

Introduction

Traumatic Brain Injury (TBI) is a prominent issue in the military community. The Q-Collar is a device that is intended to reduce the occurrence of TBI for its users. The Q-Collar is currently FDA approved for use in athletics; the Department of Defense (DoD) is interested in including the Q-Collar in standard issue equipment for military personnel. For this to occur, the Q-Collar must be approved by validating that the Q-Collar can perform as intended in a military setting. The TBI24 team's role in this DoD endeavor is to perform mechanical testing on the Q-Collar. The team must validate that the Q-Collar can maintain mechanical performance over the deployment timeframe for military personnel.

Testing Procedure

Test 1 - Initial Force Test

- Establish the initial force provided by each Q-Collar at the minimum and maximum possible wearing positions.

Test 2 - 12-Hour Wear Test

- Determine if the force provided by the Q-Collar remains between 0.75 and 3.5 lbf for the maximum working day of a soldier.

Test 3 - Fatigue Test

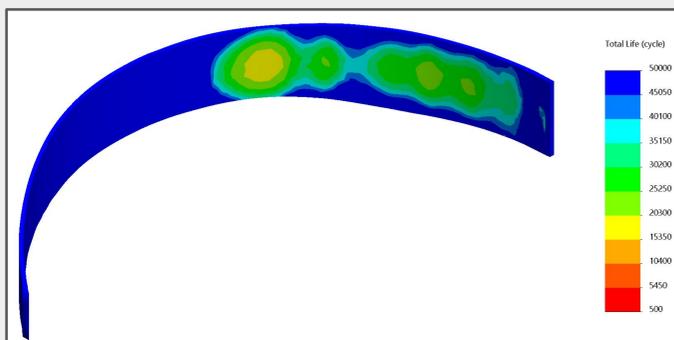
- Utilize the clamp & stage assembly to simulate anticipated cyclic loading for two military deployments.
- Measure the post-cyclic force provided by the Q-Collar.

Test 4 - Acute Failure Test

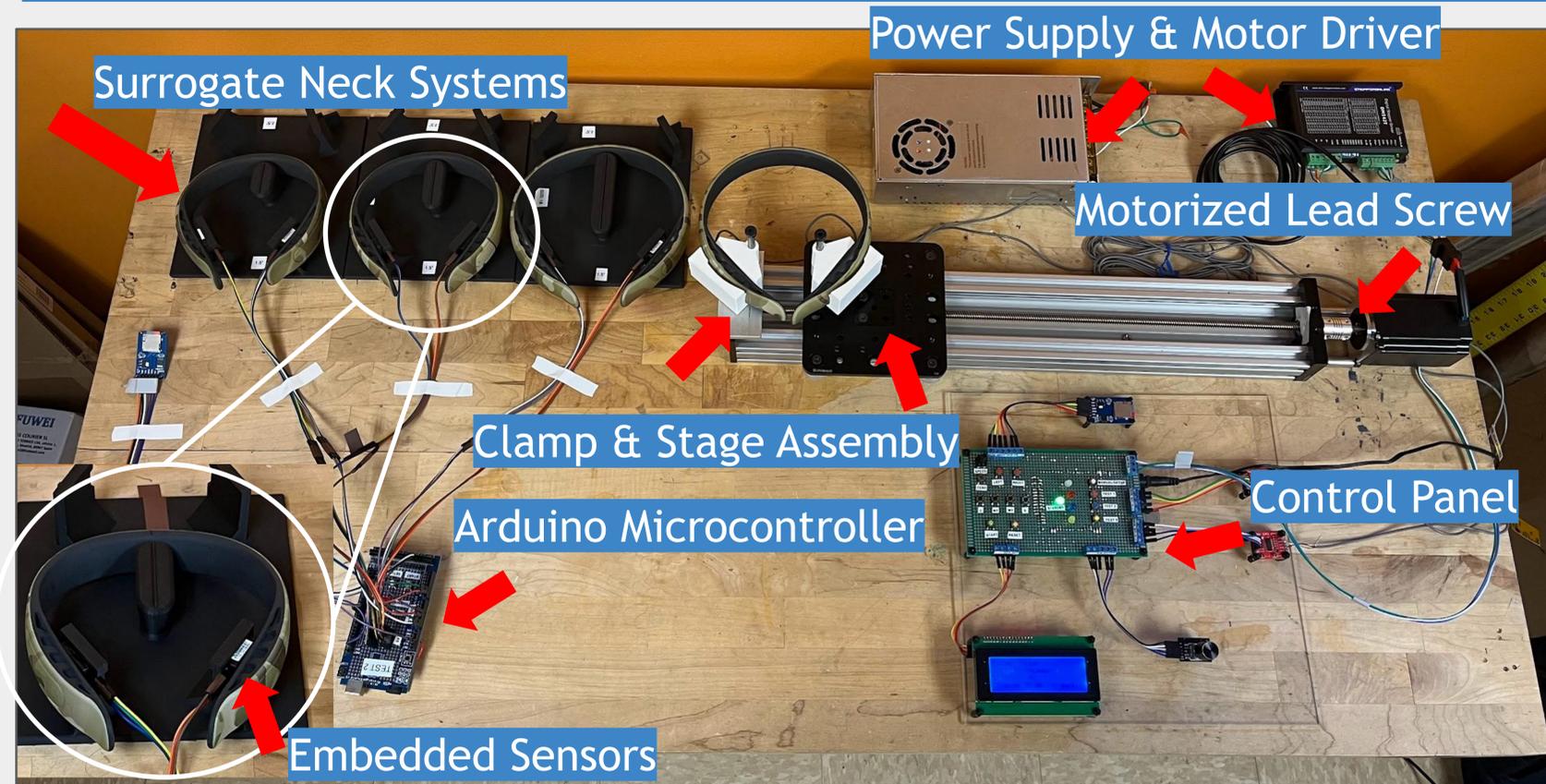
- Determine the single cycle load required to produce mechanical failure of the Q-Collar.

