

# Evidence Based Analysis of Restoration in Endodontically Treated Teeth

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**Abstract:** Aim: The aim of this study was to conduct a Questionnaire - based survey on the knowledge of post endodontic restoration among different practitioners, post graduate students and intern in Telangana state. Methodology: This cross-sectional questionnaire study was conducted among interns, postgraduate students, general practitioners of Telangana state to know their awareness about post endodontic restorations in anterior and posterior teeth. This survey consists of 22 validated questions regarding post endo restorations in endodontically treated teeth, questionnaire was available by online mode and their responses were evaluated after 1 week. Results: Out of 220 questionnaires sent through online, 206 were finally included for the study. According to the results of this survey, post graduate students and speciality practitioners were aware of conservative approaches to treat endodontically treated teeth such as inlays, onlays, multiple post and core, whereas interns and general practitioners preferred full coverage crowns and results were statistically significant. Additionally, it demonstrates that no statistical significance was found when questions about the length of post-space preparation and the ferrule impact were asked. Conclusion: The findings of this survey concludes that the post graduates and speciality practitioners are more aware about the conservative preparations of endodontically treated teeth when compared to interns and general practitioners.

**Keywords:** ETT, endodontically treated teeth, RCT, root canal treatment

## 1. Introduction

Root canal treatment (RCT) is the most common treatment of practice in dentistry till date to salvage a tooth decay. It is considered mainly in teeth which are significantly affected by caries, multiple restorations or fractures. The constant thrive to deliver best outcomes to the patients mainly depends on wide number of variables such as extension of carious lesion, residual tooth structure remaining, proximal contacts, location of tooth, type of restorative material used, post endodontic treatment, ferrule effect<sup>1-3</sup>. Hence a thorough knowledge of these variables is necessary to best retain an ETT.

But certain drawbacks of endodontic procedure include weakening of tooth structure due to irreversible chemical-physical alterations i.e. dehydration of dentin, collagen alteration, and especially bio-mechanical changes i.e. loss of tooth structure in order to provide optimal access cavity. Thus, there is a necessity to rebuild and rehabilitate this lost tooth structure which reduces the risk of the propensity to fracture and improves function and longevity of tooth in oral cavity.

Therefore, proper RCT and the subsequent post-endodontic restorative treatment with proper coronal seal significantly influence the success of ETT. Ray HA et al in 1995 concluded that more emphasis should be placed on coronal restoration as a means to secure the successful results of the endodontic treatment<sup>4</sup>.

Innovations in material sciences and clinical techniques have expanded the number of treatment options available for ETT<sup>3</sup>, but the clinician should have the expertise to know and utilise different treatment options depending on the remaining tooth structure. There are various options that can be chosen by the practitioner to manage the post endodontic restoration such as amalgam restoration, composite restoration, inlay, onlay, sharonlay or overlay, post and cores, crown placement and others based on different case

scenarios. (Biacchi, Mello and Basting, 2013; D and Rihab, 2019)

In the case of root canal treated anterior teeth with relatively minimal coronal damage, tooth colored composite resin or glass ionomer cement restoration is indicated. Tooth with moderate coronal damage requires composite resin restoration with partial coverage crown. In cases of significant coronal damage with loss of marginal or incisal edges can be restored with veneers, full crowns or in combination with custom-made/ prefabricated post and cores (Ratnakar P et al 2014).

The posterior teeth that underwent endodontic treatment which have minimal access cavity preparations can be restored with amalgam, composite resin or cast metal. Whereas moderately defective teeth can be repaired using resin composite core or amalgam coronal-radicular core followed by full coverage prosthesis, and aforementioned assertion shows that an important most conservative approach is ceramic onlay/inlay/overlay. As of today, there is a paradigm shift towards conservative treatment options to strength and reduce risk of fracture after root canal treatment. Endocrown is a more conservative option to maintain maximum cervical tooth structure by utilizing the internal wall of the pulp chamber for retention (Dennis Fasbinder in 2017)

According to literature, when restoring ETT the clinician should consider the following factors are to be considered as to: What type of final restoration is indicated, Is the post required? The answer to the former question relies on different factors like amount of remaining tooth structure, location of tooth in dental arch, the tooth's functional requirements, to restore the tooth's forms, function, and aesthetics, to prevent bacterial micro leakage into the root canal system, to preserve periodontal health, to prevent any restorative fracture and wear, and to guard against abrasion of the antagonistic teeth.<sup>5</sup>

Similar investigations showed that a substantial root filling had a greater impact on treatment outcomes than the quality

of the coronal restoration, (Tronstad et al., 2000; Kirkevang et al., 2000;) but they also indicated the significance of a good recovery to the periapical health. (Segura-Egea et al., 2004)

Various options are available for post endodontic restoration including post and core, partial or full coverage crowns, direct resin composites or amalgam fillings, endocrowns depending on the clinical scenario<sup>6-12</sup>. With this background the present study was undertaken to determine the frequency of preferred methods, materials, timing and other concerning factors regarding restoration of ETT.

