Evaluation of a Bioceramic Root Canal Sealer with Different Obturation Techniques

Thesis submitted for partial fulfillment of the Masters Degree in

Endodontics

By

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Soha Alaa Emam

Dedication

For my mother, father, husband and siblings who are my support system throughout life. I would not have reached what I am today without them.

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Introduction:

In endodontic practice, along with proper cleaning and shaping of the root canal, the long-term success of the treatment applied is mainly dependent on the existence of a fluid tight or hermitic seal throughout the entire length of the root canal and ending with the apical one third of the canal. This is required to prevent the ingress of bacteria either coronally from the oral cavity or apically through the periapical tissues and fluids. In order to achieve this seal, proper selection of the obturating material and the sealer is essential.

The ideal requirements of an endodontic sealer should be tacky to helps with good adhesion between it and the canal wall when set, provide hermetic seal, radiopaque to be evaluated through a radiograph, easy to manipulate, doesn't shrink upon setting, bacteriostatic, sets slowly, insoluble in tissue fluids and biocompatible.

Bioceramic sealers have shown a considerably unique type of bonding to the dentin of the canal by the reaction of phosphate in the tooth structure with calcium silicate hydrogel and calcium hydroxide, produced through the hydration reaction of calcium silicates in the presence of the dentin's moisture, thus resulting in

the formation of hydroxyapatite along the mineral infiltration zone.

Recently different manufacturing companies and researchers claim that using single cones of gutta-percha impregnated and coated with bioceramic particles along with bioceramic sealers would form a fluid tight seal between the canal wall and the root filling material through the strong hydroxyapatite bond. This fluid tight strong seal would act as a barrier to ingress of bacteria and other microorganisms from both the coronal and apical portion of the canal. Therefore, assessing the bond strength and the adaptability of a single cone impregnated and coated bioceramic gutta percha when used as a sole obturating material along with the bioceramic sealer would be of value.

Review of literature

Historically root canal obturation was performed by silver points, however leakage and corrosive products occurred around the points resulting in treatment failure. This placed a demand for the development of a better obturating material. Thus, the development of gutta percha took place to overcome the shortcomings of the silver points. Sealers have the disadvantage of being soluble which makes them the weak point in the obturation phase, so although the gutta percha decreased the leakage compared to its predecessor however sealers remained the weak link. An improvement in sealer solubility and bonding to root canal walls occurred by the development of resin sealers, yet there was still a quest for a greater bond with dentin and a tighter seal. This was the reason behind the development of bioceramic based sealers and bioceramic impregnated and coated gutta percha points.

I. Bioceramic sealers and core materials:

In case of presence of any irregularities due to shaping technique or anatomical variations, sealers serve in sealing of these irregularities. The most commonly known sealers are calcium hydroxide, zinc oxide–eugenol, glass ionomer, resin based (epoxy

resin or methacrylate resin) and later on, calcium silicate–based (bioceramic) sealers got introduced in the market.

Ghoneim et al[1] used in their study Activ GP, which is glass ionomer coated gutta percha cones that manufacturers claim to bond to the intra-radicular dentin when used with glass ionomer sealer. The concept of creating a Monoblock was the goal behind using ActiV GP. Fifty single rooted mandibular premolars were selected for their study. Ten teeth were left as negative control with no preparation done and forty teeth were instrumented by 0.06 taper Endosequence rotary files. Teeth were irrigated by 3ml 2.5% NaOCL followed by 17% EDTA, then divided into four groups according to the obturating system. All teeth were obturated using single cone obturation technique. Group 1was obturated by bioceramic-based sealer (iRoot SP) and ActiV GP cones, group 2 was obturated iRoot SP sealer and conventional GP cones, Group 3 was obturated by ActiV GP sealer and ActiV GP cones and Group 4: ActiV GP sealer and conventional GP cones. Fracture resistance was evaluated in all the teeth using universal testing machine. The results showed significantly that the highest fracture resistance was found in both the negative control group and group 1 and that there was no significant difference between them. The significantly lowest value was reported in group 4 showing the great potential of

bioceramic root canal sealers in reinforcing the endodontically treated teeth against fracture specifically when using it with ActiV GP cones.

Wang[2] discusses the prevalence of bioceramic materials in endodontics in the past two decades. The bioceramic materials have proven to overcome many of the limitations in the previously mentioned generations of sealers present in the market. Bioceramic sealers have a lot of advantageous properties, short setting time, high mechanical and bond strength, high alkaline pH with calcium ion release. They also have of low solubility, long sealing ability, biocompatible and can stimulate bio-mineralization. Many of their properties are attributed to the hydration reaction that occurs between the calcium ions released form the calcium silicates in the bioceramics that reacts with hydroxyl ions found in dentin, which results in the formation of hydroxyapatite crystals, and deposition of hard tissue.

Trope et al[3] discusses the effect of the core material on the overall seal of the root canal system. The gutta percha by itself is a core filling material that is hydrophobic in nature and cannot adhere to the sealer irrespective of its type. Thus, the effect of the gap formed between the gutta percha and the sealer could result in potential leakage and compromising of the root canal system integrity. When the gutta percha cones are modified by an

impregnated and a coated layer of bioceramic nano particles, this will promote the creation of a true bond between the core material and the sealer.

Chybowski et al[4] in a retrospective study evaluated the success rate and the outcome of endodontic treatment using single cone technique with Endosequence bioceramic sealer. The study included patients from 2009 to 2015 that were both receiving initial and/or retreatment procedures and obturation by using single cone technique and Bioceraic sealer. In the total period of 30.1 months three hundred and seven teeth exhibited 90.9% success rate. Teeth with lesions less than 5 mm showed significantly higher success rates than teeth with lesions greater than 5 mm in diameter. They concluded that using single cone technique with bioceramic sealer presented a viable option for obturation of endodontically treated teeth.