

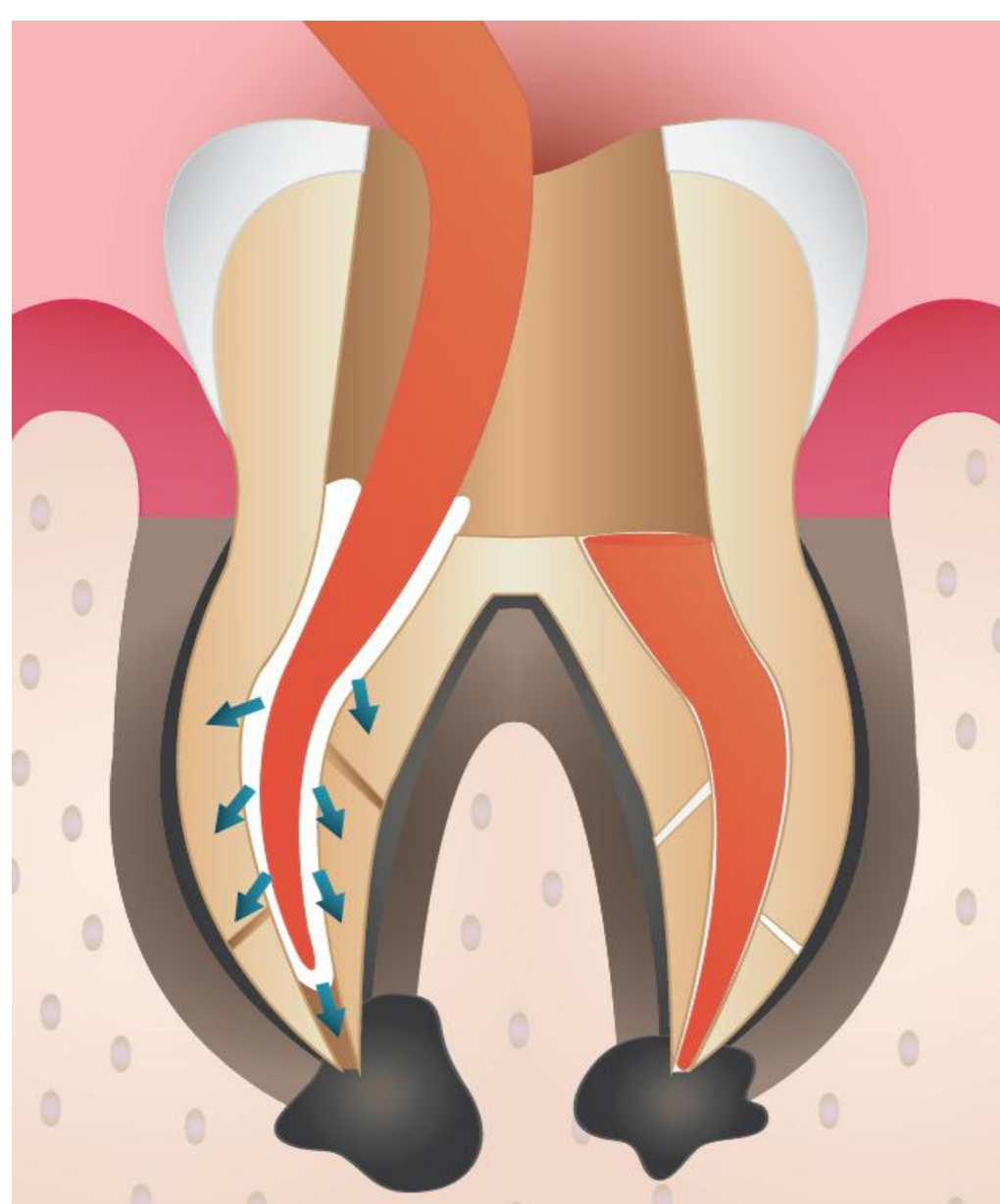
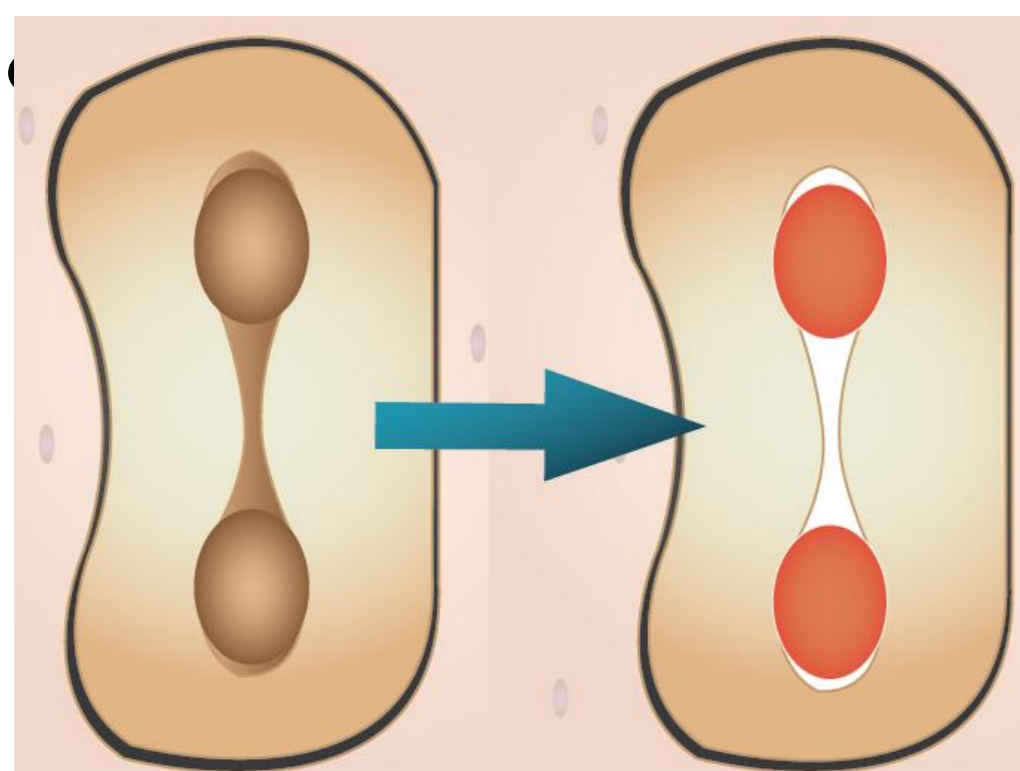
Introduction

