

Begin with the End in Mind: A Questionnaire-Based Survey on the Restoration of Endodontically Treated Teeth among Dental Practitioners in India

Simar Kaur Manocha, Anjali Surana, Suparna Ganguly Saha, Rolly S. Agarwal, Saloni Rath, Mrinali Chaddha

Department of Conservative Dentistry and Endodontics, Index Institute of Dental Sciences, Indore, Madhya Pradesh, India.

Abstract

Background: To evaluate the knowledge and attitude towards the implementation of the current treatment concepts for the restoration of endodontically treated teeth (ETT) among endodontists, prosthodontists, and general practitioners in India. **Materials and Methods:** A Questionnaire was framed and prepared with Google Forms with 19 closed-ended questions. It was sent randomly to a total of 750 Participants (Endodontists, Prosthodontists, or General Practitioners) in India, working in various government and private hospitals or clinics. All the collected data were analyzed using the statistical package for the social sciences (SPSS) software. **Statistical Analysis:** Data from the Google questionnaire forms were analyzed by using SPSS. **Results:** The findings of this simple observational study were tabulated and the results were analyzed to get an idea about different restoration modalities for ETT among clinicians in India. The results of the present survey indicate that there is a wide variation in the approach of clinicians toward the restoration of endodontically treated among dental practitioners in India. **Conclusion:** Within the limitations of the present study, it may be concluded that the restoration of non-vital teeth varies from a completely empirical approach to biomechanically driven concepts, with the conservation of tissue and application of a modern adhesive approach.

Keywords: Computer-assisted designing/computer-assisted milling, Ceramics, Endocrowns, Fiber reinforced composite, Lithium disilicate crowns, Minimally invasive restoration, Post endodontic restoration, Sharonlay, Tabletop restoration.

INTRODUCTION

The completion of root canal treatment alone does not signify the end of patient management. The endodontically treated tooth should be restored back to form, function, and esthetics. The quality of the coronal restoration has a direct impact on the survival and success of endodontically treated tooth.^[1,2]

Root canal-treated posterior teeth are more susceptible to biomechanical failures because of the impact of the dimensions of the endodontic access cavity, alteration in moisture content and collagen structures, and loss of tooth structure during chemomechanical preparation.^[3] Adequate and timely post-endodontic rehabilitation plays a primary role in determining the long-term survival of such teeth.

Hence, definitive restoration of endodontically treated teeth (ETT) aims not only to promote coronal sealing to avoid microleakage and contamination, but it is also directed toward the replacement of lost tooth structure and protection of the remaining tooth structure against fractures.^[4]

Conventionally, root canal-treated teeth have been reconstructed using amalgam restorations, direct resin composites, partial- or full-coverage crowns, cast metal posts and cores.

In recent times, various novel techniques have been introduced depending on the amount of remaining tooth structure and the position of the tooth in the arch. These include contemporary approaches such as fiber-reinforced composites (FRC), endocrowns, crowns involving computer-assisted designing, and computer-assisted milling (CAD/CAM) techniques.

The aim of this survey, therefore, is to evaluate the preferred treatment choices for the restoration of ETT among clinicians in

Address for correspondence: Dr. Simar Kaur Manocha,
No. 26, Shankaracharya Marg, Kalaseri, Namakmandi, Ujjain, Madhya Pradesh, India.
Email: simarkaur559.sk85@gmail.com

Received: Feb. 20, 2023; **Accepted:** Mar. 22, 2023; **Published:** Jun. 02, 2023

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How to cite this article: Manocha SK, Surana A, Saha SG, Agarwal RS, Rath S, Chaddha M. Begin with the End in Mind: A Questionnaire-Based Survey on the Restoration of Endodontically Treated Teeth among Dental Practitioners in India. J Res Adv Dent 2023;14(4):1-5.

Access this article online

Website:
www.jrad.co.in

DOI:
<https://doi.org/10.53064/jrad.2022.14.4.352>

India. It also aims to assess their knowledge and understanding regarding the changing approaches in the rehabilitation of root canal-treated teeth.

