Ultrasound Dental Prophylaxis Treatment Modeling
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Prophylaxis treatment
• Remove supragingival and subgingival dental calculus from enamel surface to prevent periodontal diseases.
• Can be performed by hand instrumentation, sonic scaler and ultrasonic scales.
• Standard ISO 22374:2005 regulates ultrasonic scaling treatment: Angle between 0° and 10°, maximum force of 1 N.

The tooth structure
Pulp – The only living part and located in the center of the tooth. Contains living tissues, cells, blood vessels responsible for bringing nutrients to the tooth, nerves responsible for the sensitivity of the tooth. The pulp’s primary function is to produce dentin.
Dentin – The most abundant tissue of the tooth, composed of 70% organic and 30% inorganic materials. Contains tubules allowing transportation of nutrition from the surface to the pulp. It is very porous and less hard than enamel.
Cementum – Covers the roots of the tooth in a very thin layers composed of 50% organic and 50% inorganic materials. It helps to anchor the tooth within the bone.
Enamel – Composed of 4% water and organic materials and 96% minerals mostly hydroxyapatite. It is the harder tissue of the human body and is also brittle.

Enamel
• Grows in prismatic and apcrismatic layers.
• Does not undergo remodeling: damages are permanent.
• High mineral content provides strength to enamel and also makes it brittle.

Calculi
• Its formation is initiated by the deposition of the plaque: a biofilm (i.e. well-organized community of bacteria that adheres to the surface of the tooth) composed of more than 500 bacterial species.
• The plaque is calcified by the absorption of calcium and phosphate from saliva or gingival crevicular fluid to form calculus.
• Calculus grows in layers of 20 to 400 μm: its surface exhibits better adhesion properties and is more suitable for deposition of calcifying plaque.
• Its composition depends on several parameters: hygiene, alimentation, genetic, tobacco, drugs. It varies from one tooth to another.
• It can be supragingival (above the gum line) or subgingival (below the gum line), the latter is harder than the former.

Mechanical properties
• Hardness about 350 HV.
• Young’s modulus of 83 GPa.
• Yield stress of 330 MPa.
• Tensile strength of 46 MPa.

Ultrasonic scalers – Mode of operation
Module
• Generates an electronic signal (square or sinusoidal) and sends it to the handpiece
• Measures intensity and current feedback from the handpiece to compute impedance
• Scans between 24 and 32 kHz to find the minimum impedance and tries to adjust on this value to regulate the frequency

Handpiece
• Corresponds to a motor made of a piezoelectric transducer
• Piezoelectric ceramic rings transform electronic energy sent by the module in mechanical energy resulting in longitudinal vibrations of the transducer
• Vibrations are amplified by the sonotrode and transmitted to the instrument

Instrument
• Vibrates in flexion
• The tip of the instrument vibrates with an amplitude of about 200 μm
• Mechanically removes calculus from the tooth by chipping
• Different instruments exist depending on the application: supragingival (A), supragingival and subgingival (P), subgingival (PS)