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ABSTRACT

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The rising incidence of bone fractures, driven by increased osteoarthritis, osteoporosis in the elderly, urbanization-related accidents, and the popularity of high-impact sports, has escalated the demand for orthopaedic medical devices. Devices such as bone plates, metaphyseal plates, intramedullary nails, and joint implants are being used more frequently, with bone screws playing a critical role in internal fixation procedures. However, screw failure is a possibility during surgical procedures due to factors such as material fatigue and improper torque application. These failures can prolong the surgical procedure, complicate bone recovery, and increase the risk of postoperative infections.

This project aims to develop a bone screw test rig conforming to ASTM F543 standards, capable of measuring the torsional properties of bone screws. The rig will measure various parameters, including insertion torque, removal torque, breaking torque, and the angle of rotation at failure. This initiative seeks to refine the understanding of how screw thread profiles and materials impact their torsional properties, which are vital for ensuring screw performance and safety.

The project's objectives include redesigning the slotted disk with advanced 3D modelling and printing, constructing an optical switch circuit for precise measurement, calibrating the test rig with a strain gauge for enhanced accuracy, and developing analytical software for detailed data visualization. Initial progress has been made with the functioning slotted disk and optical switch circuit, which are crucial in determining the angle of rotation, with further advancements expected in the coming weeks. This comprehensive approach will facilitate a more refined evaluation of screw performance, contributing to improved orthopaedic device standards and patient outcomes.