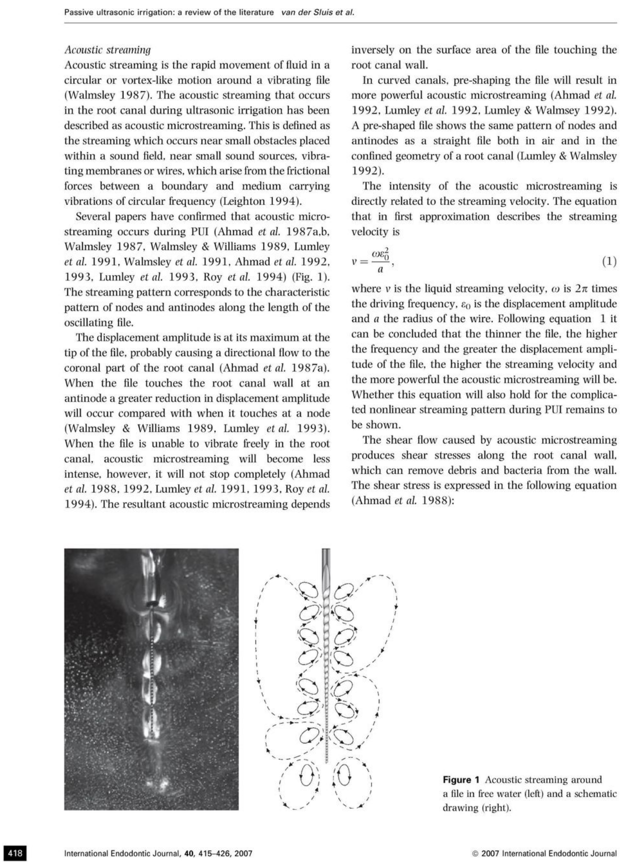
Irrigants In Endodontics Pdf Free



Acoustic streaming

Acoustic streaming is the rapid movement of fluid in a circular or vortex-like motion around a vibrating file (Walmsley 1987). The acoustic streaming that occurs in the root canal during ultrasonic irrigation has been described as acoustic microstreaming. This is defined as the streaming which occurs near small obstacles placed within a sound field, near small sound sources, vibrating membranes or wires, which arise from the frictional forces between a boundary and medium carrying vibrations of circular frequency (Leighton 1994).

Several papers have confirmed that acoustic microstreaming occurs during PUI (Ahmad *et al.* 1987a,b, Walmsley 1987, Walmsley & Williams 1989, Lumley *et al.* 1991, Walmsley *et al.* 1991, Ahmad *et al.* 1992, 1993, Lumley *et al.* 1993, Roy *et al.* 1994) (Fig. 1). The streaming pattern corresponds to the characteristic pattern of nodes and antinodes along the length of the oscillating file.

The displacement amplitude is at its maximum at the tip of the file, probably causing a directional flow to the coronal part of the root canal (Ahmad *et al.* 1987a). When the file touches the root canal wall at an antinode a greater reduction in displacement amplitude will occur compared with when it touches at a node (Walmsley & Williams 1989, Lumley *et al.* 1993). When the file is unable to vibrate freely in the root canal, acoustic microstreaming will become less intense, however, it will not stop completely (Ahmad *et al.* 1988, 1992, Lumley *et al.* 1991, 1993, Roy *et al.* 1994). The resultant acoustic microstreaming depends inversely on the surface area of the file touching the root canal wall.

In curved canals, pre-shaping the file will result in more powerful acoustic microstreaming (Ahmad *et al.* 1992, Lumley *et al.* 1992, Lumley & Walmsey 1992). A pre-shaped file shows the same pattern of nodes and antinodes as a straight file both in air and in the confined geometry of a root canal (Lumley & Walmsley 1992).

The intensity of the acoustic microstreaming is directly related to the streaming velocity. The equation that in first approximation describes the streaming velocity is

$$v = \frac{\omega \varepsilon_0^2}{a}, \qquad (1)$$

where v is the liquid streaming velocity, ω is 2π times the driving frequency, ε_0 is the displacement amplitude and a the radius of the wire. Following equation 1 it can be concluded that the thinner the file, the higher the frequency and the greater the displacement amplitude of the file, the higher the streaming velocity and the more powerful the acoustic microstreaming will be. Whether this equation will also hold for the complicated nonlinear streaming pattern during PUI remains to be shown.

The shear flow caused by acoustic microstreaming produces shear stresses along the root canal wall, which can remove debris and bacteria from the wall. The shear stress is expressed in the following equation (Ahmad *et al.* 1988):

Figure 1 Acoustic streaming around a file in free water (left) and a schematic drawing (right).

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