CHAPTER 6

RESULTS

CHAPTER 6

RESULT

6.1 Introduction

The findings of this study are presented in three broad areas as follows:

i. Quality of calcium hydroxide filling:
    a) scores based on radiographs
    b) percentage of surface area from cross sections
ii. Presence/location of voids from the cross sections
iii. Three-dimensional investigation using microcomputed tomography (SkyScan 1172)

6.2 Quality of calcium hydroxide filling

6.2.1 Scores based on radiographs

The quality of filling obtained on radiographs for the types of vehicles of calcium hydroxide used and the methods of placing the material was scored as described previously. Table 6.1 shows the multiway contingency table of crosstabulation between methods of placement, types of vehicle of calcium hydroxide and the score. Almost similar results were

obtained for the Pulpdent® Tempcanal™ and Vitapex™ (Figures 6.1 and 6.2). However, differences were noted for the method of placement of the material. Extrusion of material beyond the apex (11 out of 13 for Pulpdent® Tempcanal™ and 12 out of 14 for Vitapex™) occurred when the lentulo spiral±syringe was used for placing the material. In contrast, only 2 sample from each group showed extrusion of material beyond the apex when syringe technique was used.

Table 6.1: Method*Type*Score Crosstabulation Multiway Contingency Table

Methods of placement□Types of calcium hydroxide (according to types of vehicle)
Types of calcium hydroxide (according to types of vehicle)
□□□Pulpdent® Tempcanal™
□□Pulpdent® Tempcanal™
□Pulpdent® Tempcanal™
Pulpdent® Tempcanal™
(n=30)□Vitapex™
Vitapex™
(n=30)□□□Score
□□Score
□Score
Score
□Score□□□**1**□**2**
Score□□□**1**□**2**
□□**1**□**2**
□**1**□**2**
1□**2**
2
□**3**□**1**□**2**□**3**□□
3□**1**□**2**□**3**□□
1□**2**□**3**□□
2□**3**□□
3□□
□

Syringe
(n=20)□

4 □

4 □

2
□

4 □

4 □

2
□□Syringe + Lentulo spiral
□Syringe + Lentulo spiral

Syringe + Lentulo spiral
(n=20)□

2
□

2
□

6
□

2
□

2
□

6
□□Lentulo Spiral
□Lentulo Spiral

Lentulo Spiral
(n=20)□

4 □

1
□

5
□

3
□

1
□

6
□□

□

Total
□

10
□

7
□

13
□

9
□

7
□

14
□□

□

Note:

Score 1 –at the apex (≤ 2mm from the apex – apex)

Score 2 – short of the apex (>2mm from the apex)

Score 3 – extrusion/long beyond the apex

Williams (1994)