Sample size and participants

The questionnaire was designed and distributed among 750 participants (prosthodontists, endodontists, and general practitioners) who work in private and government clinics in India. 410 participants entered the study voluntarily. Respondents were asked to indicate their working experience, affiliation and specialty.

Questionnaire

- The questionnaire was framed using Google Forms the link of which was sent to all the practitioners through E-mail
- The questionnaire consisted of 18 closed-ended, multiple choice, and multiple selections questions.

RESULTS

This is a simple observational study, the findings of which were tabulated to obtain an idea about different restoration modalities for ETT among clinicians in India.

Figures 1-3 show the distribution of participants based on working experience, affiliation, and specialty, respectively.

Results obtained are tabulated in Table 1.

DISCUSSION

ETT undergoes loss of tooth structure and alterations in physical characteristics, thus necessitating immediate and effective rehabilitation of tooth back to its normal form, function, and esthetics.

The present survey reveals that the majority of clinicians considered loss of tissue either at the coronal or radicular level (94.6%) and loss of tissue moisture (88.8%) as the most important factors governing the biomechanically compromised state of ETT. Literature reveals that in addition, the compromised biomechanical status of root canal-treated teeth can be attributed to risk factors such as weakening of tooth structure due to the use of endodontic chemicals such as calcium hydroxide, NaOCl, EDTA, CHX, dehydration of dentin, and transformation of collagen fibers structure due to loss of unbound water, reduction in the level of proprioception, which may lead to uncontrolled occlusal forces.^[5]

The prognosis of the ETT is dependent on various parameters such as the position of tooth in the arch, number of adjacent teeth, occlusal contacts, amount of hard tissue, remaining dentin wall thickness, and collagen degradation.^[6] In the present survey, practitioners chose more than one response. Therefore, all the mentioned factors in the survey were considered important in the following decreasing order of frequency- function and tooth position in the arch (96.6%), occlusion determinants (91.7%), parafunctional habits (90.7%), and caries risk (88.8%). Based on the study conducted by Chiau *et al.* the tooth position and the placement in the arch

