

CORRELATION BETWEEN THE PRESENCE OF DEAD SPACE IN CAST POST RESTORATIONS AND THE TYPE OF OBTURATION DONE

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Abstract

Introduction: Although post and core systems in endodontics are wildly attractive fields of study, there continues to be a paucity of information regarding the difference in clinical outcomes based on the type of obturation employed.

Aim: The aim of our current study is to assess whether or not the type of obturation done had an effect on the prevalence of dead space in cast post restorations.

Materials and Methodology: A retrospective cross-sectional study was conducted using the patient records of 80 patients with image-documented cast post placement entries from Saveetha Dental College between April 2020 and March 2021. Relevant data such as patient age, sex, type of obturation done and the tooth's post endodontic periapical radiograph for assessing the prevalence of dead space was acquired. These radiographs were checked for the differences in radiodensity within the root canal system to pinpoint the presence or absence of dead spaces. The data was recorded in a Microsoft Excel spreadsheet and was exported to the Statistical Package for the Social Sciences for Windows.

Results: The findings of our study suggest that there is no statistically significant association between the type of obturation done and the prevalence of dead space in cast post restorations.

Conclusion: Within the limitations of the study we may conclude that dead space severely compromises the treatment outcome for post and core restorations and that the type of obturation technique employed does not have a significant effect on it. Thus, there is no preferred obturation technique for minimising dead spaces.

Keywords: Cast Post; Dead Space; Single Cone Technique; Lateral Compaction; Innovative.

Introduction

A post and core system is a type of dental repair that is used when there is not enough healthy tooth structure to support a traditional crown (1). A post is inserted and cemented into a prepared root canal to secure a core restoration, which then holds the final crown in place (2). The endodontic post's primary function is to keep the core restoration and crown in place, and its secondary function is to divert unfavourable stresses down to the root, thus reducing the likelihood of coronal fracture (3). When deciding whether or not a tooth necessitates a post and core aided crown rather than a traditional crown, we must first check for some requirements such as the presence of an adequate ferrule, the length of the root canal and whether or not it is long enough to retain a post (4), the curvature and overall gross anatomy of the root canal

apparatus (5), the amount of radicular dentin thickness for the preparation of space for the post and the practical restorability of the tooth in question among several others (6).

The benefit of inserting a post into a root canal system is that the crown will be better retained. However, there are some drawbacks to using post and core based restorations: post space preparation increases the risk of root perforation and the likelihood of a tooth fracture, apicoectomy becomes more difficult and it is very subtractive as it requires excessive tooth structure removal (7,8). This is also why the presence of a ferrule is critical, since it can substantially improve the post's resistance to fracture (9).

As molars and premolars are multi-rooted teeth with large pulp chambers capable of providing enough retention for the core and thus the final crown, posts are more commonly needed for anterior teeth than for posterior teeth. This is because anterior teeth are much smaller and thus offer less retention (10). When a core cannot be retained on a posterior tooth and a post is required, only one post should be utilised per tooth, and it should be inserted in the biggest canal available. This is due to the fact that making many post preparations on a single tooth will result in excessive dentin removal, thus increasing the risk of root fracture (11).

There are two types of post and cores: prefabricated and cast (12). Both of these systems have a post that is inserted into the root canal system of the tooth to be treated. So the tooth must first undergo endodontic therapy (13). After the endodontic procedure has been done and the root canal is obturated with gutta percha, some of the material is removed from the root canal space (14). This removal of gutta percha can be done mechanically with Gates Glidden drills or Peeso Reamers (15), thermally with System B Tips (16) or chemically with chemical solvents when suitable precautions have been made to control the softening depth (17).

The space that now persists coronal to the remaining gutta percha material, is called the 'post space' and this is where we place our post. It is necessary to retain a sufficient amount of root filling material in the apex to maintain an efficient apical seal. This procedure does not even require a local anesthetic as teeth are non-vital post root canal treatment and thus no pain is perceived (18).

In situations where the post space that is created is not a good fit for a prefabricated post material, we can custom make a cast post for the tooth (19). For this a resin pattern is produced by placing a burnout post in the post space and the resinous material is used to further build up the tooth to the required dimensions (20). The resin pattern is then attached to a sprue former and a cast post is fabricated using the lost wax technique from metals like gold or titanium. A polyvinyl siloxane impression can also be taken for post fabrication in the dental laboratory (21).

