

## Evaluation of Sealing Ability of Biodentine as Retrograde Filling Material by Using two Different Manipulation Methods: An *In Vitro* Study

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### Abstract:

**Background:** The study was aimed to evaluate the microleakage of Biodentine using two different manipulation methods by dye penetration.

**Materials and Methods:** A total of 60 single-rooted human maxillary permanent teeth were cleaned and obturated with gutta-percha using lateral condensation method. Standardized root-end cavities were prepared after apical resection. All teeth were divided randomly into two groups of 30 specimens and were filled with Biodentine by trituration and hand manipulation methods. The samples were coated with varnish and immersed in 1% methylene blue dye for 72 h. Then the teeth were sectioned longitudinally and observed under a stereomicroscope. The depth of dye penetration was measured in millimeters.

**Results:** There was highly statistical significant difference observed between Group I and Group II ( $P < 0.001$ ) when dye penetration scores were compared.

**Conclusion:** More microleakage was seen when Biodentine was manually manipulated as compared to machine trituration.

**Key Words:** Anterior teeth, biodentine, microleakage, root-end filling, trituration

### Introduction

Most of the endodontic failures occur due to the microorganisms which persists after the conventional treatment or due to the

entry of the same through coronal leakage.<sup>1</sup> The success of surgical endodontics is again determined by the apical seal which prevents the entry of microorganisms and the tissue fluid in the periapical region in either direction.

Numerous materials have been tested previously for the apical seal such as amalgam, glass ionomer cement, zinc oxide eugenol based cements,<sup>2</sup> and mineral trioxide aggregate (MTA).<sup>3</sup> MTA has all the properties of root end filling material except its handling properties because of long setting time of 2 h 45 min and the requirement of additional moisture for activation of setting reaction.<sup>4</sup> In this series of development, many new materials have been added and tried as root-end filling materials such as bioaggregate, ceramicrete<sup>5</sup> and Biodentine.<sup>6</sup>

Biodentine is a new material based on calcium silicate technology. The powder contains dicalcium silicate, tricalcium silicate, calcium carbonate and iron oxide, and zirconium oxide filler. Liquid consists of calcium chloride which is acting as accelerator and a polymer which is acting as a water reducing agent.<sup>7</sup> Due to its better handling properties with a setting time of around 45 min,<sup>7</sup> this material can be alternatively used as a retrograde filling material. Pawar *et al.*, successfully treated a large periapical lesion using Biodentine as retrofilled material in their 18 months follow-up case study.<sup>8</sup>

The manufacturer advocates the trituration method of manipulating the cement. However, in doing so a lot of material is getting wasted. There is no evidence of any study which compares the marginal adaptation of Biodentine by hand manipulation. Hence, this study was carried out to compare the sealing ability of Biodentine as a root end filling material by two different manipulation techniques using stereomicroscopy.

### Materials and Methods

Sixty ( $n = 60$ ) (Figure 1) extracted maxillary anterior teeth with completely formed apices and straight canals were taken for this study and were divided into two groups of 30 each for performing the study. The teeth were cleaned using ultrasonics. Access cavities were made using endo access bur and working length was measured. Cleaning and shaping were done using ISO standardized 2% K file till 50 number apically and thereafter till 80 number coronally. Between each sequential filing RC Help was used as a lubricant. The irrigant solution was 20 ml of 0.5% NaOCl for each tooth. After cleaning and

shaping, paper points was used to dry the root canals and then obturated with gutta-percha by lateral compaction technique. The quality of obturation was assessed by radiographs and access cavities were sealed with composite resin restorative material after 24 h. An apical resection at 90° to the long axis of the tooth was made at 3 mm from the end of the root. Root-end cavities of 3 mm were prepared with a straight fissure diamond bur. Then the root end restoration was done with Biodentine (Figure 2) by manipulating with trituration method in Group I and by hand manipulation in Group II. Then tooth surface were coated with nail varnish except at the apex and were allowed to dry. The specimens were then immersed in 2% methylene blue for 24 h. Following this the teeth were rinsed for 15 min under distilled water. Sectioning was done in mesiodistal direction and samples were observed under stereo microscope at high magnification and microleakage was evaluated in millimeters.

The scores are given according to the dye penetration as follows:

- 0 – No dye penetration (Figure 3)
- 1 – Dye penetration between 0 mm and 1 mm (Figure 4)
- 2 – Dye penetration between 1 mm and 2 mm (Figure 5)
- 3 – Dye penetration between 2 mm and 3 mm (Figure 6).

