

Abstract

Biomechanical testing of an additively manufactured implant for mandibular reconstruction

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The structural integrity of load-bearing implants is crucial for long-term clinical success. Additive manufacturing (AM), specifically electron beam melting (EBM), enables the design of complex, thin-walled geometries tailored to patient-specific needs. Due to manufacturing-related imperfections, greater surface roughness, and the thin-walled structure itself, the mechanical properties differ from those of conventionally manufactured samples [1, 2]. Furthermore, there is no gold standard for the mechanical testing of mandible implants. These circumstances, therefore, necessitate specialised experimental analyses.

This study evaluates the biomechanical performance of a thin-walled, EBM-fabricated mandibular implant for bridging large defects due to tumour resection or trauma. To replicate biomechanics as realistically as possible during experimental tests, a test setup was developed using a numerical model. This setup enables systematic investigation of the implant-screw assembly using both minipig cadaveric bone and 3D-printed resin surrogates. A secondary objective is to validate the suitability of 3D-printed resin as a consistent surrogate material for biological bone in AM-related testing.

The results provide critical insights into the fatigue resistance and structural reliability of the additively manufactured implant and the fixation system.

AUTHOR'S STATEMENT

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