

Evaluating Modern Root Canal Obturation Techniques and their Effect on Microleakage

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Abstract

Introduction: Reliable obturation of root canals is a critical step in endodontic treatment, ensuring a dense and hermetic filling of the canal spaces and their accessory branches with sealing materials. The primary goal is to eliminate communication between the periapical tissues and the tooth's pulp chamber, thereby creating a biological barrier. Proper root canal filling prevents the ingress of periapical exudate into the canal as well as the leakage of intraradicular fluid into periapical tissues, both of which contribute to secondary infection and the development of complications. Additionally, advancements in modern obturation techniques and materials have significantly improved the sealability and durability of root canal fillings, further enhancing treatment outcomes and reducing the risk of long-term failure.

Method: An in vitro study was conducted to compare the effectiveness of root canal obturation using 30 extracted single-rooted teeth. The teeth were divided into three groups:

- Group 1 (n=10): lateral condensation with gutta-percha and AH Plus sealer (Dentsply)
- Group 2 (n=10): injection technique with E&Q Master (META) and AH Plus sealer
- Group 3 (n=10): Therafil system (Dentsply Sirona) and AH Plus sealer

All canals were prepared with ProFile instruments (Dentsply) to size 30/04 and irrigated with 5.25% sodium hypochlorite. After obturation, teeth were submerged in 1% methylene blue for 24 hours, sectioned at 2, 5, and 7 mm from the apex, and dye penetration was analyzed under 10x magnification to evaluate microleakage.

Results: The results of this experimental study revealed varying levels of intracanal seal quality among the different obturation techniques. Root canal obturation using the lateral condensation method showed significant microleakage. Dye penetration at the 2mm level was observed in 50% of cases, while at 5mm and 7mm levels, it was 30% ($p < 0.02$). This suggests that, even with radiographically confirmed adequate obturation, the lateral condensation technique does not reliably seal the apical foramen, potentially leading to complications. In contrast, the injection technique demonstrated superior results, with dye penetration at the 2mm level in only 10% of cases ($p > 0.05$), and no dye penetration observed at 5mm or 7mm levels in 100% of cases ($p < 0.001$). These findings highlight the high reliability of three dimensional obturation using the injection method for preventing apical microleakage. The Therafil system, included as a third group in the study, performed better than the lateral condensation method but slightly below the injection technique. At the 2mm level, dye penetration was observed in 20% of cases, while no dye penetration was recorded at the 5mm and 7mm levels in 90% of cases ($p < 0.01$). Although Therafil's carrier-based system provides more consistent filling and better apical sealing compared to lateral condensation, it is slightly less effective than the injection technique in achieving complete three-dimensional canal obturation, particularly in irregular canal anatomy.

Conclusions: The study revealed that obturation techniques vary significantly in their ability to provide a hermetic seal. The injection technique demonstrated the best results, achieving complete sealing and preventing microleakage at all levels. The Therafil system, while effective, showed slightly lower performance compared to the injection technique but still outperformed the lateral condensation method. These findings confirm that modern three dimensional obturation techniques, such as the injection method, are the most reliable for achieving a hermetic seal and preventing complications in endodontic treatment.

Keywords

3D obturation of root canal, formation of the root canal, hot gutta percha condensation, lateral gutta percha condensation, Therafil.