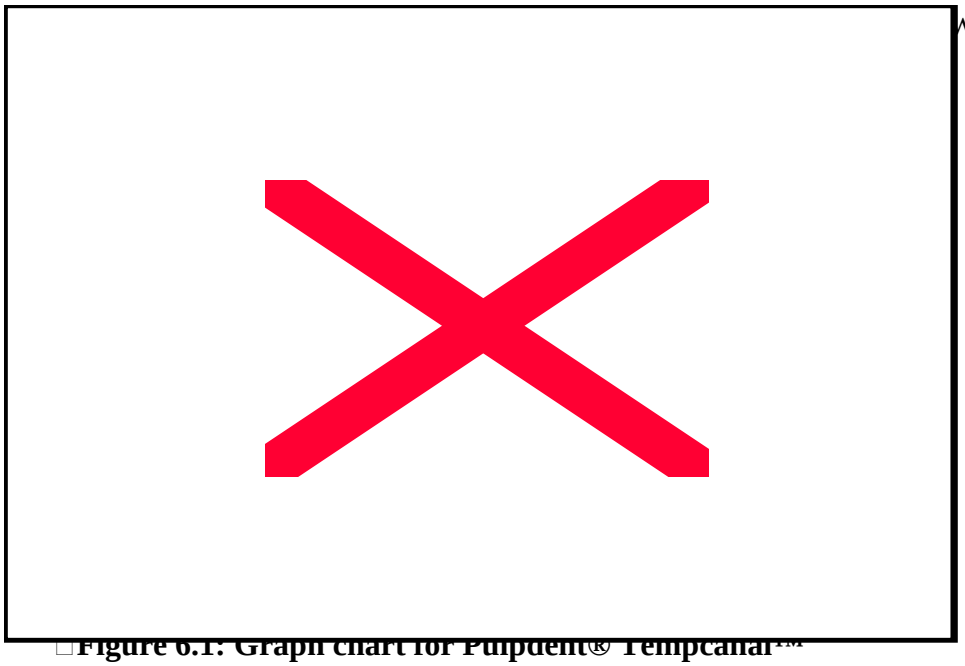

Figure 6.1: Graph chart for Pulpdent® Tempcanal™

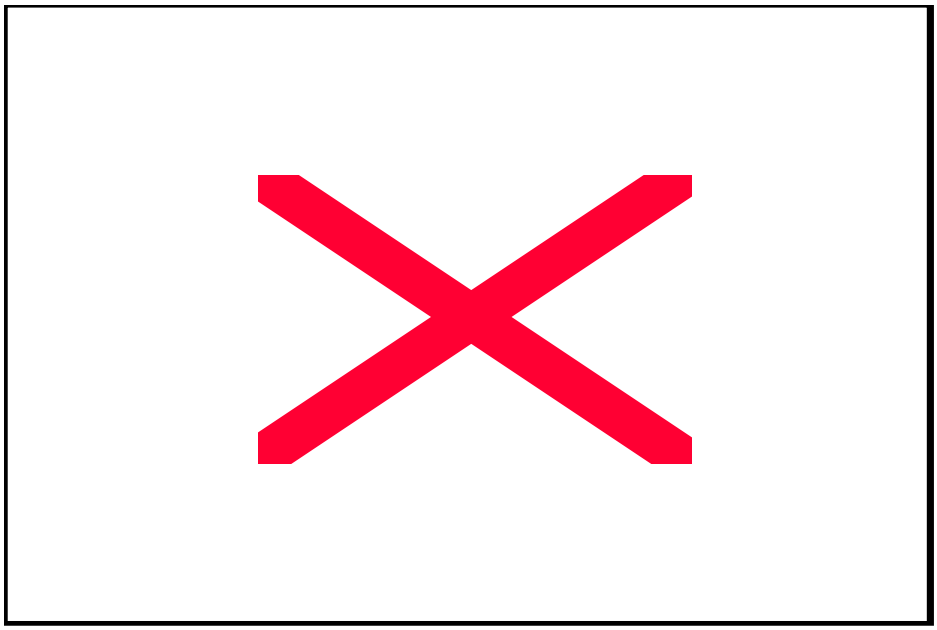

Figure 6.2: Graph chart for Vitapex™

Chi-square tests were performed to see if there was significance difference between quality of calcium hydroxide filling (score) and methods of placement and between score and types of vehicles of calcium hydroxide. Results showed there were no significant difference in score irrespective of different methods of placement and different types of vehicles of calcium hydroxide with p-value of 0.239 and 0.810 respectively (Appendix A and Appendix B).

6.2.2 Surface area from the cross sections

The quality of calcium hydroxide filling was also analysed by examining the surface area of the material at two horizontal levels. Table 6.2 shows the mean percentage of surface area for both types of calcium hydroxide using three different methods of placement at the two levels. For level A, it was observed that the highest mean percentage of filling/surface area (97.89±4.14) was noted when Pulpdent® Tempcanal™ was placed using the lentulo spiral method. Similar results were obtained for level B where placement of Pulpdent® Tempcanal™ using lentulo spiral method showed the highest mean percentage of filling/surface area (98.97±1.80).

Table 6.2: Mean percentage of filling/surface area

Level of cross sectioning□Types of $Ca(OH)_2$ according to vehicles□Syringe

Types of $Ca(OH)_2$ according to vehicles□Syringe

Syringe

(n=20)□Syringe+Lentulo spiral (n=19)□Lentulo spiral (n=20)□□□□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ Syringe+Lentulo spiral (n=19)□Lentulo spiral (n=20)□□□□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ Lentulo spiral (n=20)□□□□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ □□□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ □□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ □Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ ±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ ±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ ±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ □Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™ Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™

Pulpdent® Tempcanal™□93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™

93.00□5.46□92.74□10.74□97.89□4.14□□□Vitapex™

5.46□92.74□10.74□97.89□4.14□□□Vitapex™

92.74□10.74□97.89□4.14□□□Vitapex™

10.74□97.89□4.14□□□Vitapex™

97.89□4.14□□□Vitapex™

4.14□□□Vitapex™

□□Vitapex™

□Vitapex™

Vitapex™

□90.05□8.24□93.47□5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

90.05□8.24□93.47□5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

8.24□93.47□5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

93.47□5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

Pulpdent® Tempcanal™□87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

87.54□7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

7.19□97.78□3.35□98.97□1.80□□□ Vitapex™

97.78□3.35□98.97□1.80□□□ Vitapex™

3.35□98.97□1.80□□□ Vitapex™

98.97□1.80□□□ Vitapex™

1.80□□□ Vitapex™

□□ Vitapex™

□ Vitapex™

Vitapex™

□91.82□10.35□94.12□6.86□91.62□4.93□□

91.82□10.35□94.12□6.86□91.62□4.93□□

10.35□94.12□6.86□91.62□4.93□□

94.12□6.86□91.62□4.93□□

6.86□91.62□4.93□□

91.62□4.93□□

4.93□□

□

Multivariate analysis of variance (MANOVA) was then used to analyse these data as described in section 5.8.2. This was done in four broad categories:-

i. Boxplots for visualization of distributions
ii. Assessment of normality of distributions
iii. Mean percentage of filling/surface area
iv. Multivariate analysis of variance test

6.2.2.1 Boxplots for visualization of distributions

Boxplots were done to visualize the pattern of distributions for each group.

