

濾波耳塞對降低牙科疼痛感受之評估

Evaluation of dental pain decreasing with acoustic wave-filtering earplugs

中文摘要

在一般人的記憶中，「看牙」是一項令人感到害怕的經驗，特別是在治療時聽到機器產生的聲響及伴隨而來的酸、痛，是大多數人無法忍受的。爲了要來解決這樣一個問題，減低病人的恐懼及全身僵硬，所帶來治療上的不便，也爲了減輕牙醫師的工作壓力及病人對聲響害怕的刻板印象，並提高診所的工作效率。本研究開發出一種可伴隨著音樂播放的噪音濾除耳塞系統，來濾掉由診療機械所產生的噪音；同時，如果必要的話，它也可當一種來降低病人在看牙時的疼痛與焦慮感覺，此外，這項新開發的系統，也可當成牙醫師與病人溝通的工具。本研究首先以離線的方式收集各類牙科噪音，然後將它傳遞到個人電腦，並使用 CoolEdit 及 LabVIEW 軟體程式，分析出在牙科治療過程中所產生之噪音的頻率範圍，最後透過各種比較，找出適當的截止頻率，在截止頻率(1KHz)被決定之後；針對該截止頻率，使用主動式濾波的方式設計出相關的電路，組成主動式噪音率除系統，來濾除那些高於截止頻率的噪音信號，只保留語音頻率範圍；此外透過 mp3 或 cd player 所播放出的音樂訊號，也可以同時被傳遞到耳塞系統來增加信號雜訊比，那麼當病人在治療時，因爲有這音樂可以使病人的焦慮跟緊張獲得舒緩。此外，本系統有另外一個功能是，當牙醫師要跟病人做溝通時候，當語音訊號(醫師說話聲)傳達到本系統時，會自動將音樂信號降低 12dB，以便於醫師可隨時與病人溝通。本研究所開發出的噪音率除系統透過經由一些測試顯示出良好的功能，這些測試包含，透過波型觀測來檢測出各種不同訊號的能量，使用這個噪音濾除耳塞系統前後，語音及噪音的變化，也檢測出所設計出不同電路的工作狀況，爲了要更進一步確認所開發的噪音濾除耳塞系統適用性，一項問卷調查，有關於病人使用本系統的效果評估，並配合生理監視器觀察病人在就醫前、就醫時及配戴濾波耳塞系統三個階段時的生理反應，提供實質的數據當作參考，而這些結果透過統計分析出來時，反應出本系統更適合相關的臨床研究。

英文摘要

It is usually a terrible experience to people who have toothaches for dental treatments especially when they are cured along with ache and mechanical noise such that most of them cannot be tolerated. For reducing such a condition and to promote the work efficiency for a dentist, in this paper, a new noise-filtered earplug system with available music is developed to filter out dental machine noise and if necessary, it can be adopted as a solution to reduce pain and anxiety of patients during treatments. Furthermore, it can also be a communication tool between the

patient and the dentist simultaneously. In this study, various kinds of noises, first of all, are collected through a wireless receiver and then, connected to a personal computer with the software of CoolEdit and LABVIEW to analyze frequency ranges of mechanical noises and finally the cut-off frequency is identified through several comparisons. After the cut-off frequency has been determined, the active noise-filtered system can be designed with several circuits to filter out those frequencies higher than the cut-off frequency and reserve the speech voice only. Besides, the music signals from the MP3 or a CD player can also be transmitted to the earplug system for increasing the signal noise ratio. The anxiety and tension of patients during treatments can, thus, be relaxed due to the euphonious music and toothaches of the patient might be further reduced. Moreover, when the speech signal from the dentist is transmitted into the patient's earplug, the musical signal can be automatically reduced 12 dB for convenient communications. It is found that the developed noise-filtered earplug system shows good performance by conducting several tests, such as detecting various powers of signals with monitoring the wave forms, identifying the variations of noise and speech signals before and after the use of the filter, and checking working conditions of the designed circuits. To further investigate the adaptability of the noise-filtered earplug system, a cross-sectional study using a self-report questionnaire, including of effectiveness assessment of the earplug system and physical reaction assessment along with the Hume Dynamic Monitor for patients with and without the earplug system, was undertaken. After the results being statistically analyzed, it is show that the designed earplug system does not only reduce the machine noise but also has dominant effect in relieving the anxiety especially when the patients choose their favorite music during treatment.