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The Low-Cost Design and 3D Printing of Structural Knee Orthotics for Athletic Knee Injury Patients

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Abstract : Knee orthotics play an important role in aiding in the recovery of those with knee injuries, especially athletes. However, structural knee orthotics is often very expensive, ranging between $300 and $800. The primary reason for this project was to answer the question: can 3D printed orthotics represent a viable and cost-effective alternative to present structural knee orthotics? The primary objective for this research project was to design a knee orthotic for athletes with knee injuries for a low-cost under $100 and evaluate its effectiveness. The initial design for the orthotic was done in SolidWorks, a computer-aided design (CAD) software available at Loyola Marymount University. After this design was completed, finite element analysis (FEA) was utilized to understand how normal stresses placed upon the knee affected the orthotic. The knee orthotic was then adjusted and redesigned to meet a specified factor-of-safety of 3.25 based on the data gathered during FEA and literature sources. Once the FEA was completed and the orthotic was redesigned based from the data gathered, the next step was to move on to 3D-printing the first design of the knee brace. Subsequently, physical therapy movement trials were used to evaluate physical performance. Using the data from these movement trials, the CAD design of the brace was refined to accommodate the design requirements. The final goal of this research means to explore the possibility of replacing high-cost, outsourced knee orthotics with a readily available low-cost alternative.

Keywords : 3D printing, knee orthotics, finite element analysis, design for additive manufacturing
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