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A Cross-Sectional Study on the Preference of Root Canal Sealers Among Pediatric Dentists For Obturating Permanent Teeth

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ABSTRACT

Utilisation of root canal sealers to perform obturation procedures is an endorsed method in endodontics and has an indispensable role in the success of treatment. The objective of this study was to explore the pediatric dentists' preference for root canal sealers for obturating permanent teeth. 360 permanent teeth with gutta-percha obturation done by pediatric dentists were analyzed for the study. The variety of root canal sealers that are utilised for obturating the permanent teeth by pediatric dentists were assessed. The data were obtained from a patient management software. Chi-square test was performed. Out of the 360 permanent teeth, 186 teeth were obturated using resin-based sealers, 101 teeth using zinc oxide eugenol-based sealers and 73 teeth were obturated using calcium hydroxide-based sealers, with statistically significant difference between the three materials ($P<0.05$). Based on the findings of the present study, resin sealers followed by zinc oxide eugenol sealers and calcium hydroxide sealers were more preferred by pediatric dentists for root canal therapy in permanent teeth.

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INTRODUCTION

Root canal treatment incorporates a sequence of steps with the objective of treating the infected root canal of a tooth, thus resulting in the resolution of the infectious process and in the counteraction of microbial invasion in the affected tooth (Torabinejad and Walton, 2009). Attainment of optimal root canal therapy is ascribed to numerous imperative components such as biomechanical preparation, absolute irrigation, root filling, and post-endodontic restoration (Govindaraju and Gurunathan, 2017; Govindaraju *et al.*, 2017a; Jeevanandan, 2017).

The purpose of endodontic treatment is to eradicate the infection of the root canal and to meticulously restore the root canal space in three-dimensions, in order to counteract the apical and coronal penetration of liquids and microorganisms which could cause re-infection (Gurunathan and Shanmugaavel, 2016; Facer and Walton, 2003). Relatively root canals of permanent teeth are filled with gutta-percha points in consolidation with a root canal sealer which are crucial elements of root canal obturation to establish a fluid-tight seal that provides a biological environment for healing of periapical tissue (Wiemann and Wilcox, 1991). The principal function of an endodontic sealer is to function as a lubricating agent that fills the space between the

core material and the walls of the root canal and between the gutta-percha points, in an endeavor to form a explicit mass of root filling material without voids (Bouillaguet *et al.*, 2008; Kumar and Shruthi, 2012).

Utilisation of root canal sealers to perform obturation procedures is an endorsed practice in endodontics and plays an integral role in the success of treatment. Root canal sealer along with solid root filling material operates synergistically to create hermetic seal (Sjögren, 1990). The root sealer acts as a binding agent that is proposed to fill irregularities and minor disparities between the core material and canal walls and accessory canals (Patri, 2020; Trivedi, 2020). It is also anticipated to sabotage the surplus bacteria which remains after cleaning and shaping the root canals by its germicidal action (Abdullah, 2002; Spångberg and Haapasalo, 2002).

An endodontic sealer with the property of strengthening the tooth against root fracture would be of indisputable value, as the root canal therapy is reinforced by obturation, which increases the resistance of the tooth to compressive strength (Teixeira, 2004; Hammad *et al.*, 2007; Elfaramawy, 2017). Therefore, the bonding action of sealer to the dentine is predominant in preserving the stability of the seal in a root canal obturation (Perdigão, 2015). Various researchers have developed materials which hasten adhesion to root canals as it is established that adhesion and mechanical interlocking strengthens the tooth by reducing the risk of fracture (Guindy and Fouda, 2010).

It has been theorized that the thickness and homogenous dispersion of the material is also essential as the less thickness will have minimal voids, less microleakage, and lasting stability (Limkangwalmongkol *et al.*, 1992; Özata *et al.*, 1999). When the sealing material approaches the soft and hard tissues apically, it can cause persistent inflammation of periradicular tissues and may emanate in delayed wound healing that manifest as pain, tenderness, and swelling of the intervened area (Limkangwalmongkol *et al.*, 1991; Wiemann and Wilcox, 1991). Therefore, biocompatibility of sealers is of paramount importance in choosing the suitable type of root sealer for different endodontic situations (Govindaraju *et al.*, 2017b; Donadio, 2009).

Numerous types of root canal sealers are being used in dentistry, such as the resin-based AH Plus, calcium hydroxide–based Apexit plus, Zinc oxide–based Tubliseal, Glass Ionomer–based Ketac endo, Mineral Trioxide Aggregate-based sealers, bioceramic sealers, methacrylate-based resin sealers, and calcium phosphate sealers (Tyagi *et al.*, 2013; Kaur, 2015; Phukan, 2017).

An immense challenge faced by a practitioner while treating a pediatric patient is uncooperative behaviour due to anxiety or fear (Govindaraju *et al.*, 2017c). The golden rule in the practice of endodontics in children and adolescents is to obturate the canals as precisely as possible in an amount of time and appointments that are acceptable (Jeevanandan and Govindaraju, 2018; Lakshmanan *et al.*, 2020). It is accepted that most pediatric dentists have attained the essential skills to treat predictably and conveniently most of the endodontic cases in their clinical practices (Ravikumar *et al.*, 2017).

