Title: Evaluation of pH and calcium ion release of calcium hydroxide pastes containing different substances

Author: Duarte M et al.


Reviewer: Avedis Encioiu, DDS

Purpose: To evaluate whether the addition of chlorhexidine (CHX) in 1% sol. and 2% gel or Caearia sylvestris Sw extract to calcium hydroxide paste affects its pH and Ca\(^{2+}\) ion release.

Materials and Methods:

- 40 acrylic teeth with simulated root canals (AF= 400µm) were divided into 4 groups and filled with either:
  1) Ca(OH)\(_2\) + 1% CHX solution in propylene glycol
  2) Ca(OH)\(_2\) + 2% CHX gel
  3) Ca(OH)\(_2\) + Casearia sylvestris Sw extract in propylene glycol
  4) Ca(OH)\(_2\) + propylene glycol (control)
- Coronal access was sealed with CR and cyanoacrylate glue and teeth immersed in 10mL deionized water for intervals of: 10 min, 24 hrs, 48 hrs, 7d, 15d, and 30d
- Liquid was analyzed for calcium ion release using atomic absorption spectrophotometry and pH changes using a pH meter
- Data was statistically analyzed

Results: Calcium release -

- 48 hours - lower Ca\(^{2+}\) release observed in study grps compared to control grp
- ≥7 days - negligible difference in Ca\(^{2+}\) release between grps

pH -

- 48 hours - significantly higher pH for 1%CHX soln group vs control
- 15 days - significantly higher pH for 2%CHX gel vs control

Conclusions: At 30 days, calcium release and pH differences between the groups were similar, demonstrating negligible interference of Caearia sylvestris Sw extract in the release of calcium and hydroxyl ions.

LOE: 5 - Bench study
Title: Antibacterial effect of experimental chlorhexidine-releasing polymethyl methacrylate-based root canal sealers

Author: Hiraishi N et al.


Reviewer: A. Jayson Tengonciang, DMD

Purpose: To investigate the extent of chlorhexidine release and the antibacterial effect of different versions of experimental chlorhexidine-releasing polymethyl methacrylate (PMMA)-based sealers containing different concentrations of a powdered chlorhexidine salt.

Materials and Methods:

- Chlorhexidine diacetate (salt/powder form) was incorporated into SuperBond sealer (a sealer that contains PMMA) to formulate 3 experimental sealers containing 1%wt, 2%wt, or 3%wt of chlorhexidine diacetate.
- Two tests were completed using the 3 different experimental sealers: a chlorhexidine release test and direct contact test.
- The chlorhexidine release test consisted of taking the experimental sealers and forming them into disks. The disks were then immersed into 1mL of water for 12 weeks and chlorhexidine release was measured by HPLC.
- The direct contact test consisted of 96 wells, each lined with one of the experimental sealers at a thickness of 0.7mm. The wells were “aged” 1, 4, 8, or 12 weeks with 300µL of distilled water. Next, the wells were sterilized with UV light after each “aging” period and E. faecalis (1X10⁶CFU/mL) and culture medium was placed inside each well. The kinetics of bacteria growth in each well was recorded by following the absorbance measurements at 660nm every 15 min during the 24 hour incubation period.

Results and Discussion:

- Chlorhexidine Release Test
  - The three experimental chlorhexidine-releasing sealers exhibited the general trend of a high initial spurt of chlorhexidine release during the first 3 days, after which the mean release rate rapidly declined and then reducing gradually over time.
  - Chlorhexidine release was largely dependent on the amount of chlorhexidine powder that was initially incorporated into the PMMA-based sealer.
- Direct Contact Test
  - A strong antibacterial effect after an “aging” period of 4 and 8 weeks was still evident in the experimental sealer containing 2 and 3%wt chlorhexidine diacetate.
  - Antibacterial activities weakened over time.

Conclusions: The author noted a limitation of the study. The results were based on the use of a planktonic bacteria model (only E. faecalis). And that further studies using a multiple species endodontic biofilm model are required before clinical testing.

LOE: 5
Title: The self-etching potential of RealSeal™ versus RealSeal™ SE

Author: Kim Y et al


Reviewed by: Sheerin Yusuf, DMD

Purpose: To assess and compare the self-etching potential of 2 methacrylate resin–based sealers, RealSeal™ and RealSealer™ SE

Materials and Methods:

Specimen Preparation: Fifteen single-rooted human teeth, each with a single root canal, were used in the present study. A polyvinylsiloxane (PVS) mold was prepared for each tooth. Slits were prepared along the surface of each root so that each root could be split into 2 longitudinal halves. The 2 halves assembled in the mold and access, cleaning and shaping done by using Profile NiTi rotary files. Apical seat enlarged to size 60 using hand files.

Teeth divided into 3 following groups:

- Group 1: Smear Layer covered dentin.
- Group 2: Fractured dentin. To examine the true self etching potential of RealSeal™ and RealSeal™ SE without adjunctive dentin demineralization contributed by endodontic irritants.
- Group 3: NaOCl/EDTA treated dentin.

Sealer Application: Roots separated into 2 halves, one half filled with RealSeal™ and other with RealSeal™ SE. Sealers were allowed to self cure in dark and examined through Transmission Electron Microscopy by preparing 2mm thick transverse sections.

Results and Discussion:

- Group 1: RealSeal™-treated specimens exhibited a 0.3-mm-thick layer of partially demineralized dentin. RealSeal™ SE–bonded specimens exhibited intact smear layers and smear plugs with no evidence of etching of the radicular dentin.
- Group 2: 0.4-mm-thick layer of partially demineralized dentin was observed in the RealSeal™ bonded specimens. RealSeal™ SE created a very thin (approximately <100-nm-thick) layer of partially demineralized dentin although penetration of sealer into the smear plug-free tubular orifice produced a resin tag.
- Group 3: The resin-dentin interfaces created by both sealers were devoid of the smear layers and contained a 0.5-mm-thick partially demineralized zone RealSeal™ system was slightly more aggressive, because the application of the separate self-etching primer to the EDTA-treated dentin resulted in almost complete depletion of apatite crystallites.