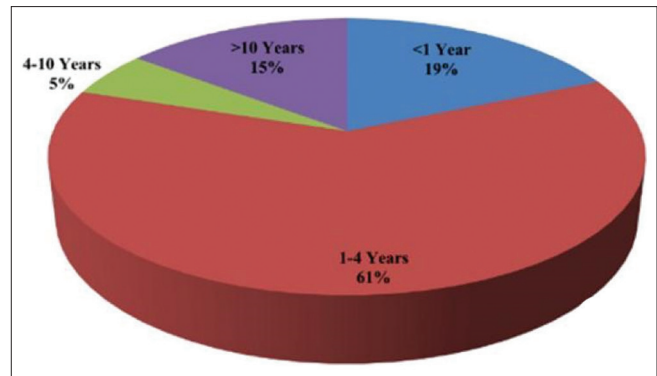


Figure 1: Distribution of study participants based on working experience

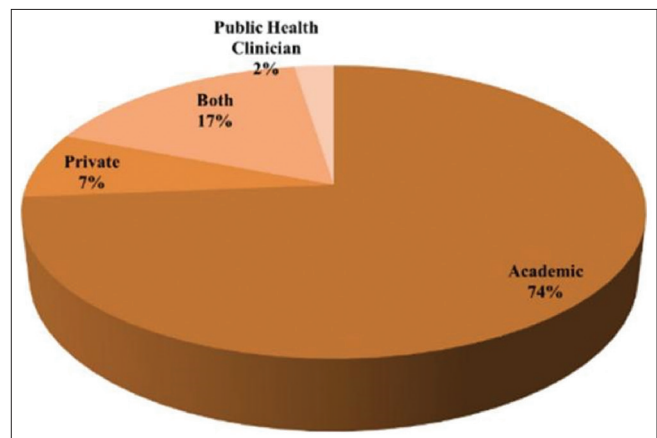


Figure 2: Distribution of study participants based on affiliation

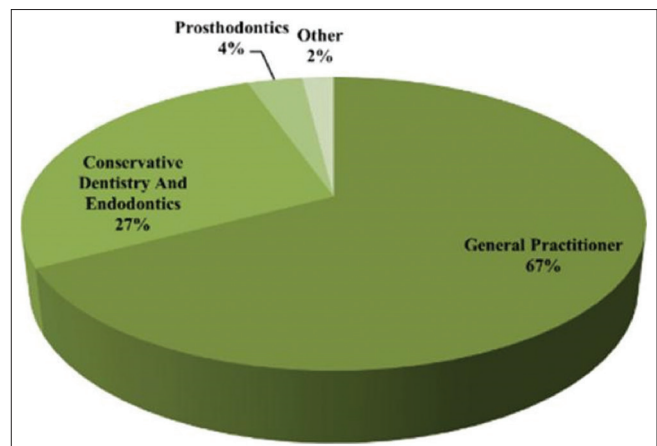


Figure 3: Distribution of study participants based on specialty

may be considered to be primary determinants when choosing a restoration due to the uneven distribution of the occlusal forces within different positions in the dental arch etc.^[7]

Anterior root canal-treated teeth with minimal loss of tooth structure and no discoloration usually do not require full coverage restoration provided that there are no parafunctional habits, this was concluded in a review article by Zarow *et al.*^[5] In the present survey, multiple factors were considered to affect the long-term survivability of root canal-treated teeth

Table 1: The results obtained

Questions	Responses	Frequency	Percentage
Why according to you, endodontically treated teeth are biomechanically compromised?	a. Loss of tissue Moisture	364	88.8
	b. Loss of collagen structure	362	88.3
	c. Loss of tissue either at coronal or radicular region	388	94.6
	d. Weakening due to medicaments and irrigants	348	84.9
What are the factors that should be considered while planning restoration of endodontically treated teeth?	a. Caries risk	364	88.8
	b. Occlusal reduction	376	91.7
	c. Parafunctional habits	372	90.7
	d. Function and tooth position in the arch	396	96.6
What are the factors that you consider to decide the necessity of placement of full coverage restoration in anterior teeth?	a. More than 50% loss of tooth structure	398	97.1
	b. All discolored tooth	20	4.9
	c. All root canal treated teeth	20	4.9
	d. Parafunctional habits	338	82.4
Choice of full coverage versus table top restoration will depend on?	a. Remaining cusp width	386	94.1
	b. Availability of enamel for bonding	358	87.3
	c. Developmental anomalies	326	79.5
	d. Shape and size of the canals	6	1.5
Which treatment modality do you prefer to restore teeth with <50% of tooth loss?	a. Fibre post and composite core	30	7.3
	b. Fibre reinforced composite	368	89.8
	c. Cast post and core	12	2.9
	d. Full crown	42	10.2
How do you restore teeth with more than 50% of tooth loss?	a. Fibre post and composite core followed by crown	370	90.2
	b. Fibre reinforced composite	16	3.9
	c. Cast post and core followed by crown	332	81
	d. Any of the above	24	5.9
What is the most recommended restoration margin for performing a safe and clean bonded indirect restoration?	a. Equigingival	354	86.3
	b. Supragingival	50	12.2
	c. Subgingival	6	1.5
How do you restore endodontically treated teeth with inadequate crown length?	a. Gingivectomy	392	95.6
	b. Orthodontic extrusion	384	93.7
	c. Osseous reduction	376	91.7
	d. Surgical extrusion	376	91.7
Where do you use sharonlay as post endodontic restoration	a. In single rooted premolars involving MO, DO, MOD lesions involving pulp	372	90.7
	b. Cases with short clinical crowns	360	87.8
	c. In premolars with 2 roots	334	81.5
	d. Multi rooted molars	4	1
Cases in which endocrowns can be used	a. Short clinical crowns	380	92.7
	b. Calcified, curved or short root canals that make post placement difficult	348	84.9
	c. Extensive loss of coronal tooth structure	350	85.4
	d. Excess interproximal space	4	1
What method do you use for fabrication of endocrowns?	a. CAD/CAM	396	96.6
	b. Pressable ceramic technology	36	8.8
What are the advantages of using fibre reinforced composite post?	a. Iso elasticity with dentin	370	90.2
	b. Decreased width of post	22	5.4
	c. Increased strength	346	84.4
	d. Increased load bearing capacity	356	86.8
What results in failure of fibre reinforced composites?	a. Weakening of interface between fibre and organic matrix due to intraoral hydrolysis	24	5.9
	b. Reduced fatigue strength	2	.5
	c. Poor bond strength	6	1.5
	d. All of the above	378	92.2
What is the preferred cementation protocol for porcelain laminates?	a. Etching the veneer with HF -> Treating the etched surface with silane coupling agent, Etching the tooth surface with Phosphoric acid-> Applying a layer of bonding agent -> luting with luting resin agent	386	94.1
	b. Luting with GIC	4	1
	c. Etching the veneer with HF -> Etching the tooth surface with Phosphoric acid-> Applying a layer of bonding agent -> luting with luting resin agent	20	4.9
	d. Etching the tooth surface with Phosphoric acid-> Applying a layer of bonding agent -> luting with luting resin agent	0	0
Selection of luting agents for ceramic crowns depend on?	a. Translucency or opacity of ceramic crowns	24	5.9
	b. Type of ceramic material used	18	4.4
	c. Crown length	8	2
	d. All of the above	360	87.8