Our team has extensive knowledge and research experience that has translated into high quality publications (22–31),(32–35),(36–40)(41). Moshonov *et al.* conducted a well designed study in 2005 (42), where they analysed whether or not the distance between the post and the residual gutta percha had a role to play in the clinical outcome of endodontic treatment. This distance is what we refer to as 'dead space', which can only be appreciated with the aid of a radiograph. They found that even the smallest dead space considerably compromised the survival of a root canal treated tooth and concluded that all posts placed should be in contact with the residual

gutta percha. This space also acts as a reservoir for anaerobic bacteria and increases the chance of microleakage because of the absence of a hermetic seal. The article did not elaborate any further with respect to different clinical scenarios. Thus the aim of our current study is to assess whether or not the type of obturation employed had an effect on the prevalence of dead space in endodontically treated teeth using cast post restorations.

Materials and Methodology

Study Design and Setting

This retrospective cross-sectional institution based study examined the records of 88,950 patients from April 2020 to March 2021 undergoing various treatments at Saveetha Dental College, Chennai, India. Ethical approval was obtained from the Institutional Ethics Committee. The study population included patients with established records of cast post placement following root canal therapy as mentioned in the hospital's online database - Digital Information Archiving System (DIAS) of all ages. They were separated according to the type of obturation employed, gender and the presence or absence of dead space. Mentally or physically disabled individuals were excluded from the study.

Data Collection

The records of patients who visited the hospital from April 2020 to March 2021 were analysed and were used to identify 80 patients with image-documented cast post placement entries in the hospital database. Relevant data such as patient age, sex, type of obturation used by the clinician and the tooth's post endodontic periapical radiograph for assessing the presence of dead space was acquired. Repeated patient records and patients with incomplete treatment statuses were excluded. The data obtained was verified by an external reviewer.

Radiographic Analysis

80 intraoral periapical radiographs that were taken in Saveetha Dental College were analysed for the prevalence of dead space following cementation of the cast posts. The radiographs were labelled with numbers and saved in a file to maintain patient confidentiality. The radiographic findings were re-verified by an external reviewer to dismiss the chance of perception errors. The differences in radiopacity between the remnant gutta percha and the cast posts served as our means for appreciating the presence of dead space in custom made post systems. Scaling tools were not employed because the study only mandates the presence or absence of dead space and not the measurement of its dimensions.

Statistical Analysis

The obtained data was recorded in a Microsoft Excel 2016 spreadsheet (Microsoft Office 10) and was later exported to the Statistical Package for the Social Sciences for Windows (Version 20.0, SPSS, Inc., Chicago, U.S.A.) and was then subjected to statistical analysis. A Chi Square test was used with the level of significance set at $p < 0.05$.

Results and Discussion

The final dataset consisted of two equal groups of a predominantly South Indian population with established records of completed cast post placement following root canal therapy with no

age or tooth number criteria. The first group - 'Matched Taper Single Cone Technique' had 40 patients who received a custom made post following root canal therapy done by single cone obturation while the second group - 'Lateral Compaction' had another 40 patients who received a custom made post following root canal therapy done by the lateral compaction method of obturation. Both groups were analysed for the presence or absence of dead space using periapical radiographs, and thus the prevalence of dead space in each type of obturation group was studied and then compared with one another to see if different methods of obturation had a role to play in the incidence of dead space. In IOPARs, custom made posts appeared highly radiopaque with respect to the remnant gutta percha. This difference in radiopacity provided a means for us to radiographically assess the terminal point of the post and the beginning of the gutta percha seal. The dead space was the area of radiolucency that existed between the coronal most part of the remnant gutta percha and the apical most part of the employed post.

From the results Figure 1 it is evident that we have chosen to split the total 80 cast post cases into 2 groups based on the type of obturation technique used - 'Matched Taper Single Cone Technique' and 'Lateral Compaction' - with 40 samples each for bias-free comparison of the prevalence of dead space between them. Figure 2 describes the gender distribution of our study population. Among the total number of participants, 38.8% were females while 61.3% were males.

The results of Figure 3 suggest that dead space is more often present (73.8%) than absent (26.3%), irrespective of the type obturation done which is similar to the findings of Grieve and McAndrew *et al.* who reported that dead space was very highly prevalent among all the cases they examined in a study conducted in 1993 (43) and Mendonca *et al.* in 2017 (44). This could possibly be due to the fact that most of these treatments were carried out by undergraduate students.