Conclusions: RealSeal™ SE might not be aggressive enough to achieve optimal dentin bonding to root canal walls in locations that are not reachable by calcium chelating irrigants. Conversely, RealSeal™ possesses mild etching ability on the fractured and smear layer–covered radicular dentin.

LOE: 5
Title: Diabetes induces metabolic alterations in the dental pulp

Author: Mariana Ferreira et al.


Reviewer: Sorin Purtuc, DMD

Purpose: To show some of the changes that can occur in dental pulps as a result of diabetes.

Materials and Methods: Researchers used the rat model to study diabetic changes in pulps. Diabetes was induced using a single dose of streptozocin injection. Controls received only the vehicle (citrate buffer). Only rats whose blood glucose level was 300mg/dl or above were considered diabetic. Animals were sacrificed after 6 weeks. Maxillary and mandibular incisors dental pulps were removed, samples were homogenized in sodium phosphate buffer and centrifuged for 10 min at 3,020 g. The resulting supernatant was used in analysis. Free, total, and bound sialic acid concentrations were measured. Catalase activity and peroxidase activity were measured.

Results: Diabetic Rats as compared with normal rats showed a significant decrease in weight by the end of the experiment. At the same time they showed increased consumption of liquids and food. The free, conjugated, and total sialic acid concentrations in dental pulps were significantly lower in the diabetic rats. A significant increase in catalase activity was observed in diabetic rats. There was no change in peroxidase activity.

Discussion: Diabetes Mellitus (DM) is a metabolic disease that has oral manifestations such as xerostomia, taste impairment, and sialosis, which can affect the progression of such diseases as dental caries, periodontal disease, and fungal infections. DM may be a modulation factor for endodontic infections as it impairs healing, decreases neutrophil migration, decreases leukocyte count, and increases the detection rate of anaerobic bacteria in dental pulps. DM also impairs microvasculature, and thus affects pulp tissues repair and nutrition.

DM seems also to affect the antioxidant defenses in the body. Hyperglycemia induces metabolic changes which result in overproduction of superoxide which is the cause of the micro- and macrovasculature complications. Overproduction of Reactive Oxygen Species (ROS) can also cause stimulation of matrix metalloprotease (MMP) which can cause damage to the connective tissue ground substance in dental pulp and elsewhere in the body.

The first defense against superoxide is the enzymatic system (ex: catalase, peroxidase). Second defense consists of the nonenzymatic system such as Vitamin E, C. Other compounds can act as H2O2 scavengers such as sialic acid. Sialic acid exists in free form or as a terminal residue of oligosaccharide chains on different macromolecules in body fluids, mucosa, epithelium, cell membranes, and nervous system.

The reduction in sialic acid observed in DM pulps in this study could be explained by the pathophysiology of DM complications. Other studies also observed alterations in sialic acid metabolism in DM.

The increase in catalase activity observed in DM rats can be attributed to increased oxidative stress in the pulp. Other studies explored using catalase for controlling pulp inflammation and as a direct pulp cap agent. Also important, dental bleaching using peroxide can cause potentially more inflammation in DM patients.
Title: Development and validation of a three-dimensional computational fluid dynamics model of root canal irrigation

Author: Gao Y et al.

Journal: JOE 35(9): 1282 -1287 September 2009

Reviewer: Jay Gupana, DMD

Purpose: To construct a 3-d computational fluid dynamics (CFD) model of root canal irrigation, with a suitable turbulence model, and validate it to provide a novel method for studying root canal irrigation.

Background: Computational fluid dynamics is a branch of fluid mechanics that solves and analyzes problems involving fluid flow by means of computer based systems.

Materials and Methods:
- In vitro irrigation model was based on a simulated curved root canal prepared in a plastic testing block
- Canal was prepared to apical size of 30 with .09 taper
- Apical foramen was filled with wax
- A red dye was then used to fill the entire canal w/o air bubbles
- A 28 gauge side vented needle was attached to a 10ml- plastic syringe and inserted 10mm into the canal
- The canals were then irrigated with water at a rate of .1g/s for 10 seconds, which was regulated with an Instron testing machine
- The model was then scanned with a scanning electron microscope
- The simulated resin canal used for the in vitro irrigation model as scanned with a micro-computed tomography scan system with an isotropic voxel size of 20.

Results/Discussion:
- Length of clear zone immediately below the top of the needle was 2.3 mm beyond the tip of the needle
- Highest velocity of irrigant from the needle lumen was 7.3m/s
- Irrigation pressure of apical wall was 500 Pa
- The irrigant velocity of the canal facing the open side of the needle was .1m/s as opposed to the closed side which had a velocity of .44m/s
- The SST k-w turbulence model appeared to be the most suitable for the problem investigated (it is a 2 equation eddy-viscosity model)
- The CFD model showed that irrigant in the canal is only flushing to a limited distance beyond the tip of the needle
- It is recommended that the smallest needle should be placed at the apical foramen to remove debris. However, this may pose a risk for greater potential for extrusion of irrigant.
- Irrigant velocity is considered a highly significant factor in determining the replacement of the irrigant in certain parts of the root canal. The CFD measured irrigant velocity is higher with side vented needles and are recommended for use in vivo.
- Although this analysis may not be accurate pictures of a tooth it provides the correct model for analysis in root canal irrigation.

LOE: 5