## 2. Materials and Methods

A total of 220 randomly sample were initially included for the cross-sectional online questionnaire study among interns, postgraduates of various departments from dental colleges, general practitioners in public and private sector, specialised practitioners of Telangana state members, 14 were excluded due to incomplete answers and a final sample of 206 were included for the further study.

A questionnaire with 22 validated questions was framed regarding knowledge on post endodontic restoration for anterior and posterior teeth. Individuals were contacted via electronic media and explained that study would be available for 1week via goggle forms platform. Response to each question in the questionnaire were summarized and expressed in relevant proportions.

## 3. Results

A total of 206 individuals including 60 dental interns, 56 postgraduates, 43 general practitioners, 47 speciality practitioners participated in the study. Most of the members participated in the study i.e., 116 members had 1-5 years of experience while 60 members had 5-10 years, 25 members had 11-15 years of experience.

When questioned about how long they wait for final restoration after root canal completion, 79.6% of them would like to wait for less than 1 week and remaining 20.4% would wait for greater than 1 week.

### General Perspective on Post Endodontic Restoration:

After endodontic treatment of the anterior teeth, the majority of participants (48.5%) chose full coverage crowns when there was >50% of tooth structure left. Interns (43% of them) overwhelmingly preferred this choice. 48.1% chose composite restoration as a response. The majority of PGs (45.5%) chose this choice, which suggests a statistical significance of 0.00.

Post and core (53.9%) was the treatment of choice for PGs (45.9%) and specialist practitioners (28.8%) when more than 50% of the tooth's structure was lost. GPs and interns, however, opted for full coverage crowns. These results suggest to a 0.00 statistical significance.

Following root canal therapy, full coverage restoration (65%) was the most frequently used restorative material for posterior teeth. Interns (33% of those who chose this)

dominated. The second most popular type of restoration is indirect (23.8%), which was chosen by PGs (44.9%). There was zero statistical significance.

### Post as post Endodontic Restoration:

Post reinforces endodontically treated teeth and lowers the likelihood of fracture, according to 47.1% of respondents. However, 40.8% of respondents, particularly postgraduate students, chose "may be," and 12.1% of interns said they had no idea.

53.9% of anterior teeth with posts that are over 5 mm in length and 34% of anterior teeth with posts that are the same length as their crowns. However, the majority of the interns were not familiar with the position's premise. While 47.1% of the candidates were selected in descending order of preference, i.e., 35.1% postgraduates, 32% specialty practitioners, 22.7% general practitioners, and 10.3% interns, the time of placement of the post was immediate for them. Postgraduates and general practitioners, however, have a diverse approach, in that they would prefer to start after one week. Few interns (15 members) liked to put posts after one month, however the majority of interns (32 individuals) were completely unaware of the concept.

### Endocrown as Post Endodontic Restoration:

The knowledge of the clinical application of endocrowns was 4 intact walls with less axial crown height by most of the participants i.e., 39.8% of which 42.7% of the post graduates and 39% of the speciality practitioners opted it. The next option chosen was loss of 3 axial walls & 1 intact wall by 31.1% of which 34.4% general practitioners and 31.3% interns. But most of the interns and general practitioners were unaware of the concept.

The finish line for endocrowns preparation was circumferential butt joint by 41.7% followed by 32.5% shoulder, 25.7% chamfer finish line.

The commonly preferred tooth indicated for endocrowns by the participants was 61.7% molars, 29.1% premolars, 5.8% anteriors and 3.4% has no idea.

### Inlays and Onlays as post Endodontic Restoration:

In posterior teeth, the inlays or onlays are also chosen as PER. But the majority of them (55.3%) do not favour them. The causes of these are decreased fracture resistance (17.5%), higher coronal leakage (17%), and lower retention than crown (19.4%).