Finite Element Analysis

To estimate the number of cycles to failure expected in Test 3, a fatigue finite element analysis was performed on the force-providing insert producing the results below.



Design Overview



Testing Results

Test 1 - Initial Force Test

Size	Mean Force (lbf)	
	At Minimum Wear Position	At Maximum Wear Position
14	1.45 +/- 0.04	2.20 +/- 0.06
15	1.33 +/- 0.04	2.18 +/- 0.05
18	1.43 +/- 0.07	1.79 +/- 0.06

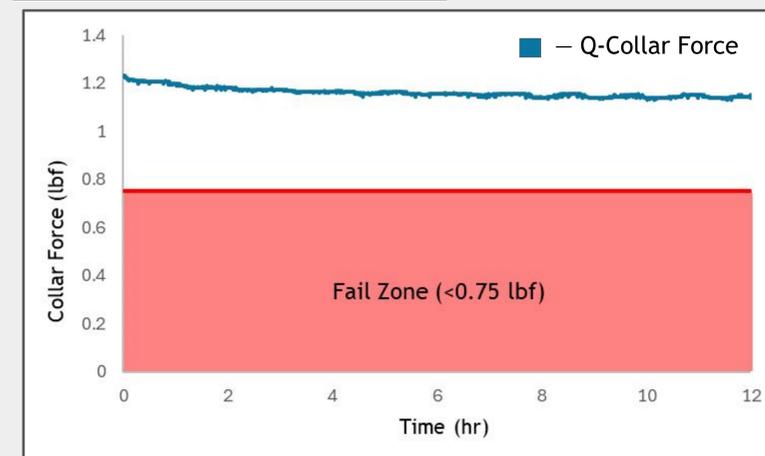
Test 3 - Fatigue Test

- All Q-Collars successfully met the required force specification (between 0.75 and 3.5 lbf) with a confidence level of 95%.

Test 4 - Acute Failure Test

- All Q-Collars remained mechanically operational after being stretched to the maximum tip-to-tip gap.

Test 2 - 12 Hour Wear Test



- All Q-Collars produced a similar trend and provided adequate force throughout the period of measurement.

Acknowledgments

JHU: Dr. Stephen Belkoff, Rich Bauernschub, Daren Ayres, Xiao Yu
RTI International: Dennis McGurk, Kristine Rae Olmstead