

# Comparative Evaluation Of The Sealing Ability Of Biodentine Carried Out Under Three Different Working Conditions Using Glucose Penetration Method –An In Vitro Study

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**Abstract:**

**Background:** *An endodontic treatment aims to recover and maintain dental elements, which have pulpal or endodontic periapical pathology, thus eliminating the microorganisms to ensure an acceptable apical seal.*

**Objectives:** *The three different conditions using naked vision, loupes and Dental operating Microscope were compared here to test the sealing ability of biodentine using glucose penetration method.*

**Methods:** *Ninty mandibular bicuspid were selected that were further divided into three groups (n=30) for which canal were prepared using F2 ProTaper Universal (Dentsply Maillefer, Switzerland) and a retrograde cavity is prepared in each of the extracted single rooted tooth using poultra surgical tip (Dentsply, USA) 3mm short of apex . Cavity was then filled with biodentine condensed against plugger placed inside the canal. All the procedure were confirmed under unaided vision/ naked vision, under dental loupes (IDS Denmed 3.3X). and under Dental operating Microscope (Carl zeiss 12.5X) for each group. All the samples were then analyzed with a spectrophotometer at a suitable wavelength. The (ANOVA) test of comparison was analysed for multiple groups preceded by the post hoc pair-wise comparison test.*

**Results:** *The filling of biodentine is observed under dental operating microscope that showed better sealing properties when compared to the unaided vision and dental loupes, thus proving statistically significant. The glucose leakage evaluated under working conditions namely unaided vision, dental loupes and Dental operating Microscope were 0.236, 0.111 and 0.055 respectively.*

**Conclusion:** *The restoration done under Dental operating Microscope showed superior sealing properties when compared to the other working conditions respectively.*

**Keywords:** *Biodentine; Liquid photo- spectrometer; Glucose penetration model; Dental operating microscopes; Dental loupes.*

**Introduction:**

The blind folded procedures in the field of endodontics are challenging. It is essential to appreciate a tool that can justify the purpose of a good endodontic outcome in the field of non-surgical and surgical endodontics.[1] Two important developments in surgical endodontics include the ultrasonic root end preparation and the use of dental operating microscope.[2] Biodentine is a biocompatible material that adheres to the dentin under dislocating force with a good marginal adaptation.[3] Moreover; the majority of the studies on micro-leakage were accomplished on dye penetration test that has few limitations.[4] In the current study, micro- leakage is the assessed by a newly introduced method using glucose penetration model.[5] These enormous developments have improved the endodontic precision further, thus creating ease at work for general dentists irrespective of dependence on selective specialists.

The purpose of an operating microscope mainly includes the search the location of unidentified canals or any physiological discrepancy, retrieval of worn out implement apparatus ; and bio mechanical preparation errors, followed by apical resection.[6] Further to this, DOM when in association with the recent rapid materiology provided phenomenal results .[7] Keeping in mind; the entire above criteria, a study was performed to investigate and compare the efficacy of micro-leakage of bio-dentine (Septodont) in root canal using different criteria based situation namely: naked vision, dental loupes, DOM using liquid photo- spectrometer.

## Materials and methods:

The inclusion and exclusion criteria comprised of ninety human mandibular first bicuspid freshly extracted for orthodontic purpose which were preserved in a concentration of 0.2 percent NaN<sub>3</sub>. The tooth length was adjusted with K file no.10 (Mani, Japan) until the apical foramen is visible. The diamond disc was used to section the crown portion of the tooth so as to ensure an optimal length of 15 mm. The coronal part of 4mm of the prepared tooth models are packed in the acrylic to form a cylindrical sphere around the tooth root that enabled a close connection to the rubber tube with the prepared model using glucose penetration apparatus.

The working length was determined for which the instrumentation is done apically upto F2 Protaper universal. The irrigation of each canal was thoroughly done with 3% NaOCl (Vishal, India) after every instrumentation. The groups of prepared tooth specimens of the root (n=30) are divided below :

For group A specimens, a retrograde cavity was prepared with poultra surgical tip (Dentsply, USA) upto 3mm. Cavity was filled with bio-dentine condensed against plugger placed inside the canal upto 3 mm apically short. All the prepared specimens are confirmed under unaided vision.