The objective of the present study was to explore the pediatric dentists' preference for root canal sealers for obturating permanent teeth.

MATERIALS AND METHODS

This cross-sectional study was performed in a university setting in Tamil Nadu, India. Ethical clearance for the study was obtained from the ethical clearance committee of Saveetha University. As the study was entirely dependent on data evaluation from existing dental records available in a patient management software, informed consent was not obtained.

Dental records of patients who underwent root canal treatment in permanent teeth from June 2019 to April 2020 from pediatric dentists were retrospectively examined by a single examiner.

Data were collected from 320 patient records; basic details of the patient, the type of tooth and the type of root canal sealer used were recorded.

Statistical analysis

The extracted data were tabulated in a spreadsheet (Excel 2017: Microsoft Office) and statistical analysis was performed using SPSS 19.0 version software (SPSS Inc., Chicago, IL, USA). Descriptive statistics and Chi-square tests were done with significance at 0.05. ($P < 0.05$).

RESULTS AND DISCUSSION

A total of 360 root canal treated permanent teeth from 320 patient records (males- 172; females- 148) were examined. The mean age of the patients were 13.2 ± 1.7 years.

Out of 360 permanent teeth, 182 were maxillary teeth (anteriors- 104; posteriors- 78) and 178 were mandibular teeth (anteriors- 20; posteriors- 158) (Table 1).

Table 1: Distribution of teeth assessed in the study were 158 mandibular posteriors followed by 104 maxillary anteriors, 78 maxillary posteriors and 20 mandibular anteriors

Type of teeth	Number of teeth
Maxillary anterior	104
Maxillary posteriors	78
Mandibular anterior	20
Mandibular posteriors	158
Total	360

Table 2: Comparison of different root canal sealers used for obturating primary teeth

Root canal sealers	Number of teeth	P-value
Resin sealer	186	0.014
Zinc oxide eugenol sealer	101	
Calcium hydroxide sealer	73	
Total	360	

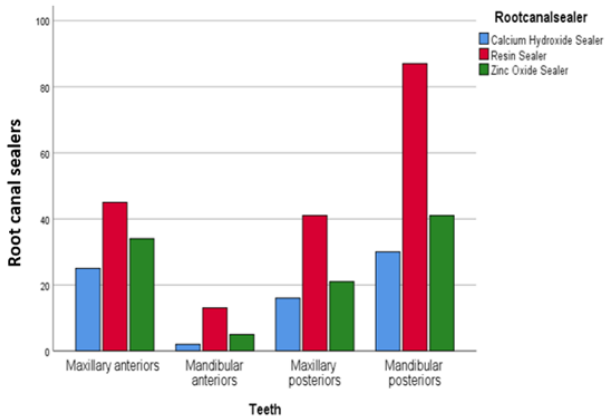

Figure 1: Represents the correlation of root canal sealers and the type of teeth

The different root sealers that were utilized by pediatric dentists were resin sealers (186 teeth), zinc oxide sealers (101 teeth) and calcium hydroxide sealers (73 teeth). Statistically significant difference was noted in comparison (P<0.05) (Table 2). The distribution of different root sealers in relation to the type of teeth are depicted in (Figure 1).

Root canal treatment engages an intensive chemo-mechanical preparation, followed by three-dimensional root canal filling. According to Ingle, about 58% of the endodontic failures may be ascribed to deficient obturation of the root canals (Rotstein and Ingle, 2019). Gutta-percha as such has no adhesive property to dentin nevertheless the obturation techniques employed. Thus, various researchers have tested many different materials to obliterate this space since the early 1800's (Hargreaves and Berman, 2015). Currently, the root canals are obturated with a core material in combination with an endodontic sealer. Endodontic sealer is presently acknowledged to be more substantial than the core root filling material itself in root canal treatment (Limkangwalmongkol *et al.*, 1992; Hargreaves and Berman, 2015; Bouillaguet *et al.*, 2008).

The present study aimed at investigating the preference of pediatric dentists' regarding the root canal sealers used for obturating the permanent teeth.

An array of endodontic sealers are accessible commercially and they are grouped based on their chemical composition. According to the present study, resin sealers, zinc oxide eugenol sealers and calcium hydroxide sealers are more commonly used by pediatric dentists.

Zinc oxide sealers have been utilized favourably for root canal obturation for over 100 years (Kaur, 2015). The major advantage of zinc oxide eugenol sealer is its antimicrobial property and acceptance among practitioners, chiefly when used with thermoplasticized root filling technique. Although it gets resorbed if extruded into the periapical tissue, eugenol is reported to leak from zinc oxide eugenol sealers, that is known to cause a lethal effect that is persistent even after the setting of material. Localized inflammation with zinc oxide sealers has been reported in soft tissue as well as in the bone. (Limkangwalmongkol *et al.*, 1991; Day, 2006).

