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Biomechanical modelling for tooth survival studies: mechanical properties, loads and boundary conditions—A narrative review

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Abstract-

Recent biomechanical studies have focused on studying the response of teeth before and after different treatments under functional and parafunctional loads. These studies often involve experimental and/or finite element analysis (FEA). Current loading and boundary conditions may not entirely represent the real condition of the tooth in clinical situations. The importance of homogenizing both sample characterization and boundary conditions definition for future dental biomechanical studies is highlighted. The mechanical properties of dental structural tissues are presented, along with the effect of functional and parafunctional loads and other environmental and biological parameters that may influence tooth survival. A range of values for Young’s modulus, Poisson ratio, compressive strength, threshold stress intensity factor and fracture toughness are provided for enamel and dentin; as well as Young’s modulus and Poisson ratio for the PDL, trabecular and cortical bone. Angles, loading magnitude and frequency are provided for functional and parafunctional loads. The environmental and physiological conditions (age, gender, tooth, humidity, etc.), that may influence tooth survival are also discussed. Oversimplifications of biomechanical models could end up in results that divert from the natural behavior of teeth. Experimental validation models with close-to-reality boundary conditions should be developed to compare the validity of simplified models.

Index Terms- biting; bruxism; clenching; characterization; experimental; FEA; modelling

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