# A Comparative Evaluation of Different Impression Techniques for Post-Space: An In Vitro Study

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## ABSTRACT

**Introduction:** For indirect technique of cast post and core, impression of post space is critical for the success of post core system. One of the main problems encountered while making impression of post space is incompleteness of impression and incorporation of voids leading to inaccurate post. Thus the present in vitro study is to compare 5 different impression techniques of post space so as to determine the technique that produces more accurate impression by assessing completeness of impression and number of voids in post space impressions.

**Methods:** Five maxillary central incisors were endodontically treated and prepared for post and core. Post space impressions using polyvinylsiloxane were made using five different techniques i.e Technique I using 23 gauge anesthetic needle which acted as a vent placed till the base of postspace during injection of light body polyvinylsiloxane impression material followed by removal of the needle and placement of orthodontic wire to the depth of preparation as support; technique II using vent only; technique III using wire only; technique IV using no vent and no wire; Technique V using lentulo spiral and wire support. The samples thus obtained were evaluated for number of voids and completeness of impression under stereo microscope.

**Result:** The completeness of impressions made by each technique was in the following order: Technique I>Technique II>Technique III and Technique V>Technique IV. Technique I was statistically significant than Technique III, IV and V. The total number of voids in each technique were maximum in the following order: Technique I<Technique II<Technique III and Technique IV<Technique V. Technique I showed statistically lower mean number of voids than Technique III, IV and V.

**Conclusion:** By assessing all parameters, Technique I that used 23 gauge anesthetic needle which acted as a vent during injection of light body polyvinylsiloxane impression material followed by removal of the needle and placement of orthodontic wire to the depth of preparation as support consistently produced maximum completeness of impression, minimum number of voids and maximum number of voids free impressions. Hence Technique I was considered to be the most accurate one and thus recommended for clinical use.

**Key words:** Elastomeric impression material, Post and core, Indirect technique, vent, voids

## INTRODUCTION

With increasing number of teeth being retained by endodontic therapy there is a concomitant need to have the knowledge and skill to restore these teeth. Endodontic therapy enables several advantages including maintenance of a natural tooth, restoration of function, esthetics and maintenance of stability of dental arches.[1,2] The

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loss of structural integrity caused by trauma, caries, access hole preparations, loss of moisture content, and reduced thickness of dentine lead to decreased fracture resistance of such teeth.[3,4] If there is less than 50% of coronal tooth structure, provision must be made for fabrication of a post and core which provide retention for a core, over which definitive crown or prosthesis can be placed.[5]

Custom made laboratory-fabricated posts fitted to root configuration, are more conservative, usually used in non-circular canals or extremely taper and excessively flared canals especially in young persons or in individuals after retreatment of endodontic failure.[3] For fabricating the custom post indirectly, the impression of post space is critical to the success of post and core system. One of the main problems encountered while making the impression of post space is incorporation of voids, incomplete impression resulting into inaccurate cast post. Incomplete pattern leads to the loss of length of the final casted dowel and incorporation of voids results loss of surface area that passively contacts the inter-radicular wall and will create a problem in its adaptation thus decreasing its retention. It is also known that the greater the post length, the better the retention and stress distribution.

There are very few literature published comparing methods to accurately impress the contours of the post space preparation. Therefore, the present study is to compare five different post space impression techniques using polyvinylsiloxane and to evaluate best technique for clinical use.

## METHODS

This in vitro study was carried in Department of Prosthodontics and Maxillofacial Prosthesis, UCMS college of Dental Surgery from 10 March 2014 to 10 October 2015. Ethical clearance for the study was obtained from the Ethical, Research and Academic Committee (UCMS/PG/06/14). Initially 30 maxillary central incisors were collected from which five teeth were selected using simple random sampling. Then, the extracted teeth were sterilized by immerging in 5.2% sodium hypochlorite for 5 days and stored in normal saline solution to maintain moisture content. Access to root canal was made and biomechanical preparation was done upto K-file (2% ISO group I) no 80 using Schilder method. Obturation was done with gutta-percha and zincoxide eugenol sealer by lateral condensation technique. An endodontic dowel space was prepared leaving 4-5 mm of gutta-percha at the apex and enlarged to No. 5 peeso reamer. The total length of dowel space was 9 mm.

