

# The effects of repeated depression on air-filled bulbs used in tongue exercises for swallowing problems

## Group Members

Sarah Reichert (Team Leader), John Byce (Communicator),  
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## Advisor

Professor John Webster

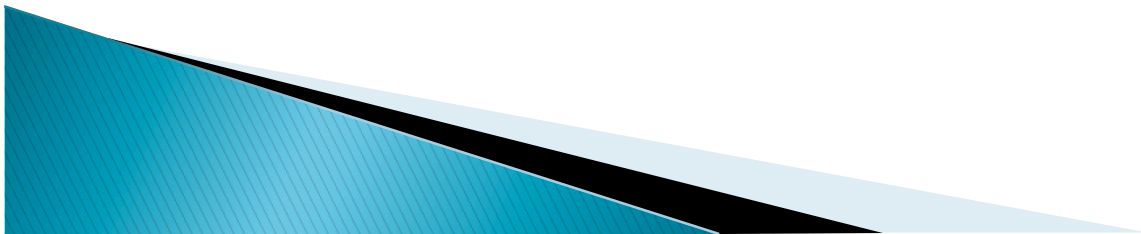
## Clients

Dr. JoAnne Robbins, Jacqueline Hind



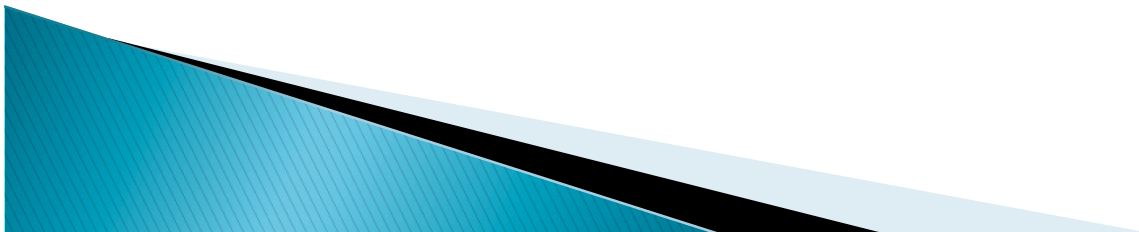
# Overview

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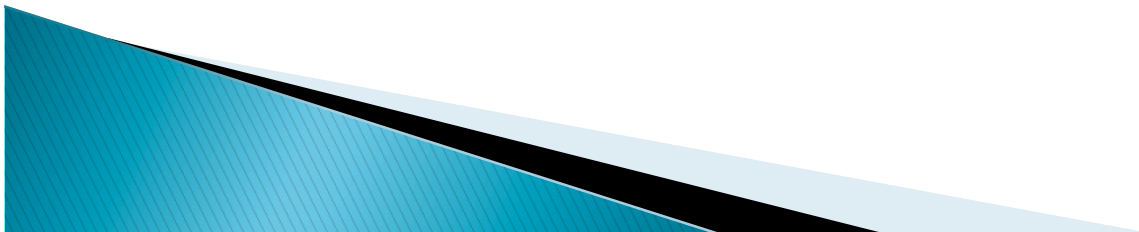
# Client Description

- ▶ Dr. JoAnne Robbins
  - Associate Director of Research
    - Geriatric Research Education and Clinical Center (GRECC)
  - Specialty: Swallowing/Geriatrics
- ▶ Jacqueline Hind
  - Specialist in Swallowing and Swallowing Disorders
- ▶ Proposal
  - Investigate bulbs used in exercise protocol