6.2.2.1.1 Pulpdent® Tempcanal™

□□ EMBED StaticEnhancedMetafile □□□

Figure 6.3: B of percentage of filling/surface area of Pulpdent® Tempcanal™ by placement methods at level A

Figur ows that for level A (10mm from the base of the curvette), the syringe group had an almo al distribution with one outlier. The other two groups showed negative skewness wi median values and these values are higher than the syringe group. The smallest spre stribution in comparison with the other two groups was noted for the lentulo spiral group, e were two extreme values in this group.

Percentage of filling at level A (10mm from the base of the curvette)

Method of $Ca(OH)_2$ placement

□□□ EMBED StaticEnhancedMetafile □□□

Figure 6.4: B of percentage of filling/surface area of Pulpdent® Tempcanal™ by placement methods at level B

Figur ows that the lentulo spiral (± syringe) groups shared the same median values and these val higher than the syringe group. One outlier was noted for the syringe+lentulo spiral group. the groups were negatively skewed and the widest distribution was exhibited by the syring .

Percentage of filling at level B (5mm from the base of the curvette)

Method of $Ca(OH)_2$ placement

6.2.2.1.2 Vitapex™

□□□□ EMBED StaticEnhancedMetafile □□□

Figure 6.5: Boxplot of percentage of filling/surface area of Vitapex™ by placement methods at level A

Figure ws intracanal filling with Vitapex™ at level A. The lowest median value was noted f yringe group. The median values for the syringe+lentulo spiral and lentulo spiral groups pproximately the same. There was no outlier and extreme value. The syringe group h widest spread of data.

Percentage of filling at level A (10mm from the base of the curvette)

EMBED StaticEnhancedMetafile □□□

Figure 6.6: Boxplot of percentage of filling/surface area of Vitapex™

Method of $Ca(OH)_2$ placement

6.6 shows the mean percentage of filling at level B using Vitapex™ as the intracar erial. The syringe and syringe+lentulo groups showed approximately similar median The lentulo spiral group showed an almost normal distribution with one outlier.

Percentage of filling at level B (5mm from the base of the curvette)

Methods of $Ca(OH)_2$ placement

6.2.2.2 Normality of distribution of percentage of surface area data

Outliers and extreme values were noted from the boxplots visualization. Thus, normality of distribution of the data was assessed by evaluating the skewness and kurtosis values. Skewness and kurtosis of between ±1.0 is considered excellent for most psychometric purposes, but a value between ±2.0 is also acceptable in many cases (George & Mallery, 2006). The SPSS DESCRIPTIVES output shows acceptable range of skewness and kurtosis values with the exception of kurtosis value of 2.464 at level A for Pulpdent® Tempcanal™ group (Appendix C). Z score or standard score was calculated to determine which outlier(s) or extreme value(s) that needs to be removed in order to get a normally distributed data. The result (in standard deviation) would indicate how far a data element was from the mean. The value can be either negative or positive. The z score values for the surface area data were between ±3.00, with only one case having a z score of -3.20 (in syringe+lentulo spiral method of Pulpdent® Tempcanal™ group (Appendix D)) which had resulted in one large value of kurtosis (2.464) as mentioned above. This outlier was then removed and the skewness and kurtosis were then re-evaluated. Values of skewness and kurtosis of between ±2.0 were subsequently noted (Appendix E). This suggests that the data are now normally distributed.

6.2.2.3 Mean percentage of filling/surface area

Data were subsequently reanalyzed with the outlier removed from the data. Table 6.3 shows the mean percentage of calcium hydroxide filling/surface area at the two levels according to types of vehicles of calcium hydroxide and methods of placement. The mean percentage of surface area of Pulpdent® Tempcanal™ present at levels A and B were higher than Vitapex™ for the lentulo spiral±syringe method of placement. However, it was noted that for syringe technique, higher mean percentage of surface area of Vitapex™ was noted at level B.

Table 6.3: Mean percentage of filling/surface area after outlier was removed

Level of cross sectioning□Types of calcium hydroxide□Syringe

Types of calcium hydroxide□Syringe

Syringe

(n=20)□Syringe+Lentulo spiral (n=19)□Lentulo spiral

(n=20)□□□□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™

Syringe+Lentulo spiral (n=19)□Lentulo spiral

(n=20)□□□□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™

Lentulo spiral (n=20)□□□□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent®

Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™

□□□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ □□Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ □Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ Mean□±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ ±SD□Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ Mean□±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ ±SD□Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ Mean□±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ ±SD□□Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ □Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ Pulpdent® Tempcanal™□93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ 93.00□5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ 5.46□**95.21**□**7.82**□97.89□4.14□□□Vitapex™ **95.21**□**7.82**□97.89□4.14□□□Vitapex™ **7.82**□97.89□4.14□□□Vitapex™ 97.89□4.14□□□Vitapex™ 4.14□□□Vitapex™ □□Vitapex™