GROUP B: Retrograde cavity was prepared with poultra surgical tip (Dentsply,USA) upto 3mm. Cavity was filled with bio-dentine condensed against plugger placed inside the canal 3 mm apically short. All the prepared specimens are confirmed under dental loupes. (IDS Denmed 3.3X)

GROUP C: Retrograde cavity was prepared with poultra surgical tip (Dentsply, USA) upto 3mm. Cavity was filled with bio-dentine condensed against plugger placed inside the canal 3 mm apically short. All the prepared specimens are confirmed under DOM (Carl zeiss, 12.5X)The storage of the specimens were done for a week at normal temperature of 37 degree and complete humidity was maintained to ensure proper setting of bio-dentine respectively.

Preparation of glucose penetration setup and evaluation of micro- leakage: The coronal portion of tooth root encircled in the resin block was attached to a pipette of length 16 cm using a stainless steel wire through a rubber tube. The entire apparatus was assembled in a sterile glass bottle with an attached screw cap that was drilled with a diamond bur (SF 41, Mani, Japan) to form an open system.(Fig. 1).

The prepared models root were fully dipped in two millilitres of 0.2% NaN<sub>3</sub> solution of the glass bottle. The tracer 1 mol L<sup>-1</sup> glucose solution (pH 7.0) used is hydrophilic in nature, with a low molecular weight and stable in nature chemically. The hydrostatic pressure of 1.5 kPa is created in such a way to draw 4.5 mL of glucose solution containing 0.2% sodium azide into the pipette to achieve top of tooth height 14 cm lower than the top of the solution. (Xu et al. 2005).

All the prepared models were incubated at 37C for 4 weeks. A micropipette was used to draw 100 micro.L of solution from the glass bottle. The analysis of the solution were done in glucose kit (Megazyme, Wicklow, Ireland) with a suitable wavelength of 340nm using spectrophotometry for the above three different group conditions.

## Results:

The comparative statistical analysis of data was performed to attain significant results. The parametric tests were performed for the analysis of continuous type data.

ANOVA test was performed to obtain a statistical data for group-wise comparisons preceding the post hoc pair-wise comparative analysis for multiple group values.

Mean values, standard deviations of micro-leakage values are shown in Table 1. For graph 1, each bar depicts mean micro-leakage values for the different groups.

The overall ANOVA results showed significant level at 5% amongst the different group comparisons for the mean values of each group comparison showing significant difference in the sealing properties. Post-hoc pair wise test reveal statistical difference that was significant at 5% for the micro leakage values for individual groups as shown in Table 2.

Sealing ability of bio-dentine performed under three working conditions are as follows:

▫ Unaided vision < Loupe < DOM

### **Discussion:**

The concept of surgical endodontics is to attain a comprehensive biomechanical preparation and obturation with precision at the apical end of the root canal which can be made accessible through surgical flap when compared to the conventional access cavity preparation.[8] Earlier a straight or contra angle hand-piece with an attached round or inverted cone carbide bur were used for class I cavity preparation. It's disadvantage being an impossible approach to prepare a longitudinal access along the buccal surface of the root canal, thus hampering the retention of the cavity ultimately leaving the chances of either lingual/ palatal perforation whatsoever.[9] The retro preparation often failed to include the isthmus area, for the diameter of root canal required burs of sufficient size, thereby inability to seal the bigger cavity further. The advent of enormous development in surgical endodontic overcome the above limitations. The ultrasonic class I cavity preparation at the root end should be at least 3 mm deep into the dentinal wall coinciding with the anatomic outline of pulpal space for which special ultrasonic tips are designed. This preparation could also limit the necessity of making undercut for further retention. With a conservative approach through mesio-distal preparation, the isthmus area can be included further to avoid root weakening/ damage.[10,11] Use of surgical loupes increased the visibility of field having varied configurations and magnifications upto 6X with Galilean / prismatic optics. Use of fiber optic headlamp with loupes initiated coaxial light that enhanced the magnification & illumination of the surgical field.[12] Clinicians soon investigated that the magnification of loupes 6X was not sufficient enough to appreciate the depth of the canal during surgical and non-surgical endodontics. Comparatively co-axial illumination of the Dental operating microscope with the magnification range of 2.5X - 25X had two advantages.[13]

- Clean retro preparation field with no shadows was observed during surgical endodontics.
- The Galilean optics when focused at infinity due to coaxial illumination prevented the operator's eye from fatigue.

