

P.02 Streaming potential in human dentin

Z Feng, R Yao, T Wang and X Luo

Department of Materials Science and Engineering, College of Materials, Xiamen University, China

Streaming potentials have been observed in wet bone and tendon [1-4]. Considering the compositions and microstructure of dentin have much in common with those of bone, it is of interest to investigate whether similar effects occur in dentin. The objective of this study is to reveal the streaming potential in human dentin and the related influencing factors.

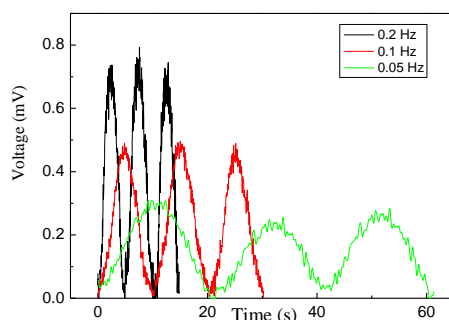
Fresh human third molars without visible evidence of caries were used in this investigation. Flaky specimens, 4 mm (L) × 4 mm (W) × 0.8 mm (T), were prepared with two surfaces parallel to the occlusal surface and the others generally along tubules. A cell was designed and manufactured for facilitating the measurement of steaming potential in human dentin under a simulated physiological condition. A system including the cell, a mechanical testing machine, a scanner and a personal computer was established for cyclic loading and data acquisition. The streaming potential of the dentin specimens was evaluated under the loading frequency ranging from 0.05 to 0.2 Hz. Subsequently, a hole of 0.5 mm in diameter was drilled in each dentin specimen for simulating the effect of deep caries on the streaming potential in dentin, the streaming potential of these dentin specimens were reexamined.

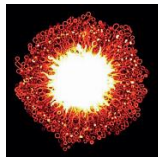
The canaliculus system of solid is attributed to its streaming potential properties. Dentin is a biological composite formed by 50 vol.% mineral in the form of carbonated apatite, 30 vol.% organic component (mostly collagen) and 20 vol.% fluid, and has a distinct microstructure characterized by tubules that are the path of the odontoblasts during tooth formation. The tissue fluid in the dentin tubules could be regarded as electrolyte. Our investigation revealed the streaming potential in human dentin under testing condition (Tab. 1). The value of streaming potential increased with the increase of the frequency of cyclic loading (Fig. 1). The phenomenon may result from the increasing difference of pressure between the opposite surfaces of the dentin specimen upon the increase of velocity of the fluid through tubules as a result of increasing loading frequency. Introducing small hole into dentin specimen resulted in the decrease of peak streaming potential (Fig. 2). It was inferred from this experiment result that deep caries on decayed tooth had certain influence to streaming potential in dentin, with the peak value getting lower. However, the influence to the tooth under the physiological condition was not so obvious and still needed further research.

Table 1. Peak voltage (mV) of the streaming potential of dentin specimens

Frequency* (Hz)	Specimen [#]	
	Intact	Drilled
0.2	0.71 (0.06)	0.45 (0.08)
0.1	0.53 (0.03)	0.31 (0.06)
0.05	0.28 (0.05)	0.26 (0.04)

* $P=0.003$, [#] $P=0.000$





The Physics of Soft and Biological Matter

Fig 1. Streaming potential of dentin at the loading frequency of 0.2 Hz, 0.1 Hz and 0.05 Hz.

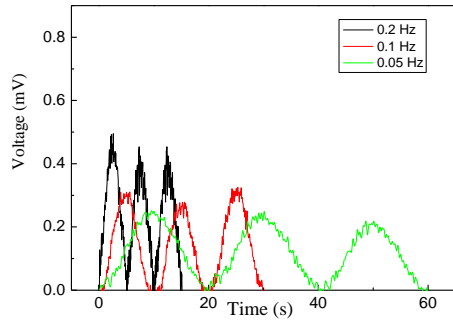


Fig 2. Streaming potential of drilled dentin at the loading frequency of 0.2 Hz, 0.1 Hz and 0.05 Hz.

- [1] Anderson *et al.*, *Nature* 1968; 218; 166
- [2] Gross *et al.*, *J Biomech* 1982; 15: 277
- [3] Guzelsu *et al.*, *J Biomech* 1990; 23: 611
- [4] Guzelsu *et al.*, *J Biomech* 1990; 23: 673