□Vitapex™

Vitapex™

□90.05□8.24□93.47□5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

90.05□8.24□93.47□5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

8.24□93.47□5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

93.47□5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

5.75□93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

93.80□6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

6.02□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

Pulpdent® Tempcanal™□87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

87.54□7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

7.19□97.96□3.50□98.97□1.80□□□ Vitapex™

97.96□3.50□98.97□1.80□□□ Vitapex™

3.50□98.97□1.80□□□ Vitapex™

98.97□1.80□□□ Vitapex™

1.80□□□ Vitapex™

□□ Vitapex™

□ Vitapex™

Vitapex™

□91.82□10.35□94.12□6.86□91.62□4.93□□

91.82□10.35□94.12□6.86□91.62□4.93□□

10.35□94.12□6.86□91.62□4.93□□

94.12□6.86□91.62□4.93□□

6.86□91.62□4.93□□

91.62□4.93□□

4.93□□

□

6.2.2.4 Assessment of differences between groups using multivariate analysis of variance (MANOVA)

Statistical analyses were carried out to determine whether there were differences between the groups. A 2x2x3 between-subjects multivariate analysis of variance (MANOVA) procedure was used. Order of entry of independent variables was types of vehicles of calcium hydroxide, then methods of placement. Total N of 60 was reduced to 59 with the deletion/removal of one outlier as described in section 6.2.2.2. Evaluation of assumptions of normality, homogeneity of variance-covariance matrices, linearity and multicollinearity of the data were subsequently carried out to ensure that all assumptions required for MANOVA were met.

6.2.2.4.1 Assessment of normality of distribution of the data

Assumption of normality was done right at in section 6.2.2.2 where values of skewness and kurtosis were noted to be within the range of -2 and +2 after one outlier was removed. Thus, the first assumption of MANOVA was met.

6.2.2.4.2 Assessment of homogeneity of dependent and independent variables

For MANOVA, the multivariate homogeneity of the variance-covariance matrices was tested using Box's M test. A p-value of 0.001 is recommended by Coakes & Steed (2003). In order for MANOVA's assumptions to be met, the Box's M test has to be non-significant ($p>0.001$). The Box's M test for the present data is significant with p-value of 0.001 (Appendix F). However, as the sample sizes in this study are equal, robustness of significance tests is expected; thus the outcome of Box's M test could be disregarded (Tabachnick & Fidell, 2001).

6.2.2.4.3 Assessment of homogeneity of variance for each dependent variable

This test assesses the homogeneity of variance for each of the dependent variables ie. percentage of surface area in level A and B, which was subjected to Levene's statistic (Appendix G). It was noted that homogeneity of variance has been violated for both level A and B with significant Levene's test of equality of error variances ($p=0.043$, $p=0.001$). Because both main effects are significant, post-hoc analyses are required later.

6.2.2.4.4 Relationship between methods of placement and vehicles used

Relationship between methods of placement and types of vehicles used was tested using Wilks' Lambda test. This test is the most common traditional test where there are more than two groups formed by the independent variables. It was noted that the dependent variables were significantly affected by methods of placement (p-value=0.012), but neither by types of vehicles

of calcium hydroxide (p-value=0.127) nor their interaction (type*method) (p-value=0.083) (Appendix H). Since the multivariate effect for methods of placement is significant, analysis of univariate/between subject was subsequently undertaken.

6.2.2.4.5 Interaction of percentage of surface area and methods of placement at both levels (test of between-subjects effect)

The univariate F-test for each dependent variable indicates which individual dependent variable contributes to the significant multivariate effect. Test of between-subjects effects indicated that there was a significant univariate interaction of methods of placement on percentage of surface area at level B (5mm from the base of the curvette) (p=0.005), but not at level A (10mm from the base of the curvette) (p=0.103) (Appendix I). This shows that at level B, the percentage of surface area is significantly influenced by methods of placement. No significant main effects were found for the percentage of surface area at level A. Thus for level B, further analysis was done to find out which method of placement differ significantly from the other methods.

6.2.2.4.6 Determination of method of placement that affects the quality of filling at level B

The post-hoc tests that could be used when assumption of homogeneity of variances is not met are Games-Howell, Tamhane's T2, Dunnett's T3 or Dunnett's C. Games-Howell test was used in this study because it is relatively liberal and more powerful than Dunnett's T3 or C, whereas Tamhane's T2 is a conservative test (Toothacker, 1993). Table 6.4 shows that there are significant differences between syringe and syringe+lentulo spiral method (p=0.035), but not between lentulo spiral and syringe+lentulo spiral method (p=0.930). The Games-Howell test

also suggests that between syringe method and lentulo spiral method, the p-value is nearly reached the significance level (p=0.054).