It is further convinced here that in order to achieve a precise incision with fewer traumas to soft tissues in surgical endodontics, use of microscope is essential for easy flap elevation and reapproximation.[10]

Dyes, radioisotopes, and bacteria penetration methods[14-19] were previously tested for the micro leakage of root canal filling material. However, the studies had unclear clinical implication with regards to sealability to endodontics.[20-23]. A new glucose model[5] was constructed to measure the continuous quantitative micro-leakage analysis of the sealing material .[24]. [25] Few authors reported superior sensitivity for glucose penetration model compared to the fluid penetration model for measuring the sealing ability.[26,27]. However a tracer material having a specific molecular weight (MW = 18 Da) with defined ability test influenced the above results.[28] Also a humid environment was essential for the same to prevent evaporation of the fluids.

A unique active bio-silicate technology biocompatible to both restorative and endodontic purposes was designed to treat the damaged dentin.[29] Bio-dentine contains accelerator that

initiates faster setting thus preventing bacterial influence, thereby conserving the physical stability of the material with ease of use when compared to obturation with MTA.[30]

Use of the DOM not only reduced the clinical errors during cavity preparation, but also initiated a good marginal adaptation of material during restoration, that minimized the chances of micro-leakage by providing a greater precision and visualisation with excellent accuracy for long term results. Within the limitations of the above study performed under in vitro conditions, the mean micro-leakage obtained for the three different criteria namely naked vision, dental loupes at 3.3X magnification and dental microscope at 12.5X magnification are 0.236, 0.111, and 0.055 respectively.

#### Conclusion

The bio-dentine filling observed under dental operating microscope showed better sealing properties when compared to the other working conditions namely: unaided vision and dental loupes. Therefore, the study showed good sealing ability with increased magnification for each observed groups.

Thus the use of DOM should be encouraged amongst all general practitioners and specialists to minimize the clinical errors encountered in the routine dental practice, to obtain a greater precision with optimum consistency, thus ensuring excellent endodontic results.

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Fig – 1

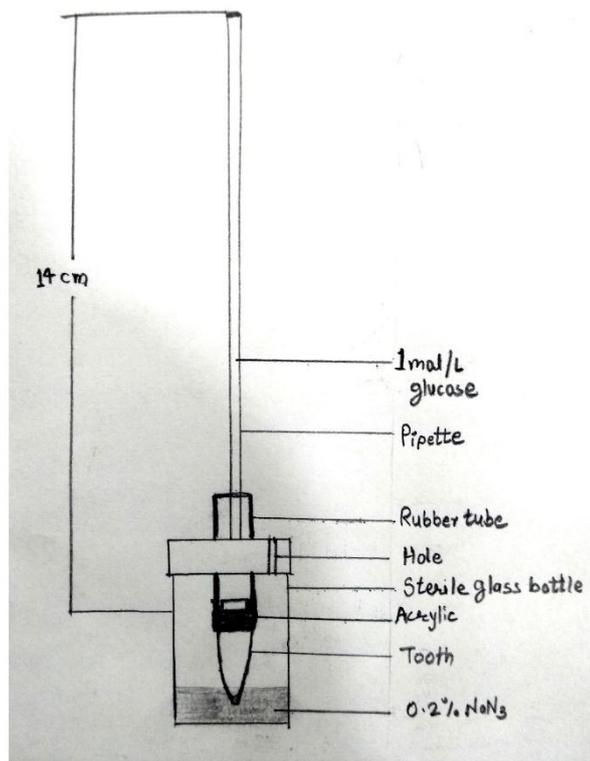


TABLE 1

Groups	Average	SD
GROUP A (n= 30)	0.236	0.17135565
GROUP B (n= 30)	0.111333	0.075873458
GROUP C (n= 30)	0.055733	0.042122099

TABLE 2

Groups	p value	Significant/Non-significant.
Unaided vision Vs DOM	<0.001	Significant
Unaided vision Vs Dental loupes	0.0005	Significant
Dental loupes Vs DOM	0.0008	Significant

Graph -1