When molars are severely damaged and have lost more than 70% of their tooth structure, post and core restorations are frequently selected (36.4%), followed by multisection/single auxiliary restorations (19.4%). On the other hand, 38.3% favoured extraction performed primarily by interns and general practitioners. In contrast, 37% of PGs selected post and core, and 55% selected multiple post and core.

## 4. Discussion

This cross-sectional study was conducted to determine the awareness, current state of knowledge, and perspectives of dental practitioners about restoration of endodontically

treated teeth in practice. According to the findings of this study, dental practitioners appear to have insufficient theoretical knowledge and clinical experience especially about the conservative approaches in restoring ETT such as inlays, onlays, endocrowns, sharonlay.

When asked about choice of restorative material in ETT anterior teeth, when <50% of tooth structure lost, most recommended is tooth coloured restoration, in the current survey majority has chosen full coverage crown followed by direct composites with statistical significance, but 44% of interns choose full coverage crown, which is in contrast to **Ratnakar p et al (2015)<sup>13</sup>**, **Alzain et al (2018)<sup>14</sup>**, where 94% of participants choose tooth coloured restoration.

when >50% of tooth structure lost, most of the respondents selected post, core and crown, whereas 48% of interns choose full coverage crowns, which is in contrast to **Ratnakar p et al (2015)<sup>13</sup>**, majority of post graduates chose cast post and crown, where 76% of interns opted for post, core and crown.

Other studies have found that when coronal damage is modest, conservative therapy in the form of composite resin or glass ionomer restorations should be explored.<sup>15, 16</sup> When more than half of the coronal component of a tooth is lost, a post and core foundation is advised. The post's main purpose is to keep the core build-up in a tooth that has lost a lot of coronal tooth structure.

For enlargement of the restorative cycle of teeth by preserving and conserving sound tooth structure with modern adhesive partial restorations (preservation of extension) instead of tooth volumetric reduction for full contoured crowns (extension for prevention). Considering the fact that indirect onlays conserve more healthy tooth tissue and provide cuspal coverage to shield weakened cusps, partial restorations like them have been advocated as an alternative to full crowns according to **Carvalho MA (2018)<sup>17</sup>**. In the current study 65% of respondents chosen for full coverage crowns, 55% of interns and general practitioners opted for full crowns where as 45% of post graduate participants choose indirect restorations as conservative approach

**Sultanah Al Mobarak et al s (2017)<sup>18</sup>** advocated in their study that 46.3% of the participants would restore an endodontically treated teeth with a crown on molars.

**Neha Mundhada et al (2019)<sup>19</sup>** 43.6% of practitioners preferred to provide all ceramic crowns in anterior and 64.2% chose full crowns in posterior teeth followed by 23% choose direct restorations. Very less incidence was reported for the use of other restorative options. **Mannocci et al in 2014<sup>20</sup>** suggested that the use of composites has also allowed the clinicians to restore teeth with adhesive techniques that would otherwise require extensive and destructive mechanical retentions.

Core is like 'Build-up' which contributes significantly to the strength and retentiveness of the crown preparation. In this study, on being questioned regarding the knowledge on the core build up material, 64% - 66% of practitioners choose

composite with different types of teeth followed by GIC and amalgam in only premolars and molars with statistically significant ( $p < 0.001$ ) difference which is supported by **Neha Mundhada et al.<sup>19</sup>** According to the study conducted in Manchester, composite resins intended to be used in anterior teeth by 51% and amalgam in posterior teeth by 44% practitioners. In the United States study (1994), 52% of practitioners were found to prefer amalgam for core build-up procedures in posterior teeth.

**S.R. Habib et Al (2014)<sup>21</sup>**, the principal purpose of a post is to retain a core through radicular anchoring and the post in ETT does not improve the resistance to fractures. **A. Polesel et al (2014)<sup>22</sup>**, the second reason why posts are used is to strengthen the restoration complex/coronal dentin, which is subjected to tangential stress. In this study, on being questioned regarding the post, it reinforces ETT and reduces fracture probability, a number (80%) of general dentists and specialist dentists in the current survey believed that a post always or sometimes, reinforces an ETT with no statistical significance (among post graduates 30% opt for yes, 31 % opted for may be, among interns 20% choose yes, 18% choose may be, which shows no statistical significance). In contrast to **LL SEOW ET AL (2003)<sup>23</sup>** Most practitioners (61%) choose posts do not strengthen endodontically treated teeth and 20% being uncertain in this matter. **A Ranganath et al (2016)<sup>24</sup>**, 98% of Endodontists and 96% of Non-Endodontists believed in posts being the ultimate factor in reinforcing the endodontically treated teeth. Presence of ferrule (minimum 2 mm) is a decisive factor, has a positive effect on fracture resistance of ETT, results in an elevation in resistance form of the crown from the extension of dentinal tooth structure.<sup>22, 25</sup> On being questioned in current survey about Ferrule effect, 45% choose always, 40% choose sometimes, with no statistical significance ( $p > 0.001$ ). In contrast to **S.R. Habib et al (2014)<sup>21</sup>**, 78% of the participants choose ferrule effect has increase in fracture resistance of ETT.

