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Development of haptic caries simulation for dental education

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Abstract

Background

Treating tooth decay (caries removal) is an essential skill for dental students to learn. The process relies heavily on the dentist's ability to evaluate the state of the dental tissue being probed, a judgement made largely based on tactile investigation. Currently, most dental schools use plastic or extracted teeth to teach caries removal. Replication of the 'feel' of caries is not available in plastic teeth, and while extracted teeth may hold some value, most extracted teeth do not reflect a realistic carious lesion, appropriate for caries removal.

Aim

To develop haptic caries simulations, allowing students to practice the tactile aspects of caries removal in a controlled environment on the Moog Simodont Dental Trainer.

Materials and methods

Early work found that, due to the anisotropic nature of dentine and tooth decay, cone beam CT data of carious teeth would not provide a realistic simulation of carious lesions. It was decided to produce the caries programmatically, allowing for full control of all variables. Custom software was created to enable the creation of blocks containing unique variations of caries. Each block is produced with segment data to enable automatic marking.

Results

A library of 'caries blocks' has been built. The blocks hold varying shape, depth and amount of caries within a simulated 'tooth' consisting of enamel, dentine and pulp tissue, allowing the student to practice on an unseen case every time. The design of the block encourages the user to follow typical pathological patterns to remove the lesion, while retaining the maximum amount of enamel, as is considered good practice. Each block contains segment information allowing for automatic objective marking.

Conclusions

Simulated carious blocks can provide a safe environment for novice dental students to practice caries removal based on tactile sensation. The caries block generation process enables the creation of a large library of disparate carious models calling for a unique solution for each case.

Keywords

dentistry education; dental student; caries; caries blocks; haptic caries simulation

Additional Information

This presentation was given at the one day symposium, Current Approaches to Understanding Surgical Error, University of Leeds, Leeds, UK, on 9 December 2016.

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