Figure 4 explains that on associating the prevalence of dead space with the type of obturation method used, 31 out of 40 cases obturated using the single cone method and 28 out of 40 cases obturated using lateral compaction had dead spaces. There is no statistically significant relevance attached to these findings as proved by our Chi Square test in Table 1, where we obtained a 'p' value of $p=0.446$. This suggests that the type of obturation technique used does not influence the prevalence of dead space.

This is comparable to the results of a study conducted by Wu *et al.* in 2009 (45) where they stated that root canal fillings can obtain the same quality regardless of whether the lateral compaction or single cone technique is used. In an article by Hörsted-Bindslev *et al.* in 2007 (46), they concluded that there was no significant difference in the quality of the fillings based on the type of obturation method. Both lateral compaction and single cone techniques have been shown to produce successful obturations in several studies (47–49). Similarly, after compiling the results of our current study, it is evident that the type of obturation technique used does not significantly cause the incidence of dead space to differ.

Conclusion

Within the limitations of the present study we may conclude that dead space severely compromises the treatment outcome for post and core restorations and that they are almost equally prevalent regardless of the type of obturation technique employed. Thus, there is no superior method choice for obturation during post and core therapy. Also since dead space areas produced by fit discrepancies can be identified before cementation, it is recommended that periapical radioanalysis should be performed before final post cementation to boost the endodontic survival rate of the tooth.

Limitations of the Study

Our small sample size where most of the participants are from South Indian cities lowers the reliability and generalizability of our results with respect to other populations. Since our study is purely observational, there are also no scalar values associated with the dimensions of the dead spaces present.

Future Scope of the Study

The study can be further bettered by involving a higher number of patient records from other ethnicities and populations as well, thus overcoming our geographical barriers and small sample size and increasing the reliability of our findings. A questionnaire based study can also be conducted to assess the comfort and treatment experience of each participant so as to determine the advantages and disadvantages of the two obturation methods.

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Conflict of Interest

None declared.

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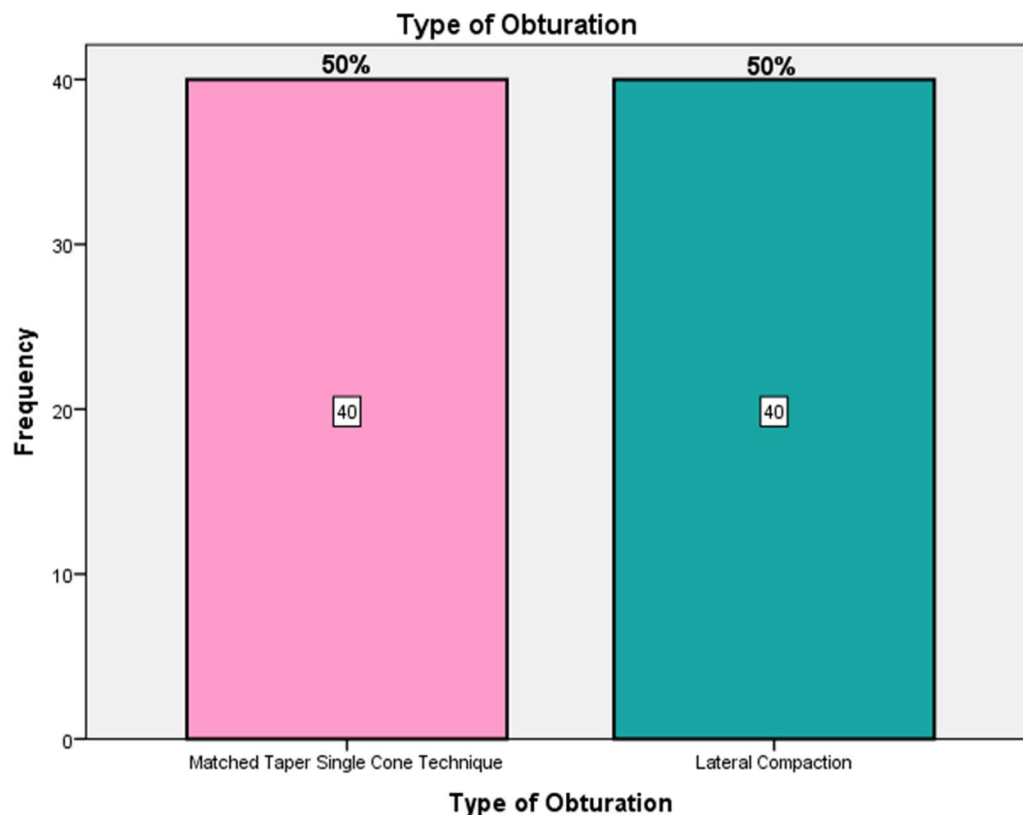