Custom trays were made to carry heavy body impression materials with 2 mm wax relief [6] and were made 1 week before final impression making session.[7] Impressions of post-space with polyvinylsiloxane impression materials was made using five different techniques (I, II, III, IV, V) repeated 20 times each to attain a sample size of 100.

Technique I: A 23 gauge anesthetic needle was used as a vent. The needle was inserted into base of the post-space with the help of tweezer and light body polyvinylsiloxane was injected in the post space using disposable intra-oral delivery tip. The same diameter of delivery tips were used to avoid influence of diameter of tips on formation of voids in elastomeric impression materials.[8] The anesthetic needle was removed after light body was injected into the canal .A half inch 26 gauge orthodontic wire slightly bent at one end (for holding and locking the wire in the impression) was coated with tray adhesive 15 min before the impression, was then inserted into the post space to the depth of 9 mm to support the impression materials. While placing vent, a new anesthetic needle should be used in each case to maintain the hole. The custom tray filled with heavy body polyvinylsiloxane

impression materials was placed over the light body impression and the post space impression was picked in the custom tray.

The basic procedure for the post space impression was kept same for all other techniques as in technique I. Following alteration was done in respective techniques.

Technique II: Although a 23 gauge needle was used as a vent, the impression was made without placing an orthodontic wire into the post space.

Technique III: No needle vent was used. Only wire was used to support the impression.

Technique IV: Neither a needle nor an orthodontic wire was used.

Technique V: Light body polyvinylsiloxane impression material was placed into the post space with the help of lentulo spiral. The orthodontic wire was then inserted into the post space and impression was made as done in technique I.

All the impressions were made by single operator to avoid effect of operator variability on voids formation of elastomeric impression material.[9] 20 samples thus obtained with each of the techniques were evaluated for their accuracy using stereo microscope. A total of 100 samples were evaluated for completeness of impression and presence or absence of voids.

**A. Completeness of impression:**

The length of the post space impression was measured in terms of completeness of impression. The length was measured with a millimeter scale in terms of difference of 0.5 mm under stereo microscope and approximated to the nearest value as follows.

| Length in between (mm) | Taken as(mm) |
|---|---|
| 6.5 -7 | 7 |
| 7-7.5 | 7.5 |
| 7.5-8 | 8 |
| 8-8.5 | 8.5 |
| 8.5-9 | 9 |

**B. Voids:**

At first, the samples were evaluated for presence or absence of voids in all three sections of the post space ( apical, middle and cervical) as well as the number of void free samples under stereomicroscope (4x). Thereafter, if voids were observed, the total number of voids were counted in each section of the sample.

## STATISTICAL ANALYSIS

The statistical analyses were performed using statistical software SPSS (Statistical Package for Social Science version 16.0, 2007) for windows. Quantitative, descriptive and inferential statistical analysis were carried out. The percentage of voids free samples at different sections (cervical, middle, apical) of post space impressions were calculated. Mean and Standard deviation of completeness and voids at different sections were also calculated. One way ANOVA and Tukey post-hoc analysis was used to analyze the data. Results were considered statistically significant at $P < 0.05$.

## RESULTS

Comparison of mean completeness of post space impressions using five different techniques is shown in Table 1(fig 1,2,3).It is observed that mean completeness is maximum in Technique I (8.92±0.18) and minimum for Technique IV (8.30±0.41). Analysis of variance Test (Table 2) shows a statistically significant difference in completeness using different techniques ($F=9.488$; $p<0.001$). Tukey HSD test (Table 3) shows Technique I has significantly higher completeness as compared to all the other techniques except technique II ($p<0.05$). On the basis of above observation the following order of mean completeness is observed for different techniques: Technique I>Technique II>Technique III and V>Technique IV.

