BMM 311L Biomaterials and Biomechanics Laboratory, Spring 2020

Instructors: Assist. Prof. Dr. Ersin Emre Oren & Dr. Fatma Kübra Erbay Elibol
Teaching Assistants: Büşra Demir and Çağlanaz Akın

EXPERIMENT 4: Mechanical Behavior of Vertebrae under Torsional Forces

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1. Scope

The goal of this experiment is to examine the intrinsic mechanical response of the vertebrae under torsional forces.

2. Introduction

In spinal structures, ligaments have to endure 3 basic stresses; traction, flexion and torsion to which can be added to concomitant wearing against tibial or femoral tunnels. An experimental approach of fretting behaviors should be performed to know the behavior of ligamants. This is important for the curing the injuries and the design of new artificial ligaments. In this experiment, mechanical behavior of ligament will be experienced applying torsional forces on sheep vertebrae. (Note: Fretting wear is the repeated cyclical rubbing between two surfaces, which is known as fretting, over a period of time which will remove material from one or both surfaces in contact.). Torsional stiffness and yield point will be calculated at the end of experiment.

As a general definition, torsional stiffness is the measure of the amount of torque that a radial shaft can sustain during its rotation in a mechanical system. The concept is central to basic mechanics and engineering, and torsional stiffness is one of the key forces of measure for any mechanical system that rotates on a fixed axis.

3. Test Specimen and Laboratory Equipment

3 segmented (three vertebrae and the intervening disc and ligaments) sheep vertebrae was stored in -20 ºC until 24 h before the experiment. Subsequently, spines were defrosted mounted in polyurethane back holders.

4. Experiments and Procedure

The 2 segmented vertebrae will be rotated with 2 degree/s angular speed using Instron torsion test system.

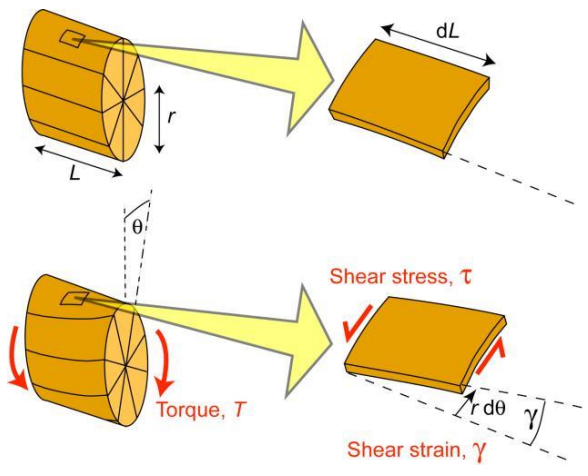

Figure1. Torsion of cylindrical bar.

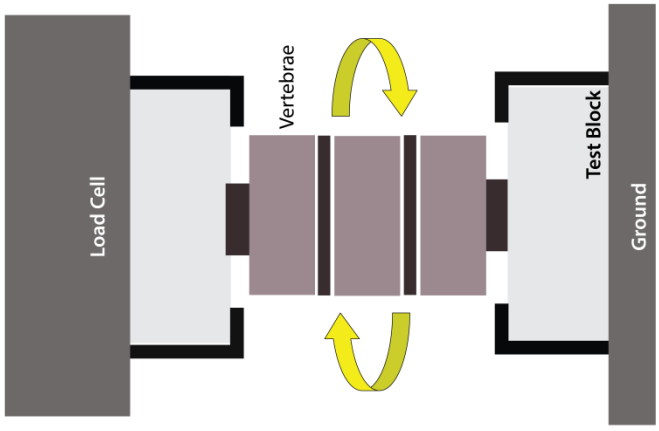

Figure 2. Schematic illustration of test apparatus for bone compression test.

At the end of this experiment aim to obtain torque, vs angle graphs. From the linear part, this graph it is possible to calculate torsional stiffness.

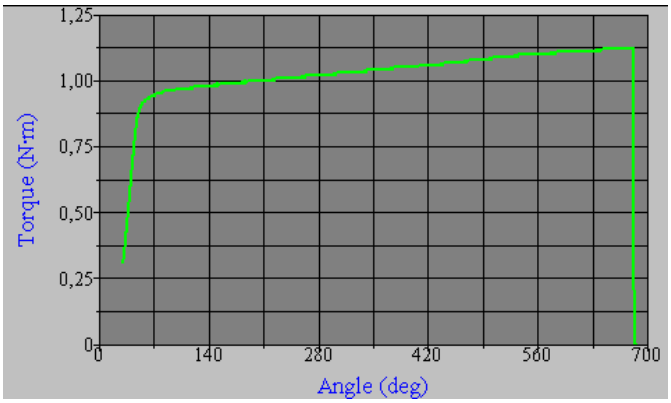

Figure 3. Typical torq-angle curve for vertebrae under torsional forces.

References

[1] Margareta Nordin, Basic Biomechanics of the Musculoskeletal System, Lippincott Williams & Wilkins, a Wolters Kluwer business, 2012.

[2] http://www.doitpoms.ac.uk

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

Büşra Demir, TOBB ETÜ Technology Center, Room 209
Çağlanaz Akın, TOBB ETÜ Technology Center, Room 209