Finite Element based Model of Modified Niagara Foot and its Effect on Stiffness

Abstract

A prosthetic foot-ankle system is designed with the purpose of improving the amputee gait by storing and releasing elastic energy during the stance stage of the gait. Such foot performance is based on its structural stiffness characteristics. Choosing the appropriate stiffness of a prosthetic foot is planned to substitute the loss of the muscles and tendons of the intact foot. The aims of this study are to study the effect of the thickness of the upper part of the S-shape and removing the prongs on the structural stiffness of a modified Niagara foot using the FEA. In this work, a simulated model based on finite element is built. Then, an analysis is conducted on the modified models of Niagara foot using the boundary conditions of the ISO-10328 and expanded using the boundary conditions of the ISO-22675 to study the effect of removing the prongs from the models. The stiffness results of the FEA are compared by considering the Kl, K2, and KH values. The prongs of the Niagara foot had a major contribution in force-displacement relationships. So, by removing these prongs, the stresses imposed in a foot due to loading the toe exceeded the yielding stress for the feet when proposing the Delrin 2700 or Hytrel 8238 materials. Also the absence of the prongs showed remarkable effects on the toe
stiffness variation with the simulated time of stance, especially at the earlier stages of the toe contact where this effect diminished gradually up to the toe-off.

References


**Index Terms**

Computer Science  
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**Keywords**

Finite Element; Niagara foot; Stiffness.