Based on the analysis of current study, the inference is uncertain/ unclear on knowledge on whether post reinforcing ETT or not and role of ferrule effect in ETT among different practitioners.

**A. Polesel et al (2014)<sup>22</sup>** The greater the loss of coronal material, the greater the depth of post cementation. With severely compromised components, it may be necessary to use more than one posts in different canals. Long posts distribute the load over larger areas and increase the adhesion surface. In the current study when asked about preference as post endodontic restoration in case of grossly decayed molars, (loss of more than 70% of tooth structure), 45% of interns and 38% of general practitioners choose for extraction whereas 83% of post graduates choose post and core and multiple post and core, with statistical significance ( $p < 0.001$ ). In contrast to **Spicciarelli V (2020)<sup>26</sup>** Multi-post design improved fracture resistance mostly in maxillary premolars lacking both marginal ridges.

Similarly, observation was made by the **Qulam. M et al (2021)<sup>27</sup>**, **Sevimli et al (2015)<sup>28</sup>** suggested that endocrown can be utilised as a prosthetic alternative in incisors, premolars, and molars with significant tissue loss. The tiny

pulp chamber in premolars, according to Bindl et al(2005)<sup>29</sup> study, restrict the adhesive and resin cement binding strength. According to Lander et al (2008)<sup>30</sup> clinical research, suggested a differing premolar crown configuration with larger height than breadth may increase the risk of rupture and displacement. As a result, the endocrowns should only be used on molars, especially those with shorter crowns, calcified root canals, or narrow canals<sup>31</sup>.

## 5. Limitations of the Study

This is a self-reporting research. As a result, there's a chance of bias in the response. This study's generalizability is restricted since it solely covers the perspectives of patients in Telangana state. Different patients in different areas of India would have different perspectives. More large-scale research should be conducted to have a better understanding of the post- endodontic care among the post-graduates and undergraduate practitioners.

## 6. Conclusions

Within the study's parameters, dental general practitioners had less training and experience with endocrown post-endodontic restoration. In terms of knowledge, postgraduates and specialty practitioners demonstrated an appropriate degree of understanding and awareness of the use of inlays, onlays, post and core, endocrown as a post-endodontic treatment option.

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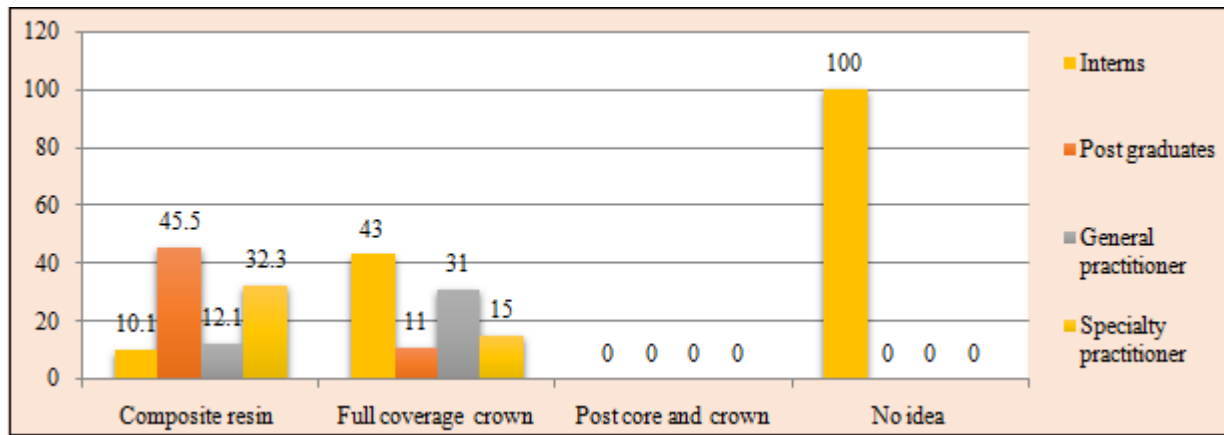
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## Annexures

