A microscopic space always exists between the restoration and the prepared cavity due to lack of adhesion of restorative materials which results in passage of saliva and salivary products between the cavity wall and restorative material applied to it. This clinically undetectable passage of bacteria, fluids, molecules, or ions has been defined as marginal leakage or microleakage. Recent studies have shown that coronal microleakage is a significant factor in the prognosis of root canal treatment. The coronal two-thirds of each canal were flared using Gates-Glidden drills up to no. 3 size and obturated with Gutta-percha using zinc oxide-eugenol (ZnOE) as sealer. The teeth were then randomly selected and divided into six groups out of which four were experimental groups and two control groups. The teeth were then immersed in 2% methylene blue dye solution for 3 days. All sealing materials and Gutta-percha were gently removed from the walls of the canal, and the entire circumference of the canal wall examined for dye penetration.

**Results:** The lowest mean leakage was in the Fermit-N group followed by Cavit-W, ZnOE, intermediate restorative materials (IRM), and positive control. **Conclusion:** Fermit-N showed better sealing ability compared to cavit, ZnOE and IRM.

**ABSTRACT**

**Introduction:** In multiple-appointment root canal treatment, a temporary filling material is used to seal the access cavity between visits. The primary function of this material is to prevent the contamination of the root canal system by fluids, organic debris, and bacteria from the oral cavity. **Material and Methods:** A total of fifty extracted noncarious unrestored human maxillary anterior teeth with intact crowns and roots were selected. The canals were instrumented using stepback technique and sodium hypochlorite (3%) and hydrogen peroxide (3%) were used as irrigants for each specimen alternatively. The coronal two-thirds of each canal were flared using Gates-Glidden drills up to no. 3 size and obturated with Gutta-percha using zinc oxide-eugenol (ZnOE) as sealer. The teeth were then randomly selected and divided into six groups out of which four were experimental groups and two control groups. The teeth were then immersed in 2% methylene blue dye solution for 3 days. All sealing materials and Gutta-percha were gently removed from the walls of the canal, and the entire circumference of the canal wall examined for dye penetration. **Results:** The lowest mean leakage was in the Fermit-N group followed by Cavit-W, ZnOE, intermediate restorative materials (IRM), and positive control. **Conclusion:** Fermit-N showed better sealing ability compared to cavit, ZnOE and IRM.
• Ease of insertion and removal
• Compatibility with the drug used
• Good esthetic appearance.

A number of temporary materials have been advocated for use in provisional restoration, but studies of their sealing ability have often shown contradictory results.\cite{6,7}

**Materials and Methods**

This study was conducted in the Department of Conservative Dentistry and Endodontics, Yenepoya Dental College, Mangalore.

**Selection of teeth and storage**

A total of fifty extracted noncarious unrestored human maxillary anterior teeth with intact crowns and roots were selected. They were stored in 10% formalin until the beginning of the study. The teeth were cleaned of calculus and debris using ultrasonic scaler under water spray and kept in 3% sodium hypochlorite solution for 24 h to remove any organic debris.

**Biomechanical preparation of teeth**

The canals were instrumented using stepback technique and sodium hypochlorite (3%) and hydrogen peroxide (3%) were used as irrigants for each specimen alternatively. The coronal two-thirds of each canal were flared using Gates-Glidden drills up to no. 3 size.

**Obturation**

The specimens were obturated with Gutta-percha using zinc oxide-eugenol (ZnOE) as sealer and by lateral condensation with vertical compaction technique.

**Coronal sealing**

Gutta-percha was removed from the coronal part of the teeth using a heat carrier instrument up to 3.5 mm. The teeth were then randomly selected and divided into six groups out of which four were experimental groups and two control groups [Table 1]. In experimental groups, there were 10 teeth each and control groups had five teeth each.