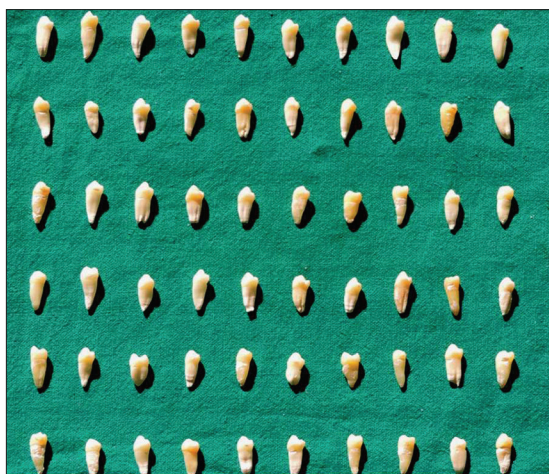


Figure 1: Tooth sample.



Figure 2: Biodentine material.

## Results

Mann–Whitney test was used for comparing penetration score between mechanical trituration and hand manipulation.  $P < 0.05$  considered to be statistically significant (Table 1 and Graph 1).

In Group I, 14 samples showed no dye penetration whereas in Group II all the samples showed some amount of dye penetration.

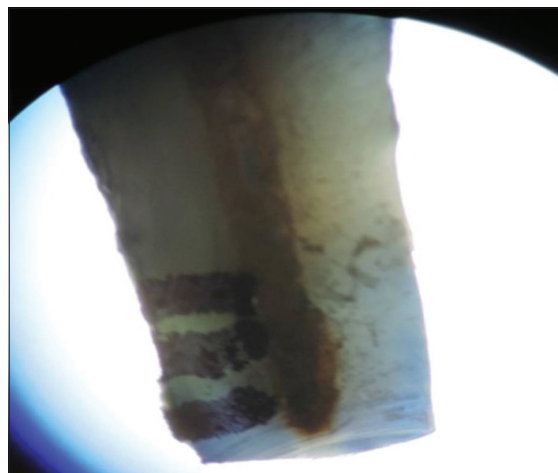


Figure 3: No dye penetration.

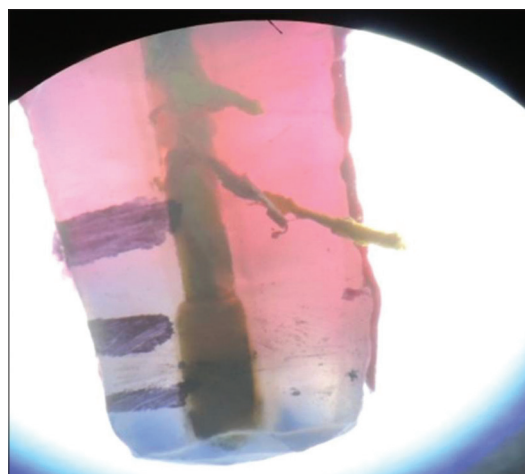


Figure 4: Dye penetration between 0 mm and 1 mm.

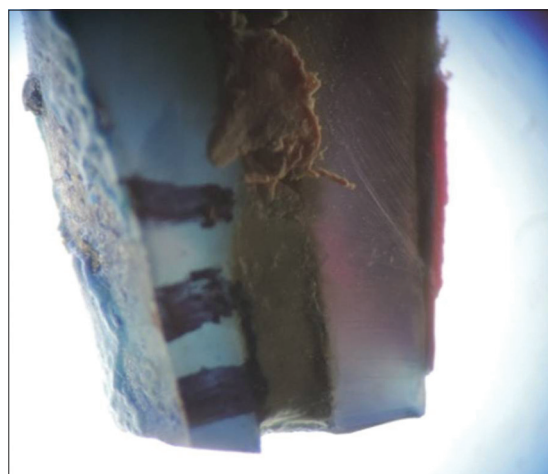


Figure 5: Dye penetration between 1 mm and 2 mm.

13 samples showed 1 mm dye penetration in Group I compared to only 7 samples in Group II.

16 samples showed 2 mm dye penetration in Group II compared to 3 samples in Group I. None of the samples in Group I showed 3 mm dye penetration.

There was highly statistical significant difference observed between Group I and Group II ( $P < 0.001$ ) when dye penetration scores were compared.