The percentage of voids free samples for different techniques at cervical, middle, apical

and total section of post space impression is shown in figure 5. The proportion of voids free impressions for Techniques I through V in total is 75%,35%,25%,15% and 10% respectively. The mean number of voids is minimum in Technique I at all three sections i.e at cervical( 0.05±0.22),middle((0±0),apical(0.25±0.55) and total(0.3±0.57) while maximum in Technique V at cervical(0.35±0.67), middle((0.6±0.75) and total(2.5±1.63). The total number of voids (collectively for all three sections) are ranged from 0 to 2 for Technique I, 0 to 5 for Technique II and III, 0 to 6 for Technique IV and 0 to 7 for Technique V(Table 4). Analysis of variance (Table 5) shows a statistically significant difference among different techniques for mean number of voids at middle, apical and total count ($p<0.05$). Tukey HSD test (Table 6) shows that at middle section, Technique V has significantly higher mean number of voids as compared to Technique I ($p<0.05$). None of the other differences are significant statistically. At apical section, Technique III, IV and V have significantly higher mean number of voids as compared to Technique I. None of the other differences are significant statistically. For total number of voids, Technique III, IV and V have significantly higher mean number of voids as compared to Technique I. None of the other differences are significant statistically. On the basis of assessment of total number of voids at all three sections, the order of mean number of voids in different techniques is as follows:

Technique I<Technique II<Technique III and IV<Technique V.

