# Differences between designs and actual measurements in 3D-printed microstructures for implement proper pore size to enhance bone growth

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INTRODUCTION:

3D printing additive manufacturing is feasible and practical in orthopedic oncology. For orthopedic implants, bone growth for implant is an important mechanism for maintaining the binding between the implant and the host bone. The target porosity to strengthen bone growth is well known and studied in existing orthopedic implants. The lattice structure can be printed by metal 3D printing and is used as a porous structure for bone growth in 3D-printed orthopedic implants. However, some literature has reported differences in design and actual output, especially in microstructural printing. Therefore, we tried to determine an appropriate target size for bone growth and see if it was printed at an appropriate size for the target. Pore size and porosity% were targeted at 300-600um and 70% ideal for bone growth, respectively.

METHODS:

The specimen was a cube shape with 15 mm of full lattice as one side, and was printed in an SLM method, and small, medium, and large specimens were printed with respect to unit size. Small, medium, and large specimens were all designed with the same dode-thin design, and the unit sizes were changed to 1.15 mm, 1.5 mm, and 2.0 mm, respectively. The beam compression was output while serially raising from 0 until the vector was lost. For all specimens, the thicknesses of unit size and strut were measured 50 times each in SEM photographs. Pore size was calculated from unit size and strut, and porosity was converted from weight.

RESULTS:

The average for small, medium, and large pore size was 257.9um, 406.2um, and 633.6um, respectively, and the error rates on design and actual output were 286%, 223%, and 174%, respectively. The maximum error of the unit size was 13.5um, and the average error of strut was 228.8um, 245.8um, and 261.6um, respectively, in small, medium, and large. In addition, porosity% was 62%, 70%, and 80% in small, medium, and large, respectively.

DISCUSSION AND CONCLUSION:

It was confirmed that the error of pore size is made by a combination of unit size and strut error and is mainly caused by the error of strut. It is confirmed that a structure in the micrometer unit could show a significant difference from the design, but this error is not a random error, a direction in which strut is thickened and pores are reduced by a certain amount, so accuracy was low but precision was high. Therefore, reproducibility was secured stably, and the target pore size and porosity% were obtained by printing the unit size 1.5 mm of the dode-thin in the SLM method.