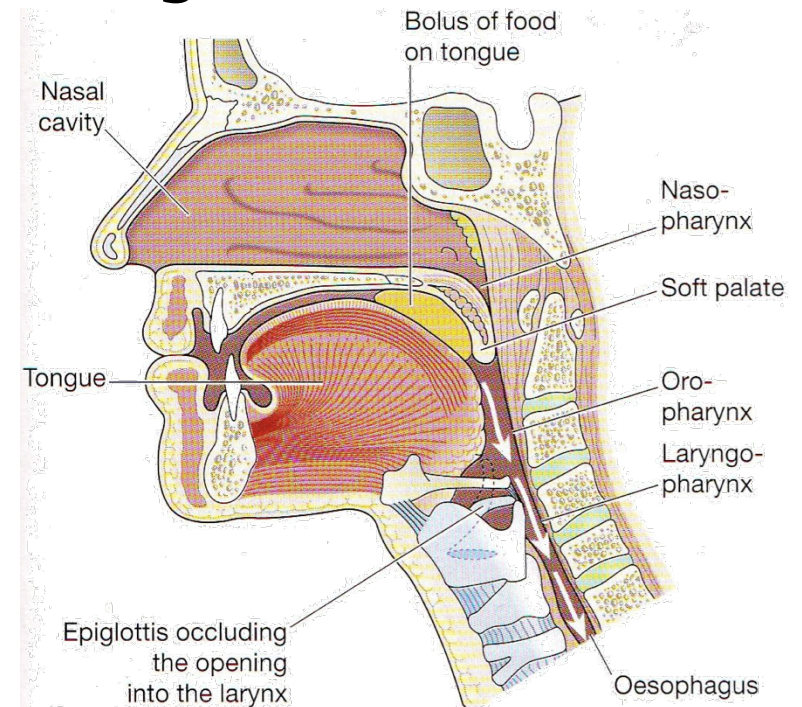
# Problem Definition

- ▶ Patient difficulty achieving exercise pressures
  - During 2<sup>nd</sup> week of use
- ▶ Possibilities
  - Patients' psychological belief
  - Actual change
    - Air leakage
    - Changes in material properties
- ▶ If flaw is found, identify cause and alter design



# Background of Dysphagia

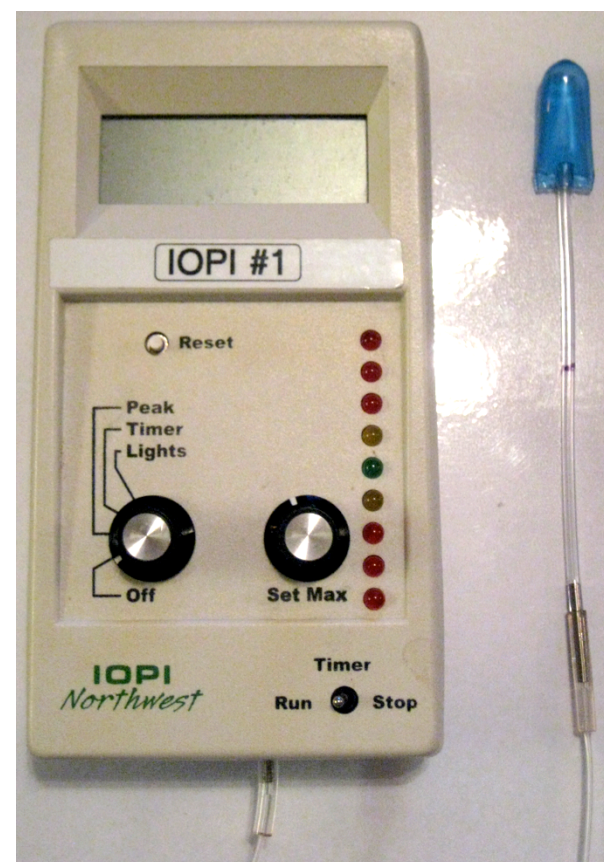
- ▶ Difficulty/discomfort swallowing
- ▶ Affects 40% of people 60+
- ▶ Potentially fatal effects
- ▶ Therapy focused on safety
- ▶ Clients' work
  - Strengthen lingual muscles to improve swallowing



From <http://faculty.ksu.edu.sa>

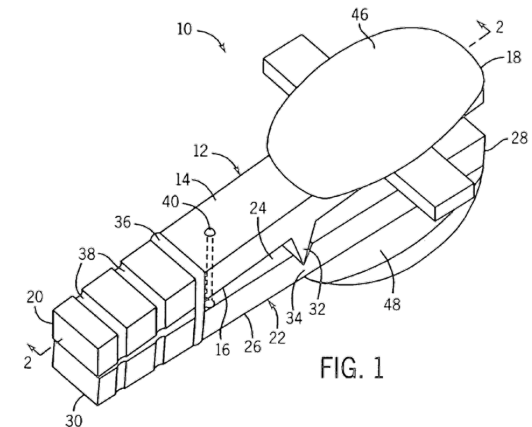
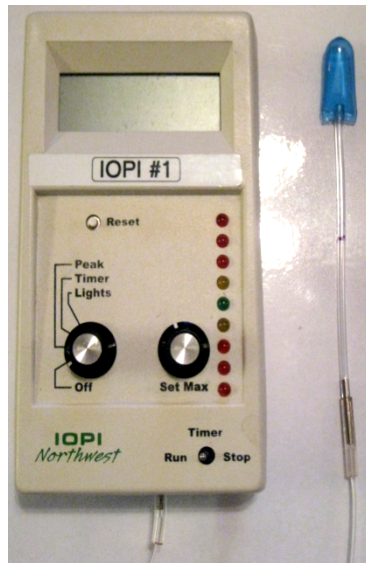
# Iowa Oral Performance Instrument