Within the field of Endodontics, survival of teeth is of utmost priority. Root canal therapy (RCT) is widely considered an effective and predictable procedure for restoring teeth with pulpal and periapical pathosis, with cited success rates ranging from 90%-95%¹. Salehrabi determined an 8 year survival rate of 97% when assessing insurance data of over 1 million patients treated in the US². With such consistently high success rates, the field of endodontics has been moving towards materials and procedures that aim to maintain success while improving efficiency.

Since traditional root canal sealers exhibit shrinkage on setting, obturation of root canals relies on compaction of gutta percha and reduction of sealer interface to establish a hermetic seal. Gutta percha cones are unable to conform to canal irregularities and provide a three-dimensional seal without being thermoplasticized or laterally condensed, methods that can be technique sensitive and time consuming. The proposed method of obturation offered by this study employs the hydraulic condensation of calcium silicate sealer, rather than gutta percha, to establish hermetic seal. The gutta percha functions as a carrier, a hydraulic plugger, and a path for retreatment, should it be required in the future. This helps increase efficiency and safety of obturation.

The use of calcium silicate sealer as a filler is only possible due to its ideal cement properties. In vitro studies have confirmed strong adherence to canal walls³, lack of shrinkage on setting³, bacteriostasis⁴, insolubility in tissue fluids⁴, and biocompatibility⁵. They have been shown to produce hydroxyapatite on setting, bonding with dentin within the canal⁶. Small particle size and hydrophilic properties allow flow into dentinal tubules, conformation to variations in anatomy, and effective marginal adaptation. Hydraulic condensation of bioceramic sealer eliminates the need for complex techniques requiring heating and compaction of thermoplastic gutta percha.

The goal of this study is to address survival rates of primary RCT using Hydraulic Condensation, a cement based obturation, which relies on its sealer as the component establishing hermetic seal.



