

Desain, Fabrikasi, dan Analisis Performa Mono-aksial Pedicle Screw = Design, Manufacturing, and Analysing Mono-axial Pedicle Screw Performance

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Abstrak

Studi ini bertujuan untuk mengembangkan produk implant tulang belakang mono-aksial pedicle screw. Prototipe implan yang terdiri dari beberapa variasi desain geometri telah didesain dan difabrikasi menggunakan metode machining. Variasi prototipe terdiri dari 3 ukuran depth thread yang berbeda, 3 ukuran pitch yang berbeda, dan 2 variasi conical. Setelah dilakukan evaluasi geometri 2 dari 7 variasi prototipe implan pedicle screw tidak sesuai dengan bentuk desainnya, dan untuk 5 variasi lainnya memiliki penyimpangan <5% dari ukuran dimensi desain. Prototipe tersebut diuji dengan pengujian pull out, torsi, dan bending untuk mengetahui performanya. Hasil pengujian pull out tertinggi dihasilkan oleh variasi pitch dengan ukuran pitch 2,1 mm dengan nilai 1658,25 N. Untuk nilai pull out tertinggi pada variasi depth thread dimiliki oleh ukuran depth thread 0,9 mm dengan nilai 1563,5 N. Sedangkan untuk nilai torsi terendah dihasilkan oleh variasi pitch pada ukuran 2,1 mm sebesar 0,15 Nm, dan untuk variasi depth thread pada ukuran 0,9 mm sebesar 0,59 Nm. Untuk pengujian bending dilakukan pada 1 variasi pedicle screw dengan beban nilai terbesar 707 N. Setelah dilakukan beberapa pengujian pada ke-7 variasi didapatkan bahwa faktor geometri desain pedicle screw dapat mempengaruhi secara signifikan maupun tidak signifikan.

The aim of this study is to develop a mono-axial pedicle screw for spinal implants. The implant prototype, which had varied geometries and designs, was produced through machining. The variation in the prototypes consisted of 3 different thread depths, 3 different pitch lengths, and 2 different conical geometries. After evaluations were made on the prototypes, 2 of the 7 variant prototypes did not match its original design geometry and dimensions. Meanwhile, the other 5 prototypes had a <5% measurement deviation compared to its original design. The prototypes were all tested for its pull out, torsion, and bending capabilities to compare their performances. The highest measurement in the pull out test, in terms of pitch, was made by the prototype with the 2.1 mm pitch which resulted in a 1658.25 N measurement. In terms of the thread depth, the highest measurement in the pull out test was made by the prototype with the 0.9 mm thread depth which resulted in a 1563.5 N measurement. For the torsion test, in terms of pitch, the least torsion was made by the prototype with the 2.1 mm pitch resulting in a 1.5 Nm in torsion. As for the thread depth, the least torsion was done by the prototype with the 0.9 mm thread depth at 0.59 Nm in torsion. For the bending test, the highest load obtained was 707 N in one variation of the pedicle screw. Based on the results of the tests, it can be summarized that the geometric design of the pedicle screw may affect its performance significantly.