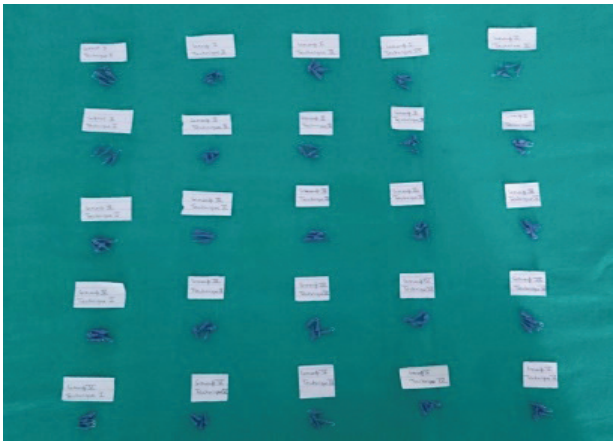

***Figure 1:*** *Samples ready for evaluation under stereo microscope*

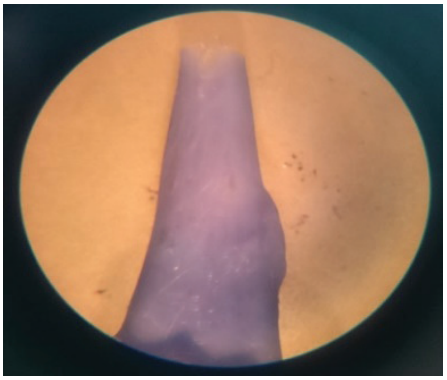

***Figure 2:*** *Sample showing incompleteness of impression*

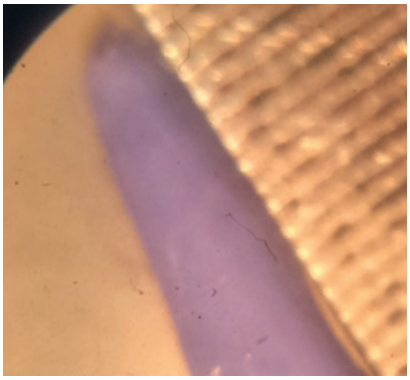

***Figure 3:*** *Sample with measuring ruler under stereomicroscope*

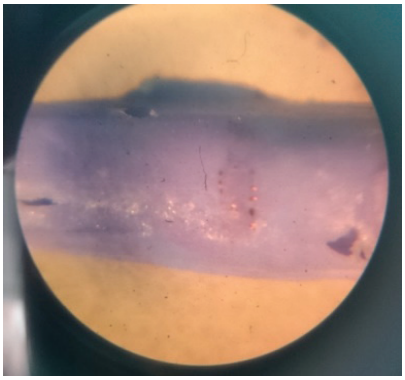

***Figure 4*** *: Samples showing voids at different section*

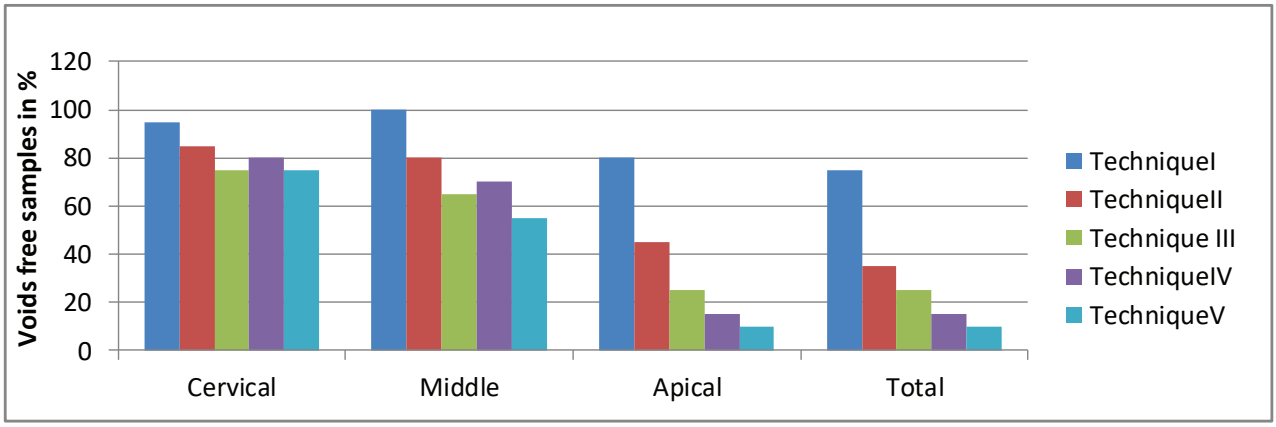


***Figure 5:*** *Percentage of voids free sample at cervical, middle and apical section of post space impression for different techniques.*

**Table 1:** Comparison of Mean Completeness in different techniques

| S.No | Technique | No of samples(n) | Mean | SD | Min | Max |
|---|---|---|---|---|---|---|
| 1 | I | 20 | 8.92 | 0.18 | 8.5 | 9 |
| 2 | II | 20 | 8.70 | 0.34 | 8 | 9 |
| 3 | III | 20 | 8.60 | 0.30 | 8 | 9 |
| 4 | IV | 20 | 8.30 | 0.41 | 7.5 | 9 |
| 5 | V | 20 | 8.60 | 0.34 | 8 | 9 |

**Table 2:** Analysis of Variance for mean completeness using different techniques (one way ANOVA)

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | 4.050 | 4 | 1.012 | 9.488 | p<0.001(s) |
| Within Groups | 10.137 | 95 | 0.107 | | |
| Total | 14.187 | 99 | | | |

**Table 3:** Differences between techniques in Completeness (Tukey HSD test)

| Comparison | Mean Difference | Standard Error | Significance |
|---|---|---|---|
| I vs II | 0.225 | 0.103 | 0.197 |
| I vs III | 0.325 | 0.103 | 0.018 |
| I vs IV | 0.625 | 0.103 | 0.000 |
| I vs V | 0.325 | 0.103 | 0.018 |
| II vs III | 0.100 | 0.103 | 0.869 |
| II vs IV | 0.400 | 0.103 | 0.002 |
| II vs V | 0.100 | 0.103 | 0.869 |
| III vs IV | 0.300 | 0.103 | 0.036 |
| III vs V | 0.000 | 0.103 | 1.000 |
| IV vs V | 0.300 | 0.103 | 0.036 |