**Evaluation of linear dye penetration**

The roots of all experimental groups and the positive group were coated with three layers of nail varnish except for the area of coronal orifice. Teeth in the negative control group had the entire surface including coronal orifice were coated with nail polish. The teeth were then immersed in 2% methylene blue dye solution for 3 days. All sealing materials and Gutta-percha were gently removed from the walls of the canal, and the entire circumference of the canal wall examined for dye penetration. The distance from the canal orifice to the maximum depth of dye penetration was recorded and calculated in millimeters. The data were then subjected to statistical analysis and the difference in the sealing ability of the different materials were compared [Figure 1].

**Results and Analysis**

The dye penetration was observed in all groups except the negative control teeth. The positive control group observed the maximum leakage. The lowest mean leakage was in the Fermit-N group followed by (in ascending order of dye penetration) Cavit-W, ZnOE, intermediate restorative materials (IRM), and positive control [Graph 1 and Table 2].

**Discussion**

Endodontic treatment is aimed at preventing microorganisms from entering the root canal system or eliminating them if

### Table 1: Groupings of temporary restorative materials used in the study

| Groups | Temporary restorative materials | Number of teeth |
|--------|---------------------------------|-----------------|
| 1      | IRM                             | 10              |
| 2      | Cavit-W                         | 10              |
| 3      | Fermit-N                        | 10              |
| 4      | ZnOE                            | 10              |
| 5      | Positive control                | 5               |
| 6      | Negative control                | 5               |

IRM: Intermediate restorative materials

### Table 2: Mean leakage between groups

| Groups               | Mean   | SD    |
|----------------------|--------|-------|
| IRM                  | 1.4460 | 0.3276|
| Cavit-W              | 0.9230 | 0.2226|
| Fermit-N             | 0.7610 | 0.1999|
| ZnOE                 | 1.2600 | 0.3029|
| Positive control     | 1.5480 | 0.4216|
| Negative control     | 0      | 0     |

IRM: Intermediate restorative materials, SD: Standard deviation

Graph 1: Comparison of mean leakage between groups

Figure 1: Dye penetration from Group 1–6
already present. Thereafter, a fluid-tight seal is obtained to prevent bacteria from invading the apex. However, in recent years, research was directed more toward the coronal seal of teeth. Coronal leakage studies after completion of endodontic treatment have shown that the canal obturating techniques and materials do not provide fluid tight seal.

Fermit-N is a single component light-curing system for temporary restoration, newly introduced in the market. Its good sealing ability could be due to:

- Immediate setting of the material when exposed to visible light source
- It undergoes hygroscopic expansion on exposure to fluids and thereby compensating for polymerization shrinkage and produce an excellent seal
- Premixed temporary materials provide excellent seal according to findings of Marosky et al., Chohayeb and Bassiouny and Anderson et al.

Cavit was the second best material observed in the study. This has been attributed to:

- Cavit has high linear expansion during setting
- Cavit showed good sealing properties before and after thermocycling
- It is a premixed paste
- The coefficient of linear expansion for cavit was almost double that of ZnOE, which explains its effectiveness as a temporary filling material.

ZnOE and IRM have shown poor sealing qualities. The poor sealing quality of ZnOE could be due to:

- Low compressive strength
- Nonadherence to tooth structure
- Large dimensional fluctuations resulting from thermocycling

IRM demonstrated the greatest dye penetration of all the specimens. This could be due to:

- Thermocycling procedures. Deveaux et al. and Parris et al.
- Higher P/L ratio of 6 g/ml Pashley et al.
- Mixing process and resulting lack of homogeneity Deveaux et al.
- Variations in the volume of IRM due to contraction Deveaux et al.

**Conclusion**

Dye penetration was observed in the entire specimen except in the negative control group. Fermit-N showed better sealing ability compared to all other materials used in the study. Cavit-W was the second best material. ZnOE showed better sealing properties than IRM. IRM showed the maximum dye penetration of all the materials.

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**Conflicts of interest**

There are no conflicts of interest.

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