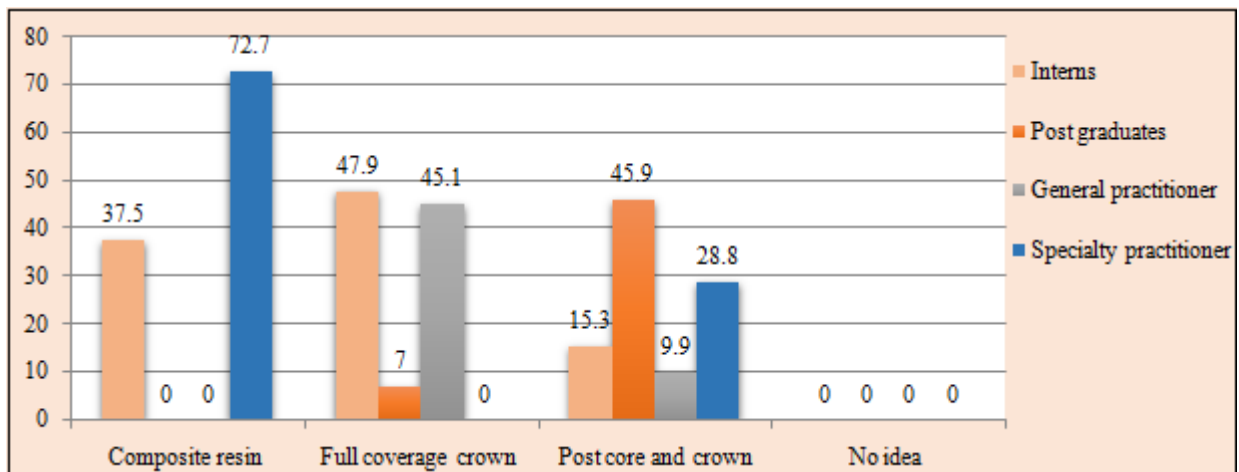
**Table 1** Frequency based on the response to Q4, Q5, Q6, Q8, Q11, Q21, Q22 and its comparison based on type of practitioner

Question	variable	I	PGs	GP	SP	Total	P Value
4. Which restorative material you use for endodontically treated anterior teeth when more than 50% of tooth structure is remaining?	Composite resin	10	45	12	32	99	<b>0.000*</b>
	Full coverage crown	43	11	31	15	100	
	Post core and crown	0	0	0	0	0	
	No idea	7	0	0	0	7	
5. Which restorative material you use for endodontically treated anterior teeth when <50% of tooth structure is remaining?	Composite resin	9	0	0	24	33	<b>0.000*</b>
	Full coverage crown	34	5	32	0	71	
	Post core and crown	17	51	11	32	111	
	No idea	0	0	0	0	0	
6. What type of final endodontic restoration do you routinely provide for root canal treated posterior teeth?	Direct restoration	0	8	5	5	18	<b>0.000*</b>
	Indirect restoration	10	22	5	12	49	
	Full coverage restoration	45	26	33	30	134	
	No idea	5	0	0	0	5	
8. Do you believe that post reinforces ETT and reduces fracture probability?	Yes	20	30	22	25	97	<b>0.000*</b>
	No	0	0	0	0	0	
	May be	15	26	21	22	84	
	No idea	25	0	0	0	25	
11. What is the most appropriate length of the post of anterior teeth?	1-3mm	0	0	0	0	0	<b>0.000*</b>
	>5mm	15	44	19	33	111	
	Same length as crown	20	12	24	14	70	
	No idea	25	0	0	0	25	
21. Do you prefer inlays or onlays as post endodontic restoration in posterior teeth? If no, why	Less retention than crown	24	0	11	5	40	<b>0.000*</b>
	Less fracture resistance	18	6	8	4	36	
	Increase coronal leakage	0	8	21	6	35	
	All of the above	7	42	3	32	84	
	No idea	11	0	0	0	11	
22 In case of grossly decayed molars, loss of more than 70% of tooth structure, what do you prefer as post endodontic restoration?	Post and core	10	28	15	22	75	<b>0.000*</b>
	Multisection /single auxillary	0	22	0	18	40	
	Extraction	38	6	28	7	79	
	No idea	12	0	0	0	12	