Table 6.4: Significance level of percentage of surface area at level B for different methods of placement.

(I) Methods of placement□(J) Methods of placement□Mean Difference (I-J)□Std. Error□Sig.□95% Confidence Interval□□□□□□□Lower Bound□Upper Bound□□Syringe□Syringe+lentulo spiral□-6.2548□2.39448□.035□-12.1340□-.3756□□□Lentulo spiral□-5.6140□2.31595□.054□-11.3178□.0898□□Syringe+lentulo spiral□Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B

(J) Methods of placement□Mean Difference (I-J)□Std. Error□Sig.□95% Confidence Interval□□□□□□□Lower Bound□Upper Bound□□Syringe□Syringe+lentulo spiral□-6.2548□2.39448□.035□-12.1340□-.3756□□□Lentulo spiral□-5.6140□2.31595□.054□-11.3178□.0898□□Syringe+lentulo spiral□Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B

Mean Difference (I-J)□Std. Error□Sig.□95% Confidence Interval□□□□□□□Lower Bound□Upper Bound□□Syringe□Syringe+lentulo spiral□-6.2548□2.39448□.035□-12.1340□-.3756□□□Lentulo spiral□-5.6140□2.31595□.054□-11.3178□.0898□□Syringe+lentulo spiral□Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B

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spiral□Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo

spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
.054□-11.3178□.0898□□Syringe+lentulo

spiral□Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo

spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
-11.3178□.0898□□Syringe+lentulo
spiral□Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo

spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
.0898□□Syringe+lentulo

spiral□Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo

spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
□Syringe+lentulo spiral□Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo

spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
Syringe+lentulo spiral□Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo

spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
Syringe□6.2548□2.39448□.035□.3756□12.1340□□□Lentulo spiral□.6408□1.75879□.930□-

3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-

.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B
6.2548□2.39448□.035□.3756□12.1340□□□Lentulo spiral□.6408□1.75879□.930□-

3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-

.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B
2.39448□.035□.3756□12.1340□□□Lentulo spiral□.6408□1.75879□.930□-
3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-

.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B
.035□.3756□12.1340□□□Lentulo spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
.3756□12.1340□□□Lentulo spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
12.1340□□□Lentulo spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
□□Lentulo spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
□Lentulo spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
Lentulo spiral□.6408□1.75879□.930□-3.6571□4.9387□□Lentulo

spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
.6408□1.75879□.930□-3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-

.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B

1.75879□.930□-3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-

.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B
.930□-3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-
.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B
-3.6571□4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-

.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B
4.9387□□Lentulo spiral□Syringe□5.6140□2.31595□.054□-

.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B
□Lentulo spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo

spiral□-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
Lentulo spiral□Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo

spiral□-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
Syringe□5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-

.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
5.6140□2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-

4.9387□3.6571□□Dependent Variable : Percentage of density at level B
2.31595□.054□-.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-

4.9387□3.6571□□Dependent Variable : Percentage of density at level B
.054□-.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B
-.0898□11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-
4.9387□3.6571□□Dependent Variable : Percentage of density at level B
11.3178□□□Syringe+lentulo spiral□-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
□□Syringe+lentulo spiral□-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
□Syringe+lentulo spiral□-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
Syringe+lentulo spiral□-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
-.6408□1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
1.75879□.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
.930□-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
-4.9387□3.6571□□Dependent Variable : Percentage of density at level B
3.6571□□Dependent Variable : Percentage of density at level B
□Dependent Variable : Percentage of density at level B
Dependent Variable : Percentage of density at level B

Post hoc : Games-Howell

6.3 Presence of voids from the cross section

Table 6.5 shows the number of specimens with and without voids and also the location of the voids according to types of vehicle of calcium hydroxide and methods of placement at the two levels. For both levels A and B, voids were not readily observed in 70% of the specimens when Pulpdent® Tempcanal™ was used. However, when Vitapex™ was used, the proportion of specimens that did not exhibit the presence of voids at level A and B were 53.3% and 60% respectively. Voids within the material were also noted at both level A and B for Pulpdent® Tempcanal™ and Vitapex™ (10% and 20% of the specimens respectively). For both levels A and B, voids were noted at the wall of the canal in 20% of the specimen when Pulpdent® Tempcanal™ was used. When Vitapex™ was used, 26.7% and 20% of the specimens had voids at the wall of the canal for level A and B respectively.

