Three Dimensional Finite Element Meshing Generation for Maxillary Second Premolar

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ABSTRACT

The finite element method （ FEM ） is a powerful tool in biomechanics. However, developing a three dimensional finite element three dimensional mesh for irregular geometry object is still a labor intensive task hence limits the usage of three dimensional analysis for dental subjects. This study presented an automatic procedure to generate three dimensional finite element mesh of a maxillary second premolar. Tooth embedding, image processing, three dimensional automesh and convergence testing were the major phases of this study. Firstly, a second premolar was embedded into a resin cube and exposed tooth-resin sections parallel to the occulsal surface. A self-developed image processing system was employed to detect the different materials' boundaries of each section and obtained a series of contours. The plane mesh process was basically a moving nodes of uniform cube approach. The boundaries of each slice were superimposed by a uniform grid points. For grid points that were within half grid space of the boundaries, they were moved to the nearest position of the boundaries. A cube was formed from the corresponding grid points between two adjacent slices, and was broken to generate the tetrahedral elements thus created the three dimensional FE mesh. Six mesh models of the second premolar with linear and nonlinear and different element sizes (0.879mm, 1.074mm,1.27mm) were analyzed. Strain energy and vonMises stresses were checked for convergence in crown for all six models. Results of this study indicated that this automatic meshing procedure can provide a feasible way to generate accurate three dimensional finite element mesh for dental biomechanics study.

Keywords: Finite element method, Strain energy, Mesh