



BMM 311L Biomaterials and Biomechanics Laboratory, Spring 2020

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EXPERIMENT 2: Axial Pull-Out Test for Metallic Medical Bone Screws

1. Scope

The goal of this experiment is to understand the axial tensile force required to fail or remove a bone screw from a defined material.

2. Introduction

Axial pullout strength could be defined as the tensile force required to fail or remove a bone screw from a material into which the screw has been inserted.

The strength of the fixation of a metallic medical bone screw can be quantified by measuring its pullout force. It helps enlightening some controversial points concerning the mechanical behavior of the metallic screw - bone tissue system. In this context Metallic Medical Bone Screws need to undergo several tests before gaining approval as internal fixation devices of the skeletal system. Axial Pull-out Tests are commonly preferred to determine the mechanical behavior of screws. One standard, **ASTM F543-02** defines the test methods Metallic Medical Bone Screws.

Some of the terms used in this experiment are shown in Fig.1 on the screw.

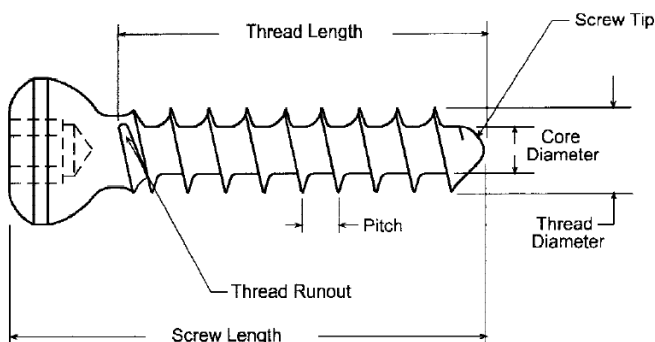


Figure 1. Schematic of screw terms.

3. Test Specimen and Laboratory Equipment

The typical test configuration is illustrated in Fig.3. Load-Displacement values will be gained from Instron 3369 universal testing system. The pedicle screws will be mounted on the foams prepared according to ASTM F1839 standards.

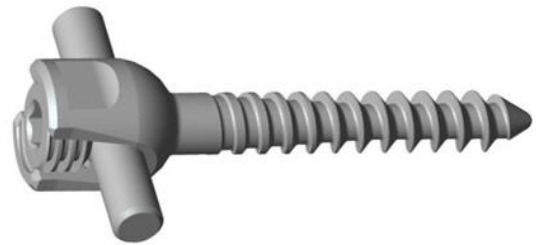


Figure 2. Illustration of typical pedicle screw.

4. Experiments and Procedure

Place the specimen in the test fixture as defined below. Drive the specimen into the test block, using the appropriate size and configured screwdriver bit, by applying a torsional force at a rate of of 3 r/min to a depth of 20 mm with the motor-driven torque wrench. The insertion depth should be 20 mm into the bone. Partially threaded bone screws should have all threads inserted into the standard material.

The test block and test block clamp depicted in Fig. 3 shall be fixed to the base of the load frame so that the longitudinal axis of the screw is aligned with the direction of the applied load. The screw's head shall be placed in the slot of the load fixture and seated in the spherical recess. The load fixture shall then be attached to the load frame. A tensile load shall be applied to the test specimen at a rate of 10 mm/min until the screw fails or releases from the test block. Load (newtons) versus load fixture displacement (millimetres) shall be recorded on a data acquisition device, noting the maximum load applied and the mode of failure (screw shaft, screw threads, or material failure).

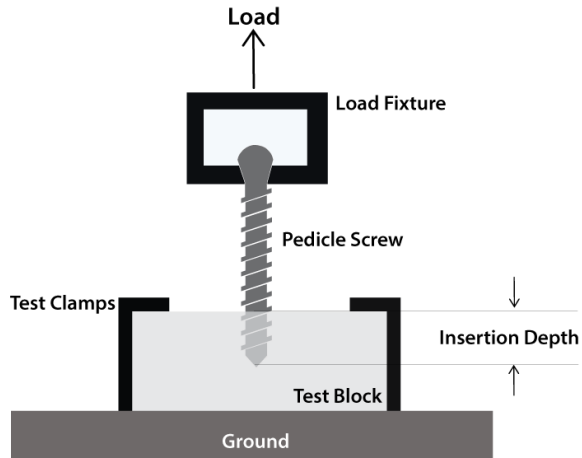


Figure 3. Schematic illustration of test apparatus for pull-out strength.

Determine the axial pullout strength (newtons) of the test specimen from the load-displacement curve. The maximum load is reached during the test method.

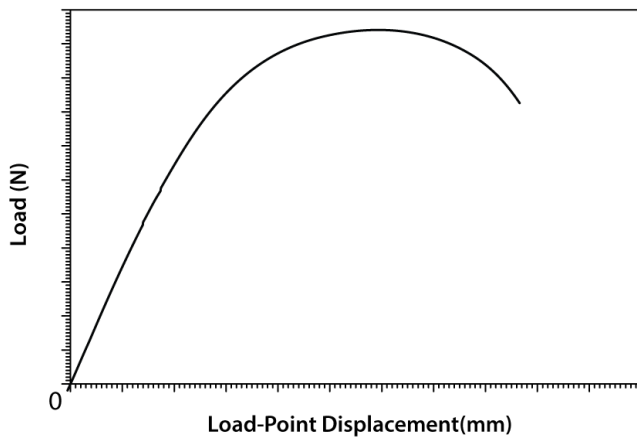


Figure 4. Typical load-displacement graph for Pull-out Test for Metallic Medical Bone Screws

References

[1] ASTM F432-02, Standard Specification and Test Method for Metallic Medical Bone Screws, Designation: F 543 - 02

Safety in Laboratory

1. Eye protection must be worn during the tensile test.
2. Wait for the Teaching Assistant before beginning the laboratory exercise so that they can guide you through testing your first sample.
3. Before beginning a test or moving/resetting the universal testing machine, make sure all items including hands, hair, etc. are clear of the machine.

Grading

Lab reports: (70%)*

Short exam at end of 3rd and 6th experiments: (30%)

* Late delivered reports will lead to lose of 10 points/day.

* Each group delivers one report.

Labs

TOBB ETÜ Technology Center, B06 (Experiments 1-4), 201 (Experiments 5), 206 (Experiment 6).

Contacts

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