Table 6.5: Presence/absence of voids at level A and B according to types of vehicle and methods of placement

Level of cross sectioning□Methods of placement□Types of calcium hydroxide (according to types of vehicle)
Methods of placement□Types of calcium hydroxide (according to types of vehicle)
Types of calcium hydroxide (according to types of vehicle)
□□□□Pulpdent® Tempcanal™
□□□Pulpdent® Tempcanal™
□□Pulpdent® Tempcanal™
□Pulpdent® Tempcanal™
Pulpdent® Tempcanal™
(n=30)□Vitapex™
Vitapex™
(n=30)□□□□Presence & location of voids□Presence & location of voids□□□□A□B□C□
□□□Presence & location of voids□Presence & location of voids□□□□A□B□C□
□□Presence & location of voids□Presence & location of voids□□□□A□B□C□
□Presence & location of voids□Presence & location of voids□□□□A□B□C□
Presence & location of voids□Presence & location of voids□□□□A□B□C□
Presence & location of voids□□□□A□B□C□
□□□A□B□C□
□□A□B□C□
□A□B□C□
A□B□C□
B□C□
C□

A
□B□C□□Level A□Syringe (n=10)□5
B□C□□Level A□Syringe (n=10)□5
C□□Level A□Syringe (n=10)□5
□Level A□Syringe (n=10)□5
Level A□Syringe (n=10)□5
Syringe (n=10)□5
5
□0
0
□5 □3 □1
5 □3 □1
3 □1
1
□6 □□□Syringe + Lentulo (n=10)□7
6 □□□Syringe + Lentulo (n=10)□7

□□Syringe + Lentulo (n=10)□7

□Syringe + Lentulo (n=10)□7

Syringe + Lentulo (n=10)□7

7

□2 □1 □6 □3 □1 □□□Lentulo (n=10)□9

2 □1 □6 □3 □1 □□□Lentulo (n=10)□9

1 □6 □3 □1 □□□Lentulo (n=10)□9

6 □3 □1 □□□Lentulo (n=10)□9

3 □1 □□□Lentulo (n=10)□9

1 □□□Lentulo (n=10)□9

□□Lentulo (n=10)□9

□Lentulo (n=10)□9

Lentulo (n=10)□9

9

□1 □0

1 □0

0

□7 □2 □1 □□Total□21

7 □2 □1 □□Total□21

2 □1 □□Total□21

1 □□Total□21

□Total□21

Total□21

21

□3

3

□6

6

□16

16

□6

6

□8

8

□□Level B□Syringe (n=10)□3

□Level B□Syringe (n=10)□3

Level B□Syringe (n=10)□3

Syringe (n=10)□3

3

□1 □6 □4□2 □4 □□□Syringe + Lentulo (n=10)□8

1 □6 □4□2 □4 □□□Syringe + Lentulo (n=10)□8

6 □4□2 □4 □□□Syringe + Lentulo (n=10)□8

4□2 □4 □□□Syringe + Lentulo (n=10)□8

2 □4 □□□Syringe + Lentulo (n=10)□8

4 □□□Syringe + Lentulo (n=10)□8

□□Syringe + Lentulo (n=10)□8

□Syringe + Lentulo (n=10)□8

Syringe + Lentulo (n=10)□8

8
□2 □0 □7 □2 □1□□□Lentulo (n=10)□10 □0
2 □0 □7 □2 □1□□□Lentulo (n=10)□10 □0
0 □7 □2 □1□□□Lentulo (n=10)□10 □0
7 □2 □1□□□Lentulo (n=10)□10 □0
2 □1□□□Lentulo (n=10)□10 □0
1□□□Lentulo (n=10)□10 □0
□□Lentulo (n=10)□10 □0
□Lentulo (n=10)□10 □0
Lentulo (n=10)□10 □0
10 □0
0
□0
0
□7□2 □1 □□Total□21
7□2 □1 □□Total□21
2 □1 □□Total□21
1 □□Total□21
□Total□21
Total□21
21
□3
3
□6
6
□18
18
□6
6
□6
6
□□

□

Note:

A – No voids

B – Presence of voids within the material

C – Presence of voids at the wall of the canal

Chi-square tests were performed to see the association between the independent and dependent variables. Results from Table 6.6 showed that there was significant interaction between methods of placement and presence/location of voids, p=0.000. Thus, there was significant difference between methods of placement and presence/absence of voids.

Table 6.6: One-to-one interaction between level, methods, types and voids

Interaction□Pearson chi-square□df□Asymp. Sig.
Pearson chi-square□df□Asymp. Sig.
df□Asymp. Sig.
Asymp. Sig.
(2-sided)□□Level*Method

□Level*Method

Level*Method
□0.000□2□1.000□□Level*Voids
0.000□2□1.000□□Level*Voids
2□1.000□□Level*Voids
1.000□□Level*Voids

□Level*Voids

Level*Voids
□0.206□2□.902□□Type*Method
0.206□2□.902□□Type*Method
2□.902□□Type*Method
.902□□Type*Method

□Type*Method

Type*Method
□0.000□2□1.000□□Type*Voids
0.000□2□1.000□□Type*Voids
2□1.000□□Type*Voids
1.000□□Type*Voids

□Type*Voids

Type*Voids
□2.996□2□.224□□Level*Type
2.996□2□.224□□Level*Type

2□.224□□Level*Type
.224□□Level*Type
□Level*Type
Level*Type
□0.000□1□1.000□□**Method*Voids**
0.000□1□1.000□□**Method*Voids**
1□1.000□□**Method*Voids**
1.000□□**Method*Voids**
□**Method*Voids**

