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The influence of sodium hypochlorite and EDTA on the chemical composition of dentine

Aim To characterise changes in the chemical composition of dentine after exposure to sodium hypochlorite and ethylenediaminetetracetic acid (EDTA) using ATR-FTIR and Raman spectroscopy.

Methodology Crown dentine was acquired from recently extracted molars stored in formal-saline (group A) or saline and frozen at −2°C (group B); it was then ground and sieved into a range of particle sizes. Samples from both groups (n = 5 each) were analysed with FTIR to investigate the influence of storage medium and to assign FTIR spectral peaks for collagen, carbonate, phosphate. As no differences were found, the samples were pooled for subsequent experiments. Ten samples of particle size range 38–75 μm were used to study the effect of mass ratio of NaOCl (2.5%): dentine over 5–10 min. Thirty samples of all sizes were reacted with 2.5% sodium hypochlorite at 1:0.5 (dentine:NaOCl) mass ratio for 2–10 min; EDTA (n = 90) for 5–1440 min; NaOCl for 10 min followed by EDTA for 10 mins (n = 30); the latter samples were further exposed to NaOCl for 10 min after obtaining FTIR spectra.

Results FTIR spectra from the surface of the particles (~1.5 μm depth) were obtained for all the samples and Raman spectra (40 μm depth) were obtained for one sample each reacted either with NaOCl or EDTA. Spectral peak assignment was confirmed by previous data. Storage media had no effect on outcome measures used. The dentine:NaOCl ratio influenced collagen depletion. NaOCl affected the collagen FTIR peaks, mostly in the first 2–4 min, but only influenced the phosphate and carbonate peaks slightly. EDTA affected the phosphate:collagen peaks, which reduced over time, whilst the collagen peak values showed an increase. The two solutions (NaOCl and EDTA) used alternately, respectively increased collagen or phosphate peaks depending on the final solution used.

Conclusions These series of investigations confirmed that sodium hypochlorite depletes the organic content of dentine and EDTA depletes the inorganic content. Used alternately, they have the ability to progressively degrade dentine structure.

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A collagen 'bio-molecular film' *ex vivo* model to evaluate the efficacy of dynamic irrigation using the RinsEndo® system

Aim To evaluate the efficacy of three irrigation protocols using a model consisting of a standard collagen film coating the root canal walls of extracted teeth.

Methodology Thirty human teeth with single straight canals were randomly allocated to three groups for static (n = 10), manual dynamic (n = 20) or automated dynamic (n = 10) irrigation. The root canals were prepared to apical size 40 with a 0.08 taper. The teeth were split longitudinally to give two halves and stained collagen was applied to the canal surfaces in a standard manner. The re-assembled teeth were irrigated using one of the protocols. Digital images were taken of the canal surfaces before and after irrigation with 18 mL of NaOCl. Static irrigation consisted of simple placement of an irrigation needle (gauge 30) in a fixed orientation 4 mm or 10 mm short of the working length. Manual dynamic irrigation consisted of push–pull agitation of the placed irrigant with a well-fitting, tapered gutta-percha point. Automated dynamic irrigation was carried out using the RinsEndo® system. The percentage canal surface coverage with stained collagen was calculated using a software package (ipWin4®). The data were analyzed using paired-t tests and GEE linear regression models.

Results The area of canal covered with stained collagen was significantly (P < 0.001) less (21% or 16%, respectively) after manual or automated dynamic irrigation compared with static irrigation. However, the RinsEndo® system was significantly (P = 0.037) less effective (5%) than manual dynamic irrigation. The 'corono-apical level of canal' and the 'depth of needle tip penetration' emerged as significant factors influencing outcome of irrigation. Residual collagen was least evident in the middle third, followed by apical and then coronal thirds. Deeper penetration of the needle tip resulted in 7.5% (P < 0.001) more effective collagen removal. The orientation of the side-port of the irrigation needle was not a significant factor (P = 0.051).

Conclusions Automated dynamic irrigation using RinsEndo® system was significantly more effective (16%) in removing stained collagen from the root canal than static irrigation. However, it was significantly less effective (5%) than manual dynamic irrigation. Irrigation was more effective (7%) when the needle was placed closer to the apex.