

Control of Microbial Biofilms in Dental Unit Waterlines

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Microbial levels as high as 10^6 colony forming units (CFU) per ml of water are common in dental unit waterlines (DUWL). The microbes, which are free-living in municipal tap water, have the capacity to attach to the lumen of waterlines where they form microcolonies. The microcolonies, comprised of diverse communities of microbes, become embedded in extracellular matrix material to form a tenacious biofilm inside the waterline. These complex microbial biofilms in DUWL are the major source of contaminated water delivered by dental units. In the present study, a unique disinfectant, Dentacide™, was tested in dental clinics/offices for the capacity to prevent the development of biofilm or to eliminate preexisting biofilm in DUWL. Dentacide™ generates a maximum and stable free iodine level of 180 ppm when dissolved in water. Test waterlines in 10 dental units were filled with Dentacide™ and allowed to stand over the weekend; waterlines in 6 of the units were also treated overnight on a daily basis. After treatment, lines were flushed with tap water for two minutes to remove residual iodide/iodine from the lines; tap water was used for routine use of the units. Water samples (~3 ml) were collected from each unit weekly for 10 weeks. Control DUWL included 5 which were untreated and 6 treated for 10 minutes weekly with 10% sodium hypochlorite; tap water for these latter 6 units routinely contained 0.01% sodium hypochlorite. Samples were also collected weekly from all control units. Each sample was quantified for total mean CFUs/ml of water by duplicate culture on R2A agar plates (containing sodium thiosulfate) with incubation of 25°C for three weeks. After 4 weeks of treatment with Dentacide™, results (expressed as the mean CFUs/ml [±S.E.M.]) were 8.33 (±6.5) for daily-treated DUWL, 209.25 (±119.8) for weekly-treated, and 1.86×10^5 (±0.45) for untreated; results at 8 weeks were 105.83 (±84.2) for daily-treated, 1.06×10^4 (±0.68) for weekly-treated, and 1.2×10^6 (±0.45) for untreated. Mean CFUs/ml were significantly lower in samples from daily-treated DUWL weekly-treated ($P=0.06$) and untreated ($P=0.001$). Results obtained from sodium hypochlorite-treated DUWL were comparable to results obtained with Dentacide™ daily-treated waterlines. In addition, DUWL clippings (1cm) were obtained for scanning electron microscopy (SEM). Clippings were fixed in 2% glutaraldehyde in 0.2M cacodylate-HCl, dehydrated, sputter coated with gold-palladium and examined with a JEOL 840A scanning electron microscope. Results are represented in the figures below.

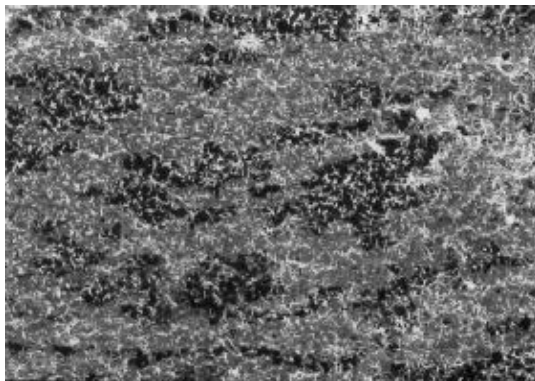


Figure A

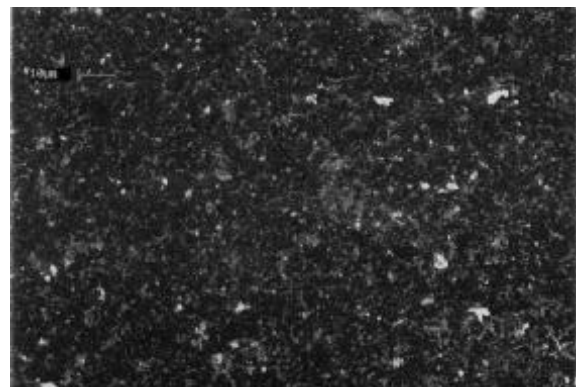


Figure B

Figure (A) shows the lumen of a preexistent DUWL prior to treatment; (B) shows the lumen after daily treatment with Dentacide™ for 4 weeks. (A) shows a mature biofilm comprised of curved rods, cocci, hyphae, spirochetes and matrix material. Dentacide™ treatment successfully removed the biofilm, as shown in (B). In conclusion, Dentacide™ appears to be an effective disinfectant for use in preventing the development of microbial biofilm in DUWL, as well as, removing biofilm present in preexistent waterlines. To date, Dentacide™-treatment has not caused any visual or functional changes in DUWL or metal parts of dental units.

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