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# Improvement of an additively manufactured subperiosteal implant structure design by finite elements based topological optimization

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**Abstract-**

**To design a new subperiosteal implant structure for patients suffering from severe Maxillary Atrophy that lowers manufacturing cost, shortens surgical time and reduces patient trauma with regard to current implant structures. A 2-phase finite-element-based topology optimization process was employed with implants made from biocompatible materials via additive manufacturing. Five bite loading cases related to standard chewing, critical chewing force, and worst conditions of fastening were considered along with each specific result to establish the areas that needed to be subjected to fatigue strength optimization. The 2-phase topological optimization tested in this study performed better than the reference implant geometry in terms of both the structural integrity of the implant under tensile-compressive and fatigue strength conditions and the material constraints related to implant manufacturing conditions. It returns a nearly 28% lower volumetric geometry and avoids the need to use two upper fastening screws that are required with complex surgical procedures. The combination of topological optimization methods with the flexibility afforded by additively manufactured biocompatible materials, provides promising results in terms of cost reduction, minimizing the surgical trauma and implant installation impact on edentulous patients.**

**Index Terms-**



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