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Abstract

Mechanical characterization of Lower Limb 3D printed socket materials under static external loading

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This paper explores the feasibility of utilizing 3D-printed materials for lower limb prosthetic sockets, focusing on two specific materials: PA6 and PA6 reinforced with carbon fiber (PA6-CF). Through comprehensive load analysis conducted using ANSYS mechanical simulation software, we examined the structural integrity of these materials under a vertical load of 1300 N. Our findings reveal that while both materials exhibited similar stress levels, however, the PA6-CF material demonstrated significantly superior performance. Specifically, the directional and total deformation of the PA6-CF sockets were reduced to approximately one-third of those observed in the PA6 sockets. Moreover, the inclusion of carbon fiber resulted in a 48.65% increase in the minimum safety factor, highlighting a notable enhancement in strength and durability. These results suggest that PA6-CF offers substantial improvements in stability and safety, making it a highly promising candidate for the development of reliable and robust 3D-printed lower limb prosthetic sockets.

Author's Statement

Conflict of interest: The authors of this publication hereby declare that there is no conflict of interest. Acknowledgments: Authors are grateful to the International Partnership Fund (IPF) scheme sponsored by Nottingham Trent University, United Kingdom for supporting this research work

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