**Table 4:** Comparison of mean number of voids in apical, middle and cervical sections using 5 different techniques.

| Voids Cervical | | | | | |
|---|---|---|---|---|---|
| **Technique** | **Number of samples** | **Mean** | **SD** | **Minimum** | **Maximum** |
| I | 20 | 0.05 | 0.22 | 0 | 1 |
| II | 20 | 0.15 | 0.36 | 0 | 1 |
| II | 20 | 0.25 | 0.44 | 0 | 1 |
| IV | 20 | 0.20 | 0.41 | 0 | 1 |
| V | 20 | 0.35 | 0.67 | 0 | 2 |
| **Voids Middle** | | | | | |
| I | 20 | 0.00 | 0.00 | 0 | 0 |
| II | 20 | 0.20 | 0.41 | 0 | 1 |
| III | 20 | 0.40 | 0.59 | 0 | 2 |
| IV | 20 | 0.40 | 0.68 | 0 | 2 |
| V | 20 | 0.60 | 0.75 | 0 | 2 |
| **Voids Apical** | | | | | |
| I | 20 | 0.25 | 0.55 | 0 | 2 |
| II | 20 | 1.15 | 1.26 | 0 | 4 |
| III | 20 | 1.70 | 1.41 | 0 | 4 |
| IV | 20 | 1.80 | 1.23 | 0 | 4 |
| V | 20 | 1.55 | 0.99 | 0 | 4 |
| **Voids Total** | | | | | |
| I | 20 | 0.30 | 0.57 | 0 | 2 |
| II | 20 | 1.50 | 1.57 | 0 | 5 |
| III | 20 | 2.40 | 1.87 | 0 | 5 |
| IV | 20 | 2.40 | 1.66 | 0 | 6 |
| V | 20 | 2.50 | 1.63 | 0 | 7 |

**Table 5:** Analysis of variance for mean number of voids at different sections for different techniques (One way ANOVA)

| | **Sum Of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|
| **Cervical** | | | | | |
| Between Techniques | 1.00 | 4 | 0.25 | 1.25 | 0.295(ns) |
| Within Techniques | 19.00 | 95 | 0.20 | | |
| **Total** | **20.00** | **99** | | | |
| **Middle** | | | | | |
| Between Techniques | 4.16 | 4 | 1.04 | 3.338 | 0.013(s) |
| Within Techniques | 29.6 | 95 | 0.312 | | |
| **Total** | **33.76** | **99** | | | |
| **Apical** | | | | | |
| Between Techniques | 31.94 | 4 | 7.985 | 6.185 | 0.000(s) |
| Within Techniques | 122.65 | 95 | 1.291 | | |
| **Total** | **154.59** | **99** | | | |
| **Total** | | | | | |
| Between Techniques | 70.96 | 4 | 17.74 | 7.530 | 0.000(s) |
| Within Techniques | 223.80 | 95 | 2.3560 | | |
| **Total** | **294.76** | **99** | | | |

**Table 6:** Differences between techniques in number of voids at different sections
*(Tukey HSD test)*

| Comparison | Mean Difference | SE | Significance of difference(P) |
|---|---|---|---|
| **Middle** | | | |
| I vs II | -0.200 | 0.176 | 0.789 |
| I vs III | -0.400 | 0.176 | 0.165 |
| I vs IV | -0.400 | 0.176 | 0.165 |
| I vs V | -0.600 | 0.176 | 0.009 |
| II vs III | -0.200 | 0.176 | 0.789 |
| II vs IV | -0.200 | 0.176 | 0.789 |
| II vs V | -0.400 | 0.176 | 0.165 |
| III vs IV | 0.000 | 0.176 | 1.000 |
| III vs V | -0.200 | 0.176 | 0.789 |
| IV vs V | -0.200 | 0.176 | 0.789 |
| **Apical** | | | |
| I vs II | -0.090 | 0.359 | 0.098 |
| I vs III | -1.450 | 0.359 | 0.001 |
| I vs IV | -1.550 | 0.359 | 0.000 |
| I vs V | -1.300 | 0.359 | 0.004 |
| II vs III | -0.550 | 0.359 | 0.545 |
| II vs IV | -0.650 | 0.359 | 0.375 |
| II vs V | -0.400 | 0.359 | 0.799 |
| III vs IV | -0.100 | 0.359 | 0.999 |
| III vs V | 0.150 | 0.359 | 0.994 |
| IV vs V | 0.250 | 0.359 | 0.957 |
| **Total** | | | |
| I vs II | -1.200 | 0.485 | 0.106 |
| I vs III | -2.100 | 0.485 | 0.000 |
| I vs IV | -2.100 | 0.485 | 0.000 |
| I vs V | -2.200 | 0.485 | 0.000 |
| II vs III | -0.900 | 0.485 | 0.349 |
| II vs IV | -0.900 | 0.485 | 0.349 |
| II vs V | -1.000 | 0.485 | 0.246 |
| III vs IV | -0.000 | 0.485 | 1.000 |
| III vs V | -0.100 | 0.485 | 1.000 |
| IV vs V | -0.100 | 0.485 | 1.000 |