- ▶ Measure tongue strength
  - Display: pressure (kPa)
- ▶ Air-filled bulb
  - Compress with tongue
- ▶ 8-week exercise regimen
  - Improve lingual muscle strength
- ▶ Strong correlation: tongue strength to swallowing ability



# Current Devices

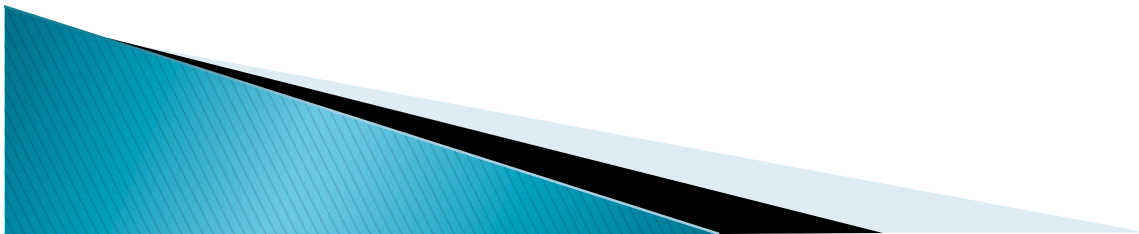
- ▶ Iowa Oral Performance Instrument
- ▶ Madison Oral Strengthening Therapeutic Device
- ▶ Oral-Lever Resistance Exercise Device



<http://www.swallowsolutions.com/images/MOST-unit.jpg> From <http://patimg1.uspto.gov/.piw?Docid=07238145&homeurl>

# Product Design Specifications

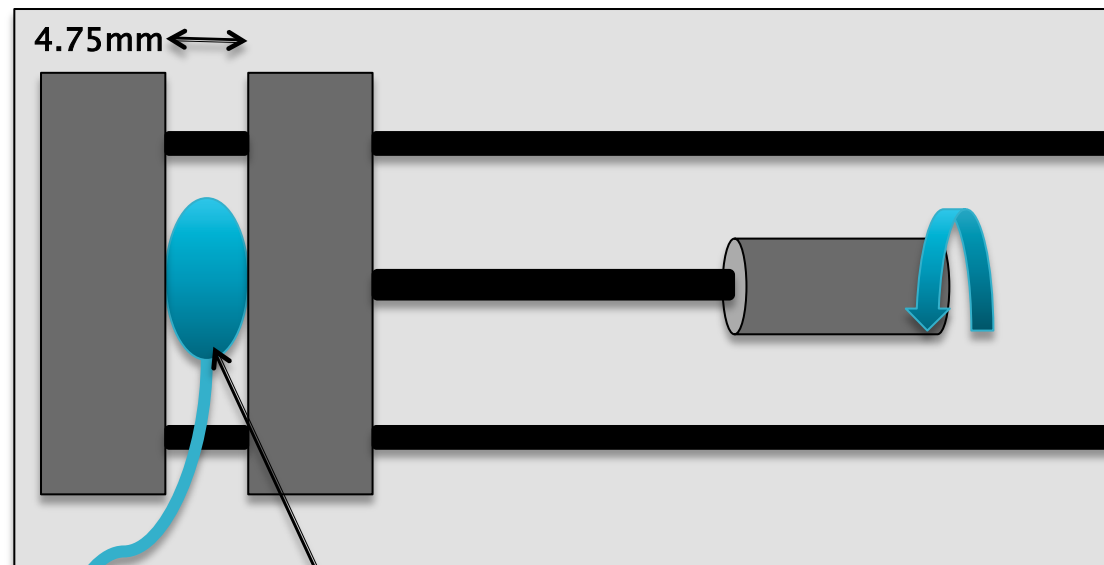
- ▶ Not harmful to mouth, tongue, or throat
- ▶ Easy to administer and use
- ▶ Accurate and consistent results
- ▶ Life in service: ~1,500 uses at 37 °C
- ▶ ~20 mm in diameter
- ▶ Shelf life: at least one year





