

化學-機械法之牙本質齲齒移除系統開發

The Development of the Chemo-mechanical System for Caries Dentin Removal

中文摘要

化學機械法(chemo-mechanical)為一種低侵入性的牙本質齲齒治療方法，但配方中次氯酸鈉之強氧化性對第一型膠原蛋白結構易造成過度破壞，使牙本質中的膠原蛋白雖有殘留，卻未能如預期提升樹脂補綴之接著強度，因此本研究之目的在以氯化鋅溶液取代傳統之次氯酸鈉作為牙本質齲齒移除藥劑，應用化學試劑對膠原蛋白結構之物理性溶解(dissolution)機制，而非化學性之變性(denaturation)或裂解(degradation)機制，使齲齒患部之去礦化牙本質結構因失去膠原蛋白纖維之支撐而軟化，以利後續簡單機械方式移除。實驗採用由牛皮萃取出之膠原蛋白，以 1 mg/ml 之比例，定量添加含有醋酸、次氯酸鈉、氯化鋅之不同組成分，觀察膠原蛋白在不同的操作環境中的溶解情形，以圓二色光譜(circular dichroism)儀偵測膠原蛋白在不同溶液中二級結構之狀態，及以 SDS-PAGE 觀察膠原蛋白多胜?鏈的劣化情形，實驗結果顯示在溶解試驗中以次氯酸鈉的效果最好，但經手搖晃或合併使用超音波後，醋酸及氯化鋅也可達到相同溶解效果，在結構維持方面，在經醋酸及氯化鋅完全溶解後的膠原蛋白溶液中仍可見到其三股螺旋結構與多胜?鏈的存在，次氯酸鈉則無法見到。本研究並以人為牙本質齲齒樣本進行體外配方效力評估，結合 SEM/FESEM 之表面形態觀察及 FTIR 分析膠原蛋白官能基之變化分析，結果顯示 0.1~5 wt% 氯化鋅水溶液，可提供良好之膠原蛋白溶解效果，不會影響其二級結構，FT-IR 光譜中存在代表膠原蛋白結構之 (1662、1637、1553 cm^{-1}) 特徵吸收峰，顯示氯化鋅水溶液具有應用於化學機械法之牙本質齲齒移除應用潛力。

英文摘要

Chemo-mechanical removal system is a minimally-invasive treatment for dentin caries. The main component of the system, sodium hypochlorite, however, would destroy the dentin collagen structure to the point that following bonding with resin became poor and unsatisfied. The purpose of this study is to explore the possibility of utilizing zinc chloride, replacing the sodium hypochlorite, not only to dissolve the collagen but also stabilize the protein structure during the dentin caries removal process. Several chemical agents, such as acetic acid, sodium hypochlorite and zinc chloride, were used to realize and compare their influences on type I collagen structure. The results showed sodium hypochlorite dissolved the collagen much more effectively than acetic acid and zinc chloride does in the static environment. However, there was no clear difference among these three agents with the mechanical aid, such

as ultrasonic or shaking. After completely dissolution of collagen, its secondary structure and the polypeptide chain were only preserved in acetic acid and zinc chloride solution, observed by circular dichroism and SDS-PAGE. This study also established artificial demineralized dentin to evaluate the removal efficiency of zinc chloride by using SEM/FESEM and FT-IR. The results showed zinc chloride could be used to remove collagen fibers after dentin demineralization and there was no influence on collagen secondary structure, since the major FT-IR functional group absorptions (1662、1637、1553 cm^{-1}) were still be observed. This study recommended the use of 0.1~5 wt% of zinc chloride as an effective ingredient for the chemo-mechanical dentin caries removal system.