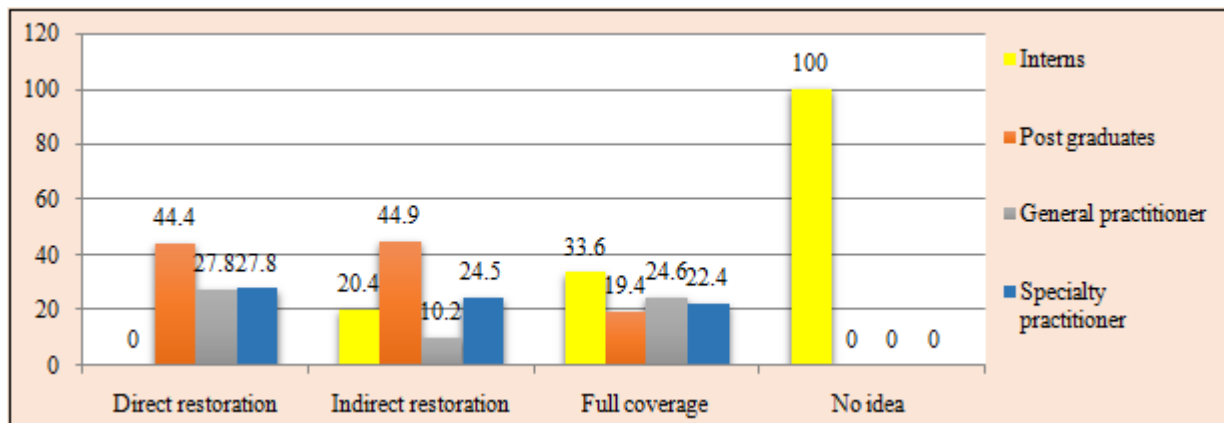
Chi square test;  $p < 0.05$  considered statistically significant



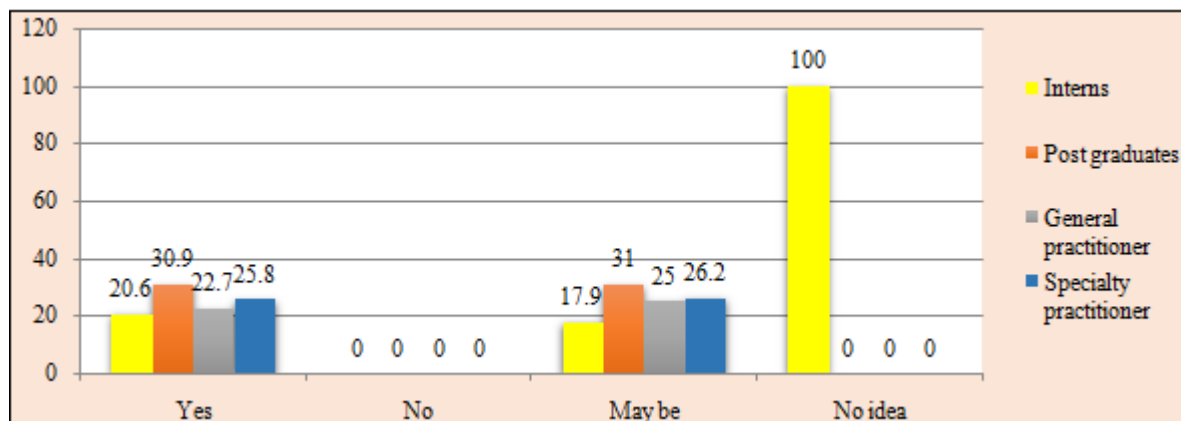
Graph 1: Frequency based on the response to Q4 and its comparison based on type of practitioner



