

Design and Optimization of a Customized External Fixation Device for Lower Limb Injuries

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Abstract : External fixation is a common technique for the treatment and stabilization of bone fractures. Different designs have been proposed by companies and research groups, but all of them present limitations such as high weight, not comfortable to use, and not customized to individual patients. This paper proposes a lightweight customized external fixator, overcoming some of these limitations. External fixators are designed using a set of techniques such as medical imaging, CAD modelling, finite element analysis, and full factorial design of experiments. Key design parameters are discussed, and the optimal set of parameters is used to design the final external fixator. Numerical simulations are used to validate design concepts. Results present an optimal external fixation design with weight reduction of 13% without compromising its stiffness and structural integrity. External fixators are also designed to be additively manufactured, allowing to develop a strategy for personalization.

Keywords : computer-aided design modelling, external fixation, finite element analysis, full factorial, personalization

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