Mini Review

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Biomechanical analysis of the femur bone with the cotyle of the hip prosthesis

Abstract

The study of the biomodel between the femur bone and the hip prosthesis cotyle focuses on the use of the finite element method (FEM) to simulate the biomechanical behavior of the femur bone and the cotyle of the hip prosthesis. The study is based on 3D models generated from CT scan data from patients with hip replacements. The results indicated that the distribution of the load on the femur and cotyle varies according to the different positions of the cotyle. In addition, different stress patterns were observed in the femur bone and the cotyle of the prosthesis, suggesting the need to consider these variables when redesigning hip replacements.

Keywords: analysis, biomechanics, femur, prosthesis, hip, cotyle

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Introduction

Hip replacement is a common solution for patients suffering from hip conditions or severe joint fractures. Although it has been widely used for decades, the long-term success of a hip replacement depends on its ability to withstand daily mechanical loads and maintain normal function. That is why, in recent years, attention has been focused on the study of the biomechanics of the femur bone and the cotyle of the hip prosthesis to optimize the design and effectiveness of these prostheses.[1]

In this context, the study focuses on the use of the finite element method (FEM) to simulate the biomechanical behavior of the biomodel under different load conditions. It relies on 3D models generated from computed tomography data from patients with hip replacements to do this.[2]

Methodology

Different load conditions were evaluated, considering the cotyle, the healthy femur bone, and the normal body load of an obese person of 101.9 kg (1000 N) in an upright position and statically. The results obtained indicated that the distribution of the load in the femur and the cotyle varies and that there are different patterns of stress, strain, and displacements in the femur bone and the cotyle of the prosthesis.[3–4]

Therefore, the information obtained from this study is of great relevance to the medical and scientific community, as it could be useful for the design and evaluation of future hip replacements that improve patients' quality of life. In addition, this type of numerical biomechanical analysis using the FEM could be useful to predict and avoid possible complications and/or failures in hip replacements (Figure 1).[5]

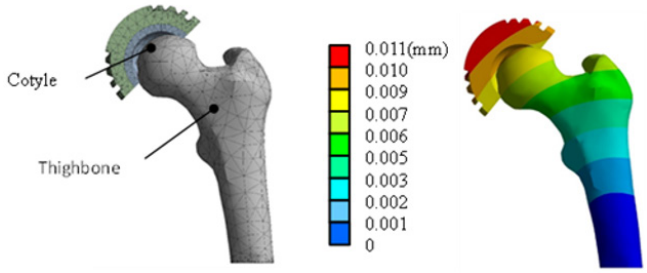

Figure 1 Biomodel and the result of system displacement.

Conclusion

In conclusion, the study of the biomodel between the femur bone and the hip prosthesis cotyle through the finite element method (FEM) is a valuable tool to improve the design and effectiveness of hip replacements. The results obtained suggest the need to consider different contemplations in the femur bone and the cotyle of the prosthesis when designing hip prostheses to guarantee greater resistance and normal function. Numerical biomechanical analyses using the FEM could be a useful tool to predict and avoid possible complications and/or failures in hip replacements, which could significantly improve the quality of life of patients.[6–7]

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Conflicts of interest

The authors declare there is no conflict of interests.

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