Methods

Teeth were selected from consecutive patients treated by a single endodontist, Dr. Allen Ali Nasseh, the first quarter of 2010. Endodontic therapy was performed using the same methodology: cleaning and shaping of canals using crown-down with Endosequence rotary filing system, negative pressure irrigation using 6% sodium hypochlorite activated with ultrasonic. Obturation was by Hydraulic Condensation of Endosequence BC Sealer. Cases were completed single visit. Vital, non-vital teeth, and teeth with periapical lesions were included.

290 patients fit the inclusion criteria. Patients were called in for 5-year follow-up appointments, at which, vitality testing and radiographs were obtained to confirm whether the treated tooth remained asymptomatic. Due to the low turnout (~10%), data collection was changed to phone interviews with patients to confirm retention of the treated tooth and lack of symptoms. Radiographs obtained from patient's general dentists were consulted, when possible, to confirm retention. Of the 290 patients randomly selected, data for 222 patients were collected, (a response rate of 76.6%), yielding 238 teeth. Retreatments and root resections were excluded due to small sample size, leaving 207 primary RCTs: 28 anterior teeth, 35 bicuspid, and 144 molars.

Data was de-identified, and the 5-year survival rate calculated with 95% confidence interval.

Results

The overall five-year survival for the 207 primary root canal-treated teeth observed was found to be 97.6% (95% confidence interval of 94.5%-99.2%). Of the 5 extracted teeth, reasons for failure included lack of full coverage restoration resulting in fracture (2 teeth) significant carious infection (1 tooth), vertical root fracture (1 tooth), and reinfection (1 tooth)

Tooth Type	Anteriors	Bicuspid	Molars	Vital	Necrotic	PARL present	Total
Total	28	35	144	140	65	31	207
Survival (%)	96.43	94.29	98.61	97.86	97.01	96.77	97.58

Discussion

A 97.6% 5-year survival rate of teeth receiving primary RCT using Hydraulic Condensation at 5 years is comparable to the 2004 Salehrabi finding of 97% at 8 years with the added advantage of confirmation of tooth retention and lack of symptoms by each patient via telephone interview. The current study reports survival, as opposed to success rate only because patient-reported lack of symptoms could not be confirmed by in-person examination and radiography for all cases.

Failures were determined to be primarily due to lack of delivery of full coverage restoration, resulting in either tooth fracture or reinfection, rendering the tooth unrestorable. The one reinfection with full coverage may be due to either root canal failure or coronal leakage.

This retrospective study has limitations due to the patient population. As this provider is a specialist, the majority of teeth treated were multi-rooted and/or severely infected teeth that were referred due to complexity. Anterior teeth and bicuspid are under-represented per referral.

Another limitation is the method of analysis. This cohort does not have a control group treated by the same practitioner, so statistical analysis could not be performed. RCTs are multifactorial; variables such as time until full coverage restoration, expertise of dental provider, and patient compliance, cannot be addressed in this study. These results show clinical viability, and are meant to encourage further research into this promising technique.

Conclusion

This retrospective cohort study suggests favorable survival rates may be obtained without the use of thermoplastic or vertically condensed gutta percha should adequate sealer be used to establish hermetic seal. The properties of bioceramic sealer examined in vitro seem to confer the expected advantages in the clinical setting. Hydraulic condensation offers a less technique sensitive and more time efficient method for practitioners, without compromising efficacy of treatment.

Larger sample sizes, longer follow up periods, treatment rendered by general practitioners, and randomized controlled trials could allow a more complete understanding of the clinical promise of obturation via hydraulic condensation of bioceramic sealer. These encouraging results should be a call to action for further long-term clinical studies.

References

1. Torabinejad. *Levels of evidence*. J Endod. 2005, 31:637
2. Salehrabi. *Endodontic Treatment Outcomes*. J Endod. 2004, 30(12):846-50
3. Madhuri. *Comparison of Bond Strength*. J of Conserv Dent. 2016, 19.5:461
4. Zhang H. *Antibacterial activity*. JOE. 2009, 35(7): 1051-5
5. Jingzhi & Haapasalo. *Biocompatibility*. JOE. 2011, 37(6): 793-8
6. Nagas. *Dentin moisture conditions*. JOE. 2011, 38 (2): 240-4