Method*Voids

□**35.534**□**4**□**.000**$^{\alpha}$□□$^{\alpha}$ significant at p-value of 0.05

35.534□**4**□**.000**$^{\alpha}$□□$^{\alpha}$ significant at p-value of 0.05

4□**.000**$^{\alpha}$□□$^{\alpha}$ significant at p-value of 0.05

.000$^{\alpha}$□□$^{\alpha}$ significant at p-value of 0.05

□$^{\alpha}$ significant at p-value of 0.05

$^{\alpha}$ significant at p-value of 0.05

Extent of interaction between methods of placement and presence/location of voids was not further analysed using log-linear analysis because significant difference was only noted in two variables.

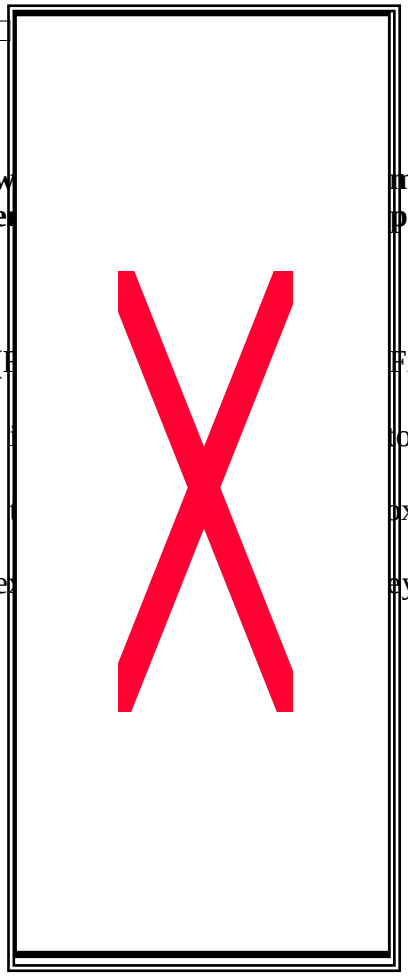
6.4 Three-dimensional investigation

Three-dimensional images of six specimens were obtained using microcomputed tomography (Figure 6.7 and 6.8). These views correspond to those images captured by conventional radiographs. Figure 6.7(a) and 6.8(a) show areas of deficiency of calcium hydroxide filling or voids that were seen along the long axis of the tooth. Less voids were noted when lentulo spiral ±syringe method was used for both types of materials (Figure 6.7(b), 6.7(c), 6.8(b) and 6.8(c)).

(a) (b) (c)

Figure 6.7: Longitudinal views of material Pulpdent® Tempcanal™ for method (a) syringe, (b) syringe + lentulo spiral and (c) lentulo spiral.

SHAPE * MERGEFORMAT



(a) (c)

Figure 6.8: Longitudinal view method (a) syringe, (b) syringe + le piral

The apical areas of these six specimens (F Figure 6.8(a), (b) and (c)) were not captured due to the difficulties i o the specimen holder of the microcomputed tomography. Thus, t oxide filling at the apical area ie. whether the material is at the ape eyond the apex, could not be obtained.

Figures 6.9 to 6.11 show the cross-sectional views at level A and B for Pulpdent® Tempcanal™ obtained from microcomputed tomography for different methods of placement. Almost similar sizes of voids were noted within the material at both levels A and B when syringe method was used (Figure 6.9). Voids were also noted within the material at both levels, however these voids appeared smaller at level B, when syringe+lentulo spiral technique was used for placing the material (Figure 6.10). When only lentulo spiral was used for placing the material, voids were located against the wall of the canal at both level A and B (Figure 6.11).

Figure 6.9: Pulpdent® Tempcanal™ with syringe method

Figure 6.10: Pulpdent® Tempcanal™ with syringe + lentulo spiral method

Figure 6.11: Pulpdent® Tempcanal™ with lentulo spiral method

Figure 6.12 to 6.14 show the cross-sectional views for Vitapex™ at level A and B using different methods of placement, obtained from microcomputed tomography. With the syringe method of placement of material, voids could be seen within the material for both level A and B. Voids within the material were noted when syringe+lentulo spiral technique was used for placing the material, however these voids were much smaller in size. When lentulo spiral method was used for placement of material, the material filled up the canal almost completely and minimal voids were detected against the wall of the canal at both levels.

Figure 6.12: Vitapex™ with syringe method

Figure 6.13: Vitapex™ with syringe + lentulo spiral method

□□ □ □

Figure 6.14: Vitapex™ with lentulo spiral method

Table 6.7 shows the comparison between the percentage of surface area at both level A and B for six specimens obtained from the microcomputed tomography (MCT) and mean value of percentage of surface area for 60 specimens examined under Image Analyser. Analysis of results for levels of cross-sectioning and the methods of placement showed almost similar results when Vitapex™ was used. However, when Pulpdent® Tempcanal™ was used, it was observed that the percentage of surface area of material was much lower when the results were analysed with MCT, regardless of methods of placement and levels of cross-sectioning. Due to the small sample size that was sent for the 3-dimensional views, statistical analysis was not carried out.

