Evaluation of Addition of Silver Nano Particles to Common Root Canal Irrigants on Root Canal Dentine, Antibacterial Efficacy and Cytotoxicity

Thesis

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بسم الله الرحمن الرحيم

"قالوا سبحانك لا علم لنا إلا ما

علمتنا

إنك أنت العليم الحكيم"

صدق الله العظيم

آيه 32 من سورة البقرة

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Dedication

To my great Father

To my Dearest mother

To my lovely wife and daughters

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Microbial populations contribute to many infectious diseases such as pulpal and periradicular pathosis. From the ecological prospective, root canal could be considered as a highly controlled environment with a limited number of niches. For bacteria to endure endodontic treatment they must resist intracanal disinfection procedures and adapt to the changes in the environment. For microorganisms to survive in biofilm, they should undergo physiological and morphological modifications to adapt to the environment. This adaptation requires that a large set of micro genes must be regulated to be able to optimize phenotypic properties for each environment.

Enterococcus Faecalis is considered the most predominant and resisting microorganism that could be detected in root canals of teeth with persistent periradicular lesions. E. Faecalis is considered a hardy, virulent microbe due to its lytic enzymes. Cytolysin, aggregation substance, pheromones and lipoteiclioc acid. It was shown that they could invade dentinal tubules and remain viable for a prolonged period, adhere and resist intracanal disinfectants.

Sodium hypochlorite is the most commonly recommended root canal irrigant, as when it interacts with micro-organisms and organic tissue causes chloramination, amino acid neutralization and saponification reaction leading to tissue dissolving and

antibacterial effect. On the other hand, the antimicrobial effect of sodium hypochlorite can be inactivated by dentin, exudates from the periapical area, and have the disadvantage of toxicity and risk of tissue destruction. Chlorohexidine gluconate is a popular anti-microbial agent. It has cationic molecular component that attached to the negative charge of a cell membrane and causes cell lysis, but not capable of dissolving pulp tissue debris.

The primary adhesion of bacteria depends on surface characteristics of dentine as well as specific adhesion properties of bacteria. Therefore, smear layer formed during canal instrumentation might have a role in bacterial adhesion. It has been reported that removal of smear layer decreased the adhesion of E. Faecalis. On contrary, bacterial invasion of dentinal tubules might be responsible for persistent root canal infection.

Nano technology has been an over expanding area of research. Chemically the nano particles (NPs) are very diverse. The synthesis of silver nano particles (AgNPs) has attracted a great interest. They have been applied owing to their broad spectrum bactericidal and virucidal properties. AgNps show multiple antibacterial mechanisms through adherence and penetration into bacterial cell wall. Mono-valent silver compounds, especially silver nitrate have been used. Many studies highlighted the importance of the anti-bacterial efficacy of

nanosilver particles against E. Faecalis biofilms. However, we lack information on the incorporation of nano-silver particles in available root canal irrigants. Silver should be used with caution because of its toxicity is concentration dependent. The small particle size of AgNPs as well as its high surface area per unit mass, chemical composition and surface property effects might be a factor in NP-induced toxicity and non-specific oxidative damage. Therefore, it is important to study the efficacy of nano particle containing irrigant in eliminating E faecalis as well as the response of rat connective tissue to AgNps compared to other irrigants.

Therefore, this study aimed to evaluate the effect of nano-silver particles as an irrigant as well as its addition to commonly used irrigants on root canal dentine, antibacterial effect and cytotoxicity.

I- Evaluation of nano-silver particles on root canal dentine:

Successful root canal therapy aimed at through chemo mechanical preparation and three dimensional obturation with complete seal of root canal system. Mechanical preparation resulted in formation of smear layer which might plug dentinal tubules impairing proper adhesion of sealer with canal wall. Therefore, chemical removal or modification of smear layer is of value to achieve proper bonding of sealer to canal wall. Many irrigants are available which could be used. The introduction of nano-particles with their novel properties in dental field might be beneficial in that aspect. Smear layer could hinder root canal irrigants and sealers from penetration into dentine. This in turn will increase the risk of bacterial infection. Therefore, removal of smear layer can increase permeability of dentine for proper disinfection and adaptation of root canal sealer.

Wettability of root canal dentine is one of the most important physical properties that affect either irrigant penetration into dentine, sealer adaptation or adhesion of bacterial biofilm, NaOCl is considered the most commonly used irrigant, also CHX is another widely used one. EDTA as a lubricant during mechanical preparation and smear layer removal also influence physical properties of dentine.