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论文

不同工况下埋伏牙的位移趋势及牙周应力的三维有限元分析

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摘要：

目的 通过建立埋伏牙三维有限元模型，分析不同工况下埋伏牙的牙周应力，从而为临床上正畸牵引治疗埋伏牙提供基础实验依据。方法 选取1例上颌尖牙完全骨埋伏患者,利用螺旋CT技术与三维有限元方法建立统一坐标系下上颌埋伏尖牙及其支持组织的三维有限元模型。保持牙尖位置不变，调整埋伏牙长轴的倾斜角度，使牵引力方向与牙体长轴的夹角分别为0°、45°和90°。在每个模型埋伏牙牙尖处施加50、100、150g的牵引力，分析比较9种工况下牙周膜等效应力云图和牙齿瞬间位移云图的特点。结果 当牵引力方向与牙体长轴一致时（0°），埋伏牙上各点的瞬间位移为沿牵引力方向，趋向于整体移动，牙周组织应力集中区域出现在牙尖及根尖点处，最大应力值出现在牙尖处；当牵引力方向与牙体长轴成45°和90°夹角牵引时，埋伏牙趋向于以沿牵引力方向的倾斜移动，旋转中心在牙颈部附近，应力集中区域出现在牙尖及面向牵引力侧，最大应力值出现在牙尖处； 同一种牵引角度下，随着牵引力大小的增加，埋伏牙牙周组织应力值逐渐增加，但应力集中区域变化不明显。结论 当牵引力方向与牙体长轴一致时，埋伏牙趋向于整体移动，牙周组织应力分布较为均匀，有利于其牵引；当牵引力方向与牙体长轴不一致时，埋伏牙趋向于倾斜移动，牙周组织应力分布不均匀，不利于其牵引。较小的牵引力值有利于埋伏牙的牵引。

关键词： 埋伏尖牙；三维有限元；瞬间位移；等效应力

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Three dimensional finite element analysis of displacement trends and periodontal stress distribution when a maxillary impacted canine are tracted in different condition

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Abstract:

Objective To analyze the the stress of its periodontal tissues in different conditions by establishing the three-dimensional finite element model of an embedded tooth, and provide experimental reference to the orthodontic traction of embedded teeth in the clinic. Methods A patient with a canine completely embedded in the maxillary bone was chosen. The three dimensional finite element model of the canine and its surrounding tissues was established by means of the finite element method (FEM) and spiral CT. On the basis of the dental cusp stable，the canine axis were changed to reach different angles of traction . Finally，the forces of 50g、100g and 150g were exerted to the three models with different angles at 0°、45° or 90° . Equivalent stress clouds of the periodontal membrane and the wink movement clouds of the tooth were observed. Results At 0° , the wink movement of the embedded tooth was to follow the direction of the force, and the movement was integral. There was a stress concentration area at apical and cusp of the tooth, and the biggest stress emerged at the cusp; At 45° and 90° ，the wink movement of the embedded tooth was to follow the traction, but, an angel appeared between the two directions with rotation center at dental cervix. There were stress concentration areas at the apical and the side facing traction forces, and the biggest stress also emerged at the cusp. The stress of periodontal tissues increased following with the growth of the drawing stress at the same traction direction，however, no obvious change of the stress concentration area was found. Conclusions When the traction direction is in line with the tooth axis，the embedded tooth is to move integrally, and the periodontal stress distribution is homogeneous, which benefits the traction. However, when the traction direction angls with the tooth axis, the tooth is inclined to move to one side and the periodontal stress distribution is not homogeneous, which is adversary to the traction. Less drawing stress is suitable to tract the

embedded tooth.

Keywords: Embedded canine; Finite element method; Wink movement; Equivalent stress

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