# Design Alternatives: Compression

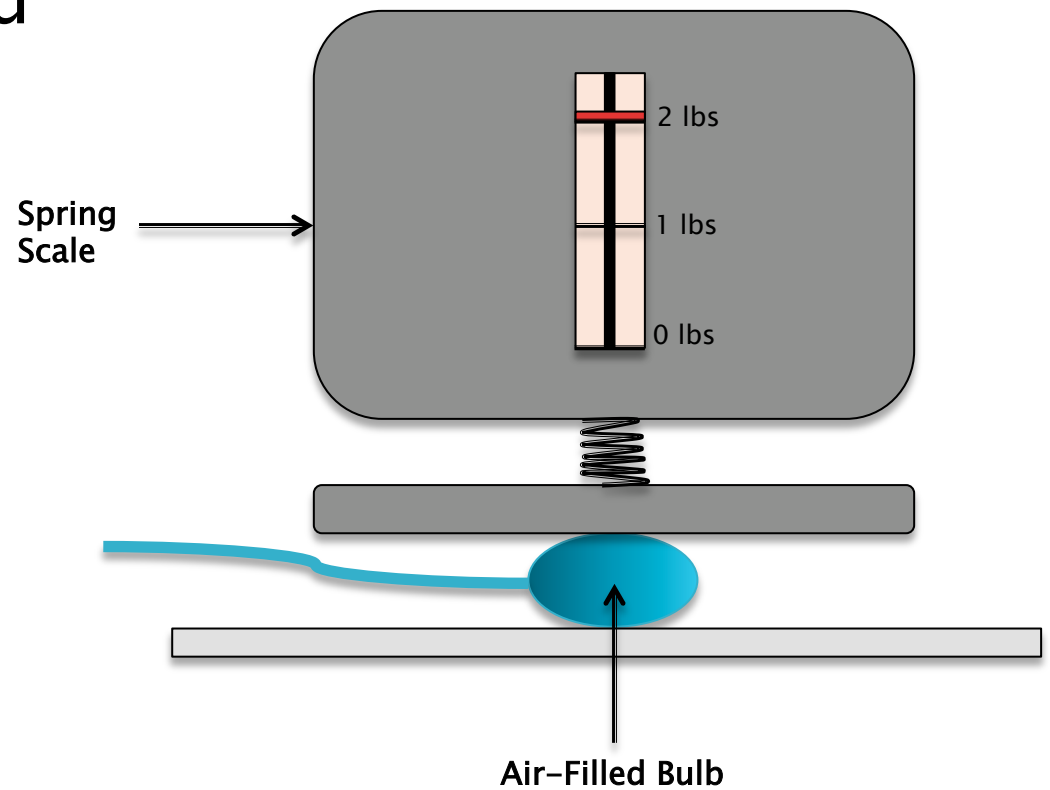
- ▶ Consistent compression
- ▶ Adjustable plate separation
- ▶ Distance measured with calipers (4.75 mm)



Air-Filled Bulb

# Design Alternatives: Force

- ▶ Consistent force
- ▶ Spring scale
- ▶ 2 lbs of force used



# Design Alternatives: Instron

- ▶ Computer-controlled
- ▶ Consistent compression
- ▶ Measure force required



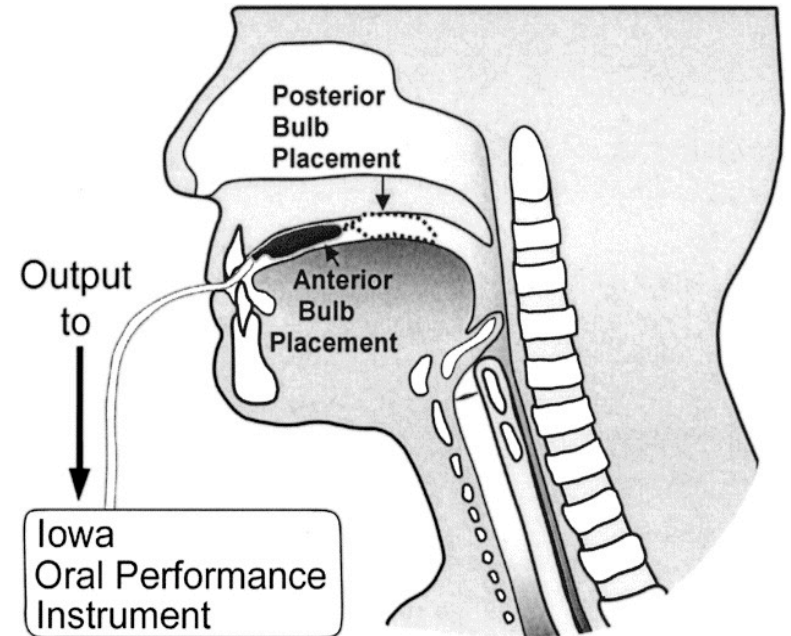
From <http://www.directindustry.com