Figure 1 - Bar chart showing the distribution of the study participants based on the type of obturation method used. Here, the 'X' axis represents the type of obturation method employed with 'Matched Taper Single Cone Technique' in pink and 'Lateral Compaction' in teal. The 'Y' axis represents the number of participants in both numbers and percentage units. Both groups contain equal numbers of patients to ensure proper comparison of dead space prevalence.

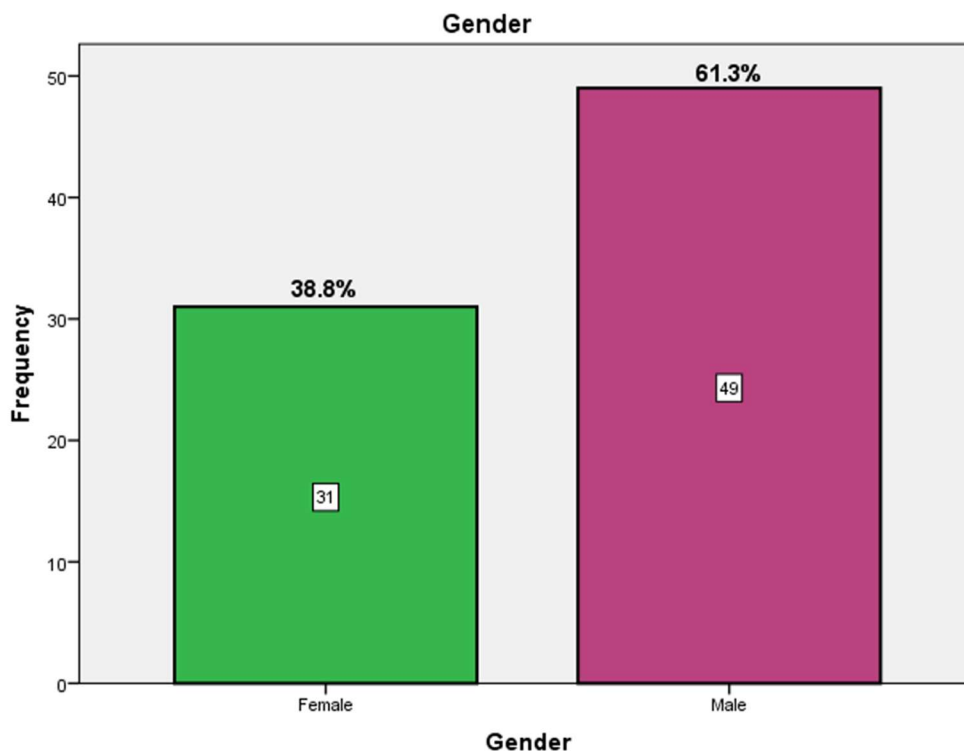


Figure 2 - Bar graph showing the gender distribution of the study participants. Here, the 'X' axis represents the gender 'Female' in green and 'Male' in maroon. The 'Y' axis represents the number of participants in both numbers and percentage units. Among the total number of participants, 38.8% were females while 61.3% were males.

