Differences in the microstructure and fatigue properties of dentine between residents of North and South America


Abstract
Spatial variations in the microstructure of dentine contribute to its mechanical behaviour.

Objectives
The objective of this investigation was to compare the microstructure and fatigue behaviour of dentine from donors of two different countries.

Methods
Caries-free third molars were obtained from dental practices in Colombia, South America and the US to assemble two age-matched samples. The microstructure of the coronal dentine was evaluated at three characteristic depths (i.e. deep, middle and superficial dentine) using scanning electron microscopy and image processing techniques. The mechanical behaviour of dentine in these three regions was evaluated by the fatigue crack growth resistance. Cyclic crack growth was achieved in-plane with the dentine tubules and the fatigue crack growth behaviour was characterized in terms of the stress intensity threshold and the Paris Law parameters.

Results
There was no difference in the tubule density between the dentine of patients from the two countries. However, there were significant differences (p ≤ 0.05) in the tubule lumen diameters between the two groups in the deep and peripheral regions. In regards to the fatigue resistance, there was a significant increase (p ≤ 0.05) in threshold stress intensity range, and a significant decrease in fatigue crack growth coefficient with increasing distance from the pulp in teeth from the US donors. In contrast, these properties were independent of location for the dentine of teeth from the Colombian donors.

Conclusions
The microstructure of dentine and its mechanical behaviour appear to be a function of patient background, which may include environmental factors and/or ethnicity.
Keywords
Dentine; Fatigue crack growth; Fracture; Microstructure; Strength; Tubules

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