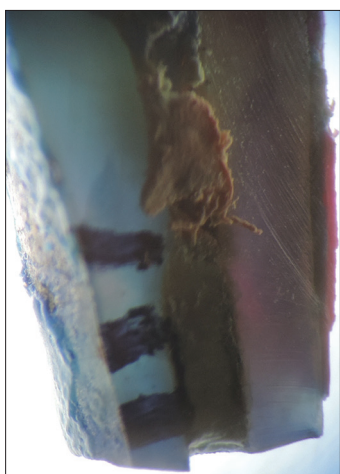
**Discussion**

The post-surgical healing of periradicular tissues depends upon the removal of all the irritants from the area surrounding the apex and stopping the entry of the newer ones into the area. The root-end filling material serves as a barrier for the possible

irritants against reentering into the periapical region. Gartner and Dorn<sup>9</sup> suggested that an ideal root-end filling material should provide a three-dimensional seal to prevent leakage of microbial irritants into the periapical tissues. In addition, the material should be compatible with apical tissues, provide long-term stability and good handling properties. There are various substances which were previously tried as root-end filling materials. The selection of material depends on the physical and biological properties such as sealing ability, biocompatibility, and handling characteristics.

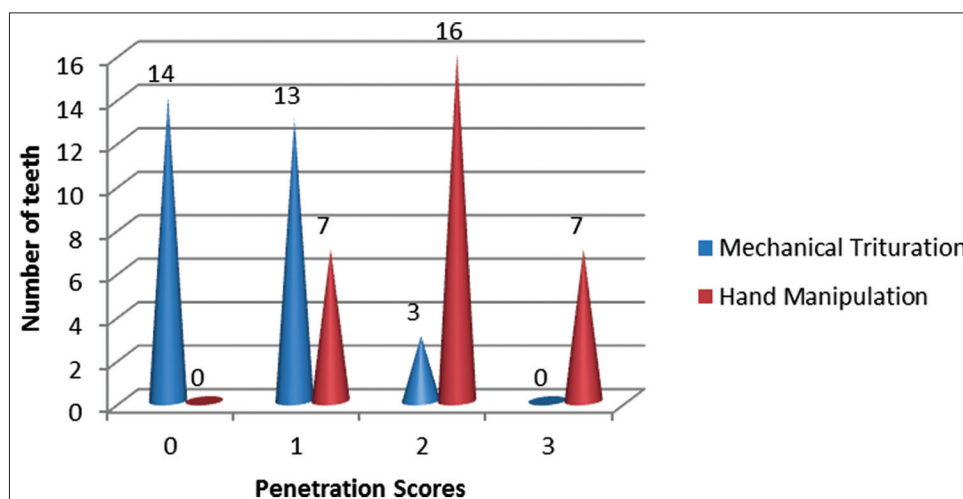
MTA is used as root-end filling material since inception and showed better sealing properties than amalgam, super ethoxybenzoic acid and vitremer irrespective of the type of root-end cavity preparation.<sup>10-13</sup> Although MTA is showing good results as retrograde filling material, but it has certain limitations also such as long setting time and high cost.<sup>14,15</sup> The basic constituents of Biodentine is same as compare to MTA. The manufacturers claim that it's modified xpowder composition i.e., the addition of setting accelerators and softeners, a new pre dosed capsule formulation for use in a mixing device largely improve the physical properties of the material making it more user-friendly.

As there is no literature available comparing the manipulation techniques for Biodentine as a root-end filling material, so we compared the sealing ability with different manipulation techniques. The results of this study showed that both (trituration and hand manipulation) techniques exhibited microleakage, but the extent of microleakage was significantly less in Biodentine manipulated mechanically when compared to hand manipulation. This can be attributed to the fact that mechanical trituration produces a more homogenous mix as compare to manual mixing. Furthermore, the water powder ratio will be altered in manual mixing resulting in non-homogenous mix.



**Figure 6:** Dye penetration between 2 mm and 3 mm.

Table 1: Penetration scores of mechanical trituration and hand manipulation.				
Scores	0	1	2	3
Mechanical trituration (n=30)	14	13	03	00
Hand manipulation (n=30)	00	07	16	07



**Graph 1:** Penetration score of mechanical trituration and hand manipulation.

## Conclusion

Within the limits of this study, the following conclusions were drawn: More microleakage was seen when Biodentine was manually manipulated as compared to machine trituration. Further, studies should be conducted in order to suggest a proper powder to liquid ratio for proper hand manipulation of the material as in trituration lot of material is wasted.

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