which include the necessity to place full coverage crowns, especially in cases of 50% loss of tooth structure (97.1%) and in individuals with parafunctional habits (82.4%).

A tabletop prosthesis is a type of overlay which is a partial restoration bonded to cover all the cusps. However, it is much more conservative as it is limited to the occlusal table.^[8,9] Based on the present survey, majority of respondents agreed that the remaining cusp width (94.1%) followed by availability of enamel for bonding (87.3%) and developmental anomalies (79.5%) were the most important factors in choosing between full coverage or tabletop restoration. A study conducted by Chafii *et al.*, revealed that tabletop restorations are minimally invasive restorations which require clinical mastery and a rigorous and rather difficult preparation and bonding. Thus, there are various factors to be considered necessary for the prosthetic realization of these restorations such as coronal decay, structural defects, and non-carious lesions.

In teeth with <50% loss of tooth structure, 89.8% of dentists preferred FRC which is in contrast with a study conducted by Guldener *et al.*,^[10] in which it was stated that placement of posts is recommended in anteriors and premolars, even with <50% loss of tooth structure. However, a review by Schwartz and Robbins^[11] concluded that in case of molars, there is no need for the placement of post except in cases involving total loss of coronal tooth structure and insufficient size of the pulp chamber.

For cases with more than 50% loss of tooth structure, 90.2% of respondents prefer to use fiber post and composite core followed by full coverage crown whereas 81% still preferred to use cast post and core followed by full-coverage crown. Based on the systematic review by Zarow *et al.*, a tooth with more than 50% structure loss necessitates the use of post and core.

The finish line of the crown margin which determines the health of marginal gingiva could be subgingival, equigingival, or supragingival.^[12] In the present survey, the equigingival margin was most preferred for performing the safe and clean bonded indirect restoration. This is in contrast to a study conducted by Alafif H *et al.*,^[1] which states that tooth preparations other than supragingival are not preferred as it violates the supracrestal attached tissues (biological width) and traumatizes the surrounding periodontal tissues. However, another study by Khuller and Sharma states that from a periodontal viewpoint, both supragingival and equigingival margins are well tolerated.^[13]

It has been observed that badly mutilated teeth often pose problems during restorative procedures due to unavailability of sufficient clinical crowns. Hence, a crown lengthening procedure before restorative treatment is sometimes mandatory for the management of such teeth.^[14] Based on the present survey, gingivectomy (95.6%), orthodontic extrusion (93.7%), osseous reduction (91.7%), and surgical extrusion (91.7%) are the most commonly preferred crown lengthening procedures. According to a study conducted by Hempton and Dominici,

surgical crown lengthening of a single tooth in anterior zone has a negative esthetic impact, particularly in medium and high smiles, thus making forced tooth eruption via orthodontic extrusion the technique of choice for anterior teeth in the esthetic zone.^[15]