The justification for the inclusion of calcium hydroxide into root sealers is from the perceptions of their use as bases and liners with antibacterial and tissue regenerating property, acting through the leaching of calcium and hydroxyl ions into encompassing tis-

sues (Rothier *et al.*, 1987; Tagger *et al.*, 1988). Calcium hydroxide sealers display antimicrobial action and have osteogenic-cementogenic potential (Zaki, 2018). It triggers healing by inciting hard tissue formation, and intervenes the degradation of bacterial lipopolysaccharides in this manner controlling inflammatory root resorption (Hosoya, 2004). Calcium hydroxide root canal sealers have been found to have adequate apical sealing with affidavit of calcified tissue at the apical foramen (Tronstad *et al.*, 1988; Barnett, 1989; Hosoya, 2004). Solubility is essential for leaching of calcium hydroxide and supported action, henceforth it isn't steady with the end goal of a perfect sealer (Tronstad *et al.*, 1988; Hosoya, 2004). Sealapex is principally made of calcium hydroxide and has been manifested to be cytotoxic in different studies, which likely resulted from ingredients such as polymethylene methyl salicylate resin and isobutyl salicylate present in sealapex (Chang, 2014). Another conceivable clarification for the cytotoxicity of sealapex may originate from the calcium hydroxide itself, which has high pH as stated Silva (2003).

Resin sealers have characteristics such as easy handling, potential for better wettability of the dentine and Gutta-percha surfaces, and exceptional sealing ability (Hamed and Al-Hashimi, 2014). Resin sealers are considered as the material of choice because of their capacity to infiltrate into dentinal tubules and the chance of creating monoblocks amid the obturating material and intraradicular dentin (Phukan, 2017; Baras, 2020). These properties are viewed as significant among endodontic sealers.

The investigations of Rothier *et al.* (1987) and Limkangwalmongkol *et al.* (1991) stated that the physicochemical properties of calcium hydroxide sealers were even or slightly better to that of zinc oxide sealer. McComb and Smith, 1976 reported that zinc oxide sealer depicted no adhesive properties. Besides, Gopikrishna (2011) showed that it had insignificant adhesive as well as cohesive strength.

Phukan (2017) reported calcium hydroxide sealers to have slightly greater fracture resistance in comparison to zinc oxide eugenol sealers. This could be due to the fact that calcium hydroxide sealers have lower microleakage values than zinc oxide sealers (Limkangwalmongkol *et al.*, 1991). For an endodontic sealer, the capability to withstand breakage in the consummated seal through micromechanical retention is extremely beneficial during intraoral tooth flexure or during the establishment of post and core spaces along the coronal and middle thirds of root canals (Phukan, 2017).

A wide range of sealers such as MTA, bioceramic, calcium phosphate and glass ionomer-based root sealers that are commercially usable and are not used in the current study have their own advantages and disadvantages (Singh, 2016).

There are an array of root sealers to choose from, and the practitioner must be careful and knowledgeable to explore all the attributes of a sealer before choosing the one. It should be tacky when blended to contribute acceptable adhesion between gutta-percha and the canal wall, and when set a fluid-tight seal should be attained, while also having sufficient setting time for the practitioner to make required modifications to the filling material (Bouillaguet *et al.*, 2008; McComb and Smith, 1976). Most importantly, they should have an acceptable biocompatibility, that is, non-toxic, non-mutagenic, and non-carcinogenic (Kaur, 2015).

Considering thousands of patients including children and adolescents requiring root canal treatment due to trauma; extensive dental caries as a result of poor oral hygiene, radiation therapy or developmental conditions of tooth; intentionally for prosthodontic or orthodontic management; dentists should be aware of the success rate and soundness of the materials used (Somasundaram, 2015; Mahesh and Masitah, 2018). Properly completed endodontic treatment is the cornerstone of restorative and reconstructive dentistry. The rate of endodontic success is directly proportional to a practitioner's knowledge of the canal anatomy, the techniques and materials selected while performing the procedure (Ravikumar and Sharma, 2017). It has been reported that the majority of undergraduate dental students had superior knowledge about endodontic sealers (Ravikumar *et al.*, 2017). The preference of root canal sealers for obturation depends on the clinical condition and accessibility by the practitioner.

The major shortcoming of the current study was that the reasons for utilizing specific material by pediatric dentists were not assessed. In future, long term studies comparing the properties of each material can be assessed to come to definite conclusions.

In Figure 1, where X-axis denotes the type of teeth and Y-axis denotes the root canal sealers used. Blue denotes calcium hydroxide sealer, red denotes resin sealer and green denotes zinc oxide sealer. Resin sealers followed by zinc oxide sealers were commonly used for obturation in all types of teeth and the differences were statistically significant (Chi-square test; P value=0.014- statistically significant).

In Table 2, wherein, resin sealer (186) was used more followed by zinc oxide eugenol sealer (101)

and calcium hydroxide sealer (73). Chi-square test, p-value: 0.014, ($p<0.05$), proving statistically significant.

CONCLUSION

Within the limits of the study, we can derive that resin sealers followed by zinc oxide eugenol sealers and calcium hydroxide sealers are more preferred for performing root canal therapy in both anterior and posterior permanent teeth.

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Conflict of Interest

The authors declare that there is no conflict of interest for this study.

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