Table 6.7: Percentage of surface area from 3-dimensional and 2-dimensional views

Level of cross sectioning□Types of calcium hydroxide□Methods of placement
Types of calcium hydroxide□Methods of placement
Methods of placement
□□□□Syringe
□□□Syringe
□□Syringe
□Syringe
Syringe
□Syringe+Lentulo
Syringe+Lentulo
□Lentulo□□□□Percentage of
Lentulo□□□□Percentage of
□□□Percentage of
□□Percentage of
□Percentage of
Percentage of
surface area (%)□Percentage of
Percentage of
surface area (%)□Percentage of
Percentage of
surface area (%)□□□□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□□
□□□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□□

□□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□□
□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□□
MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□□
Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□□
MCT (n=2)□Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□□
Image Analyser (mean value, n=20)□MCT (n=2)□Image Analyser (mean value, n=20)□□
MCT (n=2)□Image Analyser (mean value, n=20)□□
Image Analyser (mean value, n=20)□□

□

Level A (10mm from the base of the curvette)□Pulpdent® Tempcanal™
Pulpdent® Tempcanal™
□75.00□93.00□74.70□95.21□79.69□97.89□□□Vitapex™
75.00□93.00□74.70□95.21□79.69□97.89□□□Vitapex™
93.00□74.70□95.21□79.69□97.89□□□Vitapex™
74.70□95.21□79.69□97.89□□□Vitapex™
95.21□79.69□97.89□□□Vitapex™
79.69□97.89□□□Vitapex™
97.89□□□Vitapex™

□□Vitapex™

□Vitapex™
Vitapex™
□90.03□90.05□94.28□93.47□94.05□93.80□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™
90.03□90.05□94.28□93.47□94.05□93.80□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™
90.05□94.28□93.47□94.05□93.80□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™
94.28□93.47□94.05□93.80□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™
93.47□94.05□93.80□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™
94.05□93.80□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™
93.80□□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™

□Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™
Level B (5mm from the base of the curvette)□Pulpdent® Tempcanal™
Pulpdent® Tempcanal™
□78.12□87.54□82.26□97.96□86.11□98.97□□□Vitapex™
78.12□87.54□82.26□97.96□86.11□98.97□□□Vitapex™
87.54□82.26□97.96□86.11□98.97□□□Vitapex™
82.26□97.96□86.11□98.97□□□Vitapex™
97.96□86.11□98.97□□□Vitapex™
86.11□98.97□□□Vitapex™
98.97□□□Vitapex™

□□Vitapex™

□Vitapex™

Vitapex™
□93.25□91.82□97.47□94.12□95.65□91.62□□

93.25□91.82□97.47□94.12□95.65□91.62□□

91.82□97.47□94.12□95.65□91.62□□

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94.12□95.65□91.62□□

95.65□91.62□□

91.62□□

□

6.5 Summary of findings

The main findings from this study are as follows:

1. Quality of filling - radiographs:-

(a) There was no significant difference in quality of filling when different types of vehicles of calcium hydroxide were used (p=0.810).

(b) Although higher proportion of material extruded from the apex when the lentulo spiral method of placement was used, irrespective of whether it was done with or without the syringe, analysis of results showed that there was no significant difference in quality of filling using different methods of placement (p=0.239).

2. Quality of filling - percentage of surface area:-

(a) Highest mean percentage of surface area was noted in Pulpdent® Tempcanal™ group. However, statistically, there was no significant difference between the two materials (p=0.127).

(b) Significant difference was noted for different methods of placement at level B only (p=0.005). Post-hoc Games-Howell test indicated that this difference was between the syringe and syringe+lentulo spiral method (p=0.035).

3. Presence/location of voids from the cross-sections:-

(a) No voids were noted in most of the specimens at level A and B when lentulo spiral method of placement was used, irrespective of whether it was done with or without syringe for both types of calcium hydroxide. Higher proportion of specimens with voids adjacent to the wall of the canal was noted when syringe technique only was used for placing the material, irrespective of level of cross-sectioning and types of vehicles of calcium hydroxide.

(b) There was no significant interaction between types of vehicles of calcium hydroxide and presence/location of voids (p=0.224). However, significant interaction was noted between different methods of placement and presence/locations of voids (p=0.000).

4. Comparison of percentage of surface area between 2-dimensional and 3-dimensional views indicated that:-
    a) Higher percentages of surface area were noted from the 2-dimensional views for the three types of method of placement at both levels A and B in Pulpdent® Tempcanal™ group.
    b) Almost similar percentages of surface area were obtained from 2- and 3-dimensional views, irrespective of different methods of placement and level of cross-sectioning in Vitapex™ group.