduous teeth and natural deciduous teeth was measured using image J software v1.51k is a java based image processing program which helps in custom acquisition, analysis and processing of data. Canal length were graded under < ½ of original root length, > ½ - ¾ of the original root length and more than ¾ of original root length. It was observed that 7 samples showed under < ½ of original root length, 2 showed > ½ - ¾ of the original root length and 1 showed more than ¾ of original root length in case of natural deciduous teeth. On the contrary with simulated acrylic deciduous teeth, 10 showed more than ¾ of original root length. Hence simulated model provided more favorable results in terms of root length.

The results of the present study shows that mean POA simulated acrylic deciduous teeth was 97.42 more than the Natural deciduous teeth with mean POA to be 83.77 percent. The result was statistically significant. P Value < 0.001. Therefore from the study, we can strongly suggest that the current pilot study will be a boon for further research in paediatric endodontics.

CONCLUSION

Within the parameters of the present study and based on the standardized protocol followed through out the study showed that simulated deciduous tooth can be effectively used for practising and visualization of endodontic obturation as compared to using extracted natural deciduous tooth. However, a further study with larger sample size is highly recommended.

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