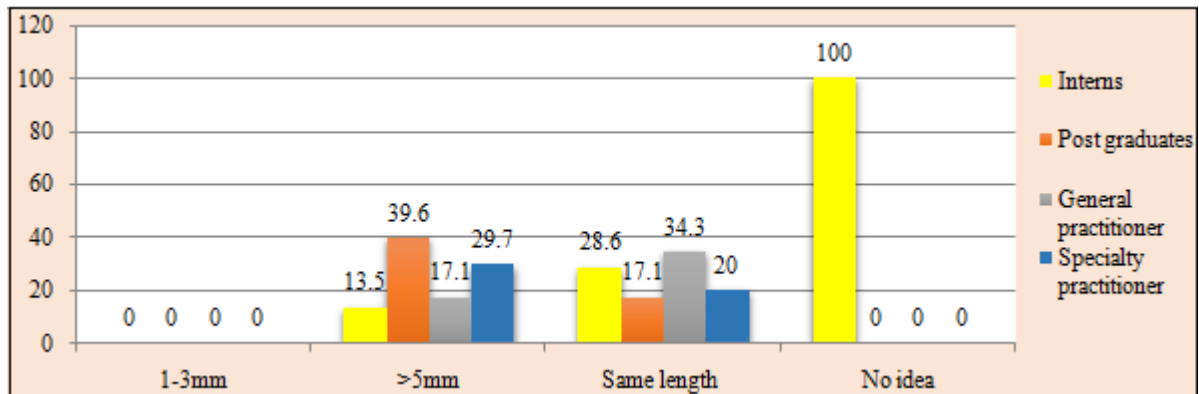
Graph 2: Frequency based on the response to Q5 and its comparison based on type of practitioner



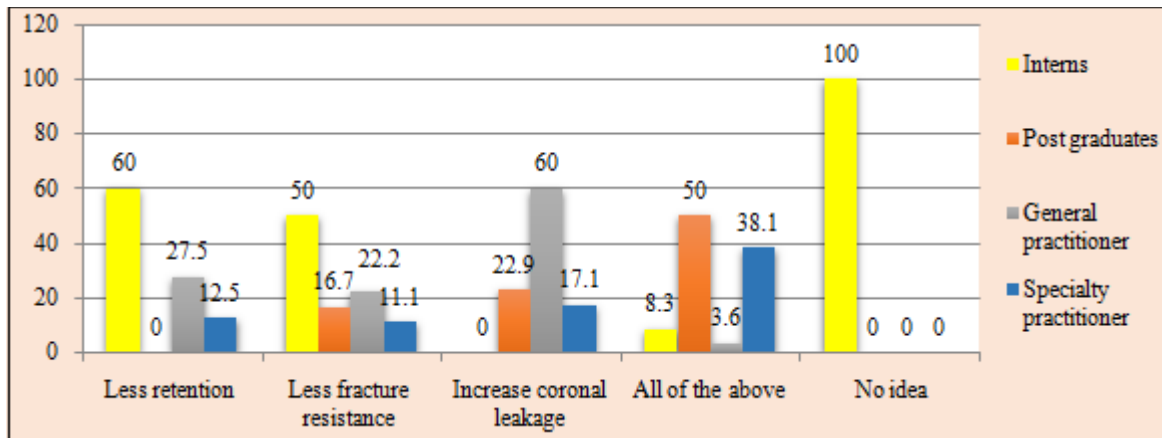
Graph 3: Frequency based on the response to Q6 and its comparison based on type of practitioner



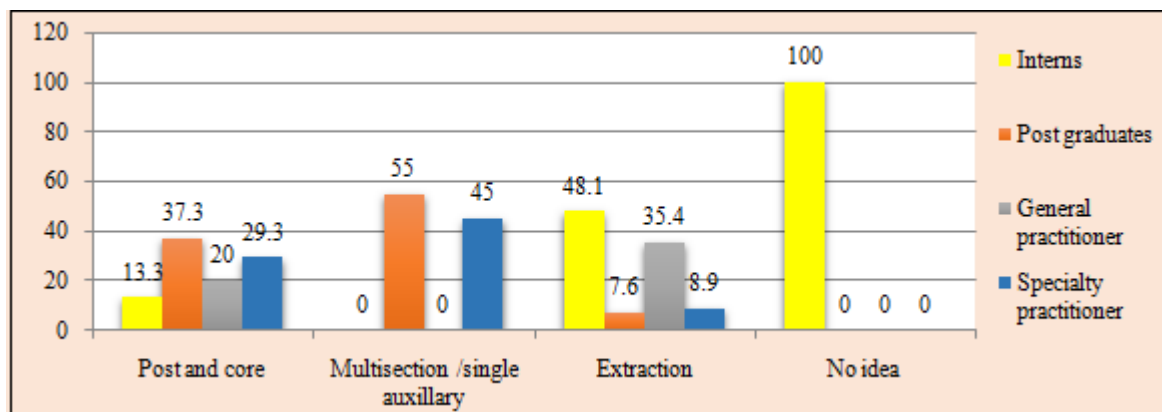
Graph 4: Frequency based on the response to Q8 and its comparison based on type of practitioner



**Graph 5:** Frequency based on the response to Q11 and its comparison based on type of practitioner



**Graph 6:** Frequency based on the response to Q21 and its comparison based on type of practitioner



**Graph 7:** Frequency based on the response to Q22 and its comparison based on type of practitioner

#### General Information Of Practitioners

1) Type of practitioner

- ☐ Interns  
☐ Post graduates  
☐ General practitioner  
☐ Speciality practitioner

2) How many years have you been practicing?

