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静态和动态条件下股骨假体结构参数研究

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摘要：

目的：对比研究静态加载和动态加载条件下股骨柄长度和横截面形状对股骨柄上应力及疲劳的影响。方法：由患者的股骨CT数据重建出股骨模型；设计了三种横截面形状（圆形，鼓形Ⅰ－鼓高8mm，鼓形Ⅱ－鼓高10mm），每种横截面的股骨柄分别有10种长度（40—130mm）；分别对建立的模型进行静态分析和动态分析，其中动态加载力为患者正常走路步态，利用动态分析结果进行疲劳分析。结果：静态分析和动态分析均显示鼓形横截面的股骨柄假体比圆形横截面股骨柄假体有更小的微小位移，但同时在柄－颈拐角处及柄远端形成应力集中，而圆形股骨柄上的应力分布均匀，三种横截面的股骨柄上最大应力都在中等柄长（80—110mm）时达到最小；疲劳分析显示短柄和长柄具有相似的疲劳安全系数，而中等长度柄有较高的安全系数。结论：综合静态分析、动态分析和疲劳分析，具有鼓形Ⅱ横截面和90mm柄长的股骨柄在30种股骨柄模型中具有最好的力学性能－较小的应力和微小位移，较高的疲劳安全系数。

关键词：股骨假体 有限元分析 疲劳分析

Research on key parameters of femoral prosthesis based on static and dynamic analysis

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Fund Project:

Abstract:

Objective: To assess the influence of stem length and cross section under static and dynamic loading on the stress and fatigue behavior of femoral prosthesis. Method: The round-shaped and drum-shaped femoral prosthesis models were analyzed under both static and dynamic (normal walking) loading conditions with finite element method. The stress on the metallic stem, cement, and adjacent bone as well as the micromotion at the cement-metal interface were analyzed. Safety factors for fatigue life of femoral prothesis were calculated based on the data obtained from the dynamic analysis. Result: Static analysis showed that the drum-shaped cross section could decrease the microdisplacement of stem and the corresponding stress was located on the corner of femoral neck and distal part of femoral prosthesis. The stress on round-shaped stem distributed evenly over most part of stem, and the maximum stress on stem fluctuated with stem length, with a minimum at stem length from 80 to 110mm, and drum-shaped stem with a height 8mm drum generated larger stresses at the distal part of stem than the drum-shaped stem with a height 10mm drum and the round stem. Conclusion:Dynamic and fatigue analysis showed that the drum-shaped stem with a height 10mm drum and a stem with length 90mm had the greatest safety factor, therefore had the longest fatigue life.

Keywords:femoral prosthesis finite element analysis fatigue analysis

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