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MECHANICAL AND MORPHOLOGICAL PROPERTIES OF HYBRID ZRO_2/β-TCP FILLED POLYAMIDE 12 FOR CRANIOFACIAL RECONSTRUCTION: 3D PRINTING AND INJECTION MOULDING

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SUMMARY

Craniofacial deformity is unique and complex that patient specific implant (PSI) is required. The emergence of 3D printing technology could be an alternative for rapid and accurate PSI fabrication. However, the developed material need to possess an adequate mechanical integrity. This study aims to compare the impact and morphological properties of hybrid ZrO_2/β-TCP filled Polyamide 12 (PA 12) fabricated using 3D printing and gold standard of injection moulding techniques. PA 12 was compounded with 15 wt% of ZrO_2 together with 15, 20, 25 wt% of β-TCP. The obtained pellets were injection moulded (Boy 22M, Dr. Boy GmbH) to form impact specimens. The remaining pellets were used to fabricate filament feedstock for 3D printing (Makerbot Replicator 2X, Makerbot) of impact specimens (n=5/composition). The impact properties were determined using Izod impact tester (5101, Zwick) equipped with 7.5J pendulum. The morphological properties of fillers as well as the selected filament feedstock and broken impact specimens were observed using field emission scanning electron microscope (Quanta FEG 450, Fei). Independent t-test (p<0.05) was employed using IBM SPSS software ver 22.0. The impact strength of 30 and 35 wt% 3D printed hybrid ZrO_2/β-TCP were 12.44 and 20.43 kJ/m2 respectively, an increase by 18~95% as compared to injection moulding (10.48 and 10.49 kJ/m^2). Whereas, the fillers were homogenously dispersed in PA 12 matrix. With sufficient mechanical integrity and novel composition integrated using advanced processing techniques, hybrid ZrO_2/β-TCP filled Polyamide 12 is potential for craniofacial reconstruction.