- ☐ 1 - 5 years ☐ 5-10 years ☐ 11- 15 years ☐ greater than 15years

#### General Perspective On Post Endodontic Restoration

3) How long do you usually wait to provide the final restoration after completion of root canal treatment?

- ☐ Less than a week

- ☐ > 1 week  
☐ 1 month  
☐ > 1 month

4) Which restorative material you use for endodontically treated anterior teeth when more than 50% of tooth structure is remaining?

- ☐ Tooth colored composite resin restoration  
☐ Full coverage crown  
☐ Post, core and crown  
☐ No idea

5) Which restorative material you use for endodontically treated anterior teeth when <50% of tooth structure is remaining?

- ☐ Tooth colored composite resin restoration  
☐ Full coverage crown  
☐ Post, core and crown  
☐ No idea

6) What type of final endodontic restoration do you routinely provide for root canal treated posterior teeth?

- ☐ Direct restoration (Amalgam/Composite/GIC/other)  
☐ Indirect tooth colored restoration (inlays, onlay, over lay)  
☐ Full coverage restoration  
☐ No idea

7) Which material do you prefer for core build-up procedures?

Type of teeth ☐ Incisors ☐ Canine ☐ Premolars/molars

Material:

- ☐ Composite  
☐ Glass ionomer cement  
☐ Amalgam  
☐ No idea

#### POST AS POST ENDODONTIC RESTORATION

8) Do you believe that post reinforces ETT and reduces fracture probability?

- ☐ Yes  
☐ No  
☐ May be  
☐ No idea

9) Do you routinely place a post in ETT?

- ☐ Always  
☐ Rare  
☐ Never  
☐ Don't know

10) Do you believe that Ferrule effect can increase fracture resistance in ETT?

- ☐ Always  
☐ Sometimes  
☐ Never  
☐ No idea

11) What is the most appropriate length of the post of anterior teeth?

- 1 - 3mm  
 >5mm  
 Same length as crown  
 No idea

12) When do you prefer to place the post?

- ☐ Immediately after root has been filled  
☐ After a week  
☐ After a month  
☐ No idea

13) Which cement do you prefer for luting the post?

Fiber post

cast post

☐ Glass ionomer cement

☐ Zinc phosphate cement

☐ Resin cement

☐ Zinc oxide Eugenol

☐ No idea

#### **Endocrown as Post Endodontic Restoration:**

14) Awareness on endocrown as post endodontics management in their previous training or experience

☐ Yes.

☐ No

15) clinical application of endocrown for loss of tooth structure,

☐ 'loss of three axial walls and one intact wall',

☐ 'loss of two axial walls and two intact wall'

☐ 'four intact wall less axial crown height'

☐ No idea

16) Finish line used in endocrown tooth preparation,

☐ Circumferential butt joint,

☐ Shoulder

☐ Chamfer

☐ No idea

17) Retention of endocrown

☐ Adhesive as luting agent,

☐ Pulpal chamber

☐ Adhesive and pulpal chamber

☐ No idea

18) Indication for endocrowns in endodontics practice,

☐ Anterior teeth

☐ Premolars

☐ Molars

☐ No idea

#### **INLAYS AND ONLAYS AS POST ENDODONTIC RESTORATION**

19) Do you prefer inlays or onlays as post endodontic restoration in posterior teeth?

☐ Yes

☐ No

20) If yes in which conditions you prefer for onlays?

☐ In case of MOD cavities

☐ Loss of 1 cusp, with less axial crown height

☐ More than 50% of crown structure is lost

☐ All of the above

☐ No idea

21) If no, why

☐ Less retention than crown

☐ Less fracture resistance

☐ Increase in rate of coronal leakage

☐ No idea

22) In case of grossly decayed molars, loss of more than 70% of tooth structure, what do you prefer as post endodontic restoration?

☐ Post and core

☐ Multi section post and core /Single core with single auxiliary post

☐ Extraction

☐ No idea