Sharonlay is an onlay design with the post extending into the radicular portion, mostly used in premolars with short clinical crowns which provide sufficient cervical reinforcement to counter the horizontal forces at the cervical region.^[16] According to a case report, published in 2015, Sharonlay can be fabricated for mesio-occlusal, disto-occlusal or MOD lesions in single-rooted premolars, as a post-endodontic restoration.^[17] This is in accordance with the results of the present survey in which Sharonlay was reported mostly to be used in cases of single-rooted premolars involving MO, DO, MOD lesions involving the pulp chamber (90.7%) in cases with short clinical crowns (87.8) and those with 2 roots (81.5%).

Endocrowns have been used as an alternative to conventional post and core for the restoration of endodontically treated molar teeth. These show superior esthetics and mechanical performance, compared to traditional approaches.^[18] In the present survey, 92.7% of respondents preferred endocrowns in cases with short clinical crowns, and 84.9% preferred in cases with calcified or curved roots. Based on a review by Shah *et al.*,^[19] endocrowns are indicated in molar teeth with short and fragile roots and those with excessive loss of coronal structures. They are, however, contraindicated in cases pulp chamber is <3 mm deep and the cervical margin is <2 mm wide for most of its circumference.^[19]

Endocrowns are either milled using computer-aided techniques or by molding the ceramic materials under pressure.^[20] CAD-CAM was correctly identified by majority of the respondents (96.6%) as the preferred method of fabrication of endocrowns. There are various advantages of CAD/CAM, i.e., elimination of impression material (94.6%), reduction of time-consuming laboratory procedures (94.6%), and increased patient comfort (91.2%).

In a study conducted by Fráter *et al.*, FRC have been intensively investigated with a particular emphasis on mechanical properties, such as fracture toughness, compressive strength, and load bearing capacity. Short FRC showed excellent load-bearing capacity and fracture resistance.^[21] Currently, FRC posts are widely used as they are user-friendly, are highly esthetic, and have an elastic modulus similar to that of dentin.^[22,23] In the present study, iso-elasticity with dentin (90.2%), increased load-bearing capacity (86.8%), and increased strength (84.4%) were the most commonly reported advantages of using FRC as post and core material for ETT.

The results of the present study reveal that the failure of FRC may be attributed to the weakening of In the review article by Drummond, the main cause of failure for most dental resin composites is the breakdown of the resin matrix and or the interface between filler and resin matrix.^[24] The results of the

present survey were in accordance with the above study that is the failure of FRC is mainly due to the weakening of interface between fiber and organic matrix due to intra-oral hydrolysis, reduced fatigue strength, and poor bond strength (92.2%).

Self-adhesive resin cements and universal adhesive cements are most preferred for all-ceramic restorations.^[25] The results of the present study reveal that the most preferred protocol for cementation of laminate veneers involves etching the veneer with Hydrofluoric acid followed by treatment of the etched surface with a silane coupling agent. Etching the tooth surface with phosphoric acid Applying a layer of bonding agent Luting with resin luting agent.^[26]

According to a review by Deepa Subramanian, the choice of cement is influenced by the preparation design, requirements of isolation and esthetics, and the amount of available enamel and dentin for bonding.^[27] In the present survey, majority of participants (87.8%) consider all three factors, i.e., translucency or opacity of ceramic crown, type of ceramic material used, and crown length, while selecting luting agents for ceramic crowns. The criteria for the selection of cement depend on the ease of manipulation, esthetics, resistance to compression and flexion, obtaining adequate marginal closure, high bond strength that prevents the dislocation of the restoration, and the marginal microleakage.^[28]

CONCLUSION

Although clinicians are aware of the routine methods of restoration of ETT, it is imperative that they constantly upgrade their knowledge and skills by attending symposiums and continuous dental education programs to incorporate the recently introduced technology, for example, Endocrowns, tabletop restorations, FRC, etc., in routine clinical practice.

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