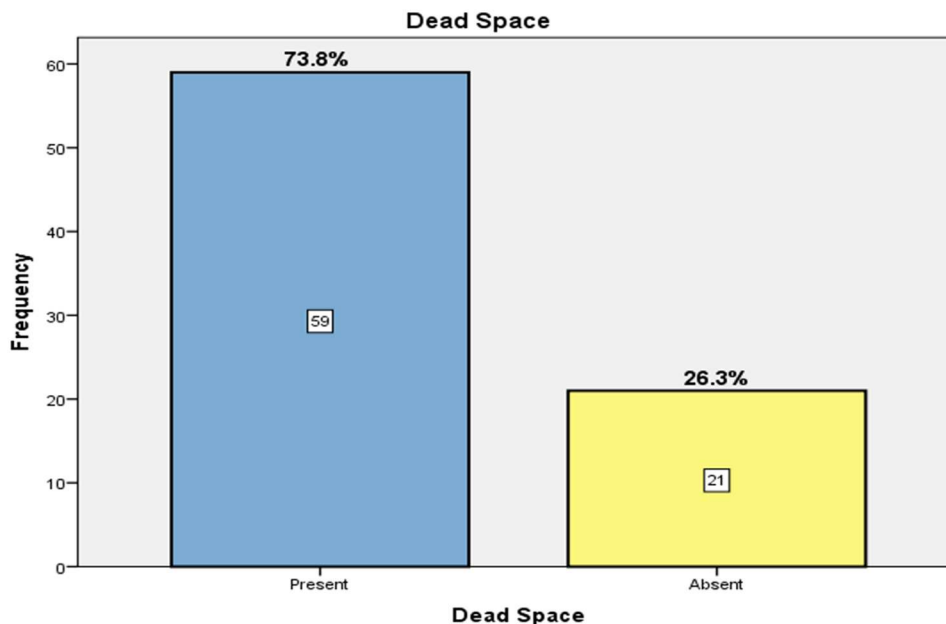


Figure 3 - Bar chart showing the general incidence of dead space, irrespective of the obturation method used. Here, the 'X' axis represents the prevalence of dead space with 'Present' in blue and 'Absent' in yellow. The 'Y' axis represents the number of cast post cases in both numbers and percentage units. Among the total number of cast post cases, 73.8% had dead spaces while only 26.3% did not have dead spaces. The results suggest that dead space is more often present than absent.

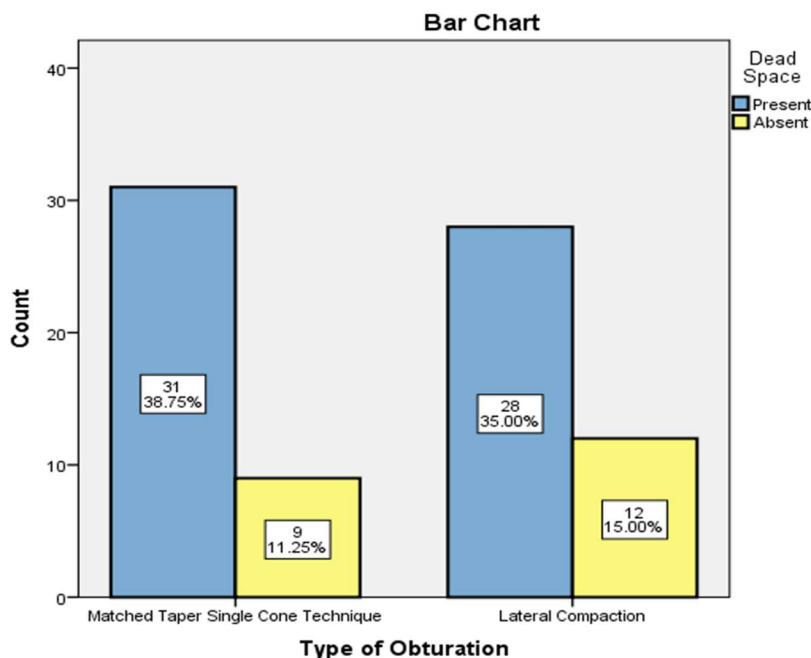


Figure 4 - Bar chart representing the association between the presence of dead space and the type of obturation technique employed. Here, the 'X' axis represents the two groups of obturation techniques - 'Matched Taper Single Cone Technique' and 'Lateral Compaction'

while the ‘Y’ axis represents the prevalence of dead space where when ‘Present’ it is represented by blue and when ‘Absent’ it is represented by the colour yellow, all in percentage and number units. The results obtained were not statistically significant with $p=0.446$, Chi Square test.

Value Type	Value	Asymp. Sig. (2 Sided)
Pearson Chi-Square	0.581	0.446

Table 1 - Crosstabulation showing a Chi Square Test with no statistically significant relationship between the type of obturation method used and the presence or absence of dead space in cast post restorations (Pearson’s Chi-Square value - 0.446; p value - 0.581).