INTISARI

Metode konvensional dalam pembuatan Hip Prosthesis seperti subtractive manufacturing maupun investment casting dengan *master pattern* lilin masih belum dapat mengakomodasi bentuk kompleks yang dibutuhkan pada Hip Prosthesis Berpori untuk mendukung oseointegrasi. Oleh karena itu, Hybrid investment casting yang memanfaatkan pencetakan Master Pattern melalui 3D printing seperti Fused Deposition Modeling (FDM) dipilih karena fleksibilitasnya yang dapat mencetak desain digital dan keunggulan material polycast yang dapat terbakar sempurna (<0.03% abu sisa). Meskipun demikian, hasil cetak FDM masih berpotensi mengalami defect. Penelitian ini bertujuan mengoptimalkan parameter proses pencetakan untuk meminimalkan defect menggunakan Response Surface Method (RSM). Parameter proses suhu nozzle, kecepatan cetak, dan build angle ditinjau untuk mengetahui pengaruhnya terhadap variabel respons (galat dimensi, galat porositas, dan skor defect). Hasil optimasi menunjukkan kombinasi optimum: suhu nozzle 220 °C, kecepatan cetak 10 mm/s, dan sudut build 0°. Konfigurasi ini menghasilkan galat dimensi 0,36%, galat porositas 8,59%, dan skor defect 18,89%.

Kata kunci: *Hip Prosthesis*, *Master Pattern*, Desain Berpori, FDM, Optimasi Parameter

ABSTRACT

Conventional methods in the manufacture of hip prostheses, such as subtractive manufacturing and investment casting with wax master patterns, are still unable to accommodate the complex shapes required for porous hip prostheses to support osseointegration. Therefore, hybrid investment casting utilizing 3D printing for master pattern creation, such as Fused Deposition Modeling (FDM), was selected due to its flexibility in printing digital designs and the advantages of polycast material, which can burn completely (<0.03% residual ash). However, FDM prints still have the potential for defects. This study aims to optimize printing process parameters to minimize defects using the Response Surface Method (RSM). Process parameters such as nozzle temperature, printing speed, and build angle were examined to determine their influence on response variables (dimensional error, porosity error, and defect score). The optimization results indicate the optimum combination: nozzle temperature of 220°C, print speed of 10 mm/s, and build angle of 0°. This configuration yields dimensional error of 0.36%, porosity error of 8.59%, and defect score of 18.89%.

Keywords: Hip Prosthesis, Master Pattern, Porous Design, FDM, Parameter Optimization