## DISCUSSION

This study was conducted to compare various post space impression techniques using polyvinylsiloxane to determine which technique produced the most accurate impression of the post space. Polyvinylsiloxane was choosen because it produces dimensionally stable impression with surface details recorded as minutely as 25µm, has acceptable tear strength[10,11,12,13] and exhibits best recovery from deformation during removal from the mouth and best wettability.[11,12]

Howlader TH et al[14] also suggested that the light body addition silicone using injection technique shows less voids ,smaller size and better dimensional accuracy for dowel space impression when compared with inlay casting wax and self- cured acrylic resin.

In this study, the maximum number of voids free impressions were obtained with technique I in which both anesthetic needle as vent as well as orthodontic wire as support was used. This can be attributed to the fact

that anesthetic needle allowed air to escape ahead of impression material leading to void free impressions. On the other hand the total number of voids were maximum in technique V. In technique II, where the reinforcement of post impression was not done the impression resulted into more voids than technique I but less than others. In technique III , there were more number of voids as compared to technique I and II, as the anesthetic needle which acts as vent was not used, thus entrapping air in the post space. Similarly in technique IV also there were more number of voids as neither vent nor wire support was used. This result is similar to the study done by Chee Winston WL et al.[15] He also compared five post space impression techniques and concluded that the technique that used anaesthetic needle as vent while expressing impression materials into dowel space followed by placing impression post consistently produced voids free impressions. These results are in confirmation with the previous studies performed by Nisha et al[16] and Mishra et al. [17] On the other hand Patel et al[18] found that technique that used anesthetic needle as vent, lentulospiral and 23 guage orthodontic wire as support gave more completeness of impression and voids free post space impression in comparison to needle and orthodontic wire technique. In this study the total number of voids were maximum in apical position than in middle and cervical position in all the techniques. The lack of space for adequate flow of the light body material induced the formation of internal pressure during impression procedure that leads to air entrapment into the root canal resulting more voids in apical portion than in middle and cervical portion of post space impression. Howlader et al.[14] found that the position of voids in dowel space impression using silicone impression material were more in apical portion and least in cervical portion.

Regardless of the technique used, the canal preparation should be complete such that the tip of impression syringe should be at the bottom of apex of post space. In cases where canals are minimally prepared, lentulospiral with wire support should be used.

Completeness of the impression along the post space length was maximum in Technique I, as air was allowed to escape through the vent and the impression material thus was able to occupy whole of the prepared post space. The minimum length of post space was recorded by Technique IV as there was no vent and no support. These results are in confirmation with the previous study performed by Panghal V et al.[19]

## Limitation of the study

1. The study was conducted on 5 teeth only which may not represent the broader population of teeth in regards to possibility of variation in canal shape.
2. This study did not classify the size of the voids.
3. A limitation of technique I is when using it in minimally prepared canals or narrow canals, the access of the impression tip to the bottom of the canal may be limited.

## CONCLUSION

Based on the finding, Technique I that used 23 gauge anesthetic needle which acted as a vent at the apex during injection of light body polyvinyl siloxane impression material followed by removal of the needle and placement of orthodontic wire to the depth of preparation as support resulted maximum completeness of impression, minimum number of voids and maximum number of voids free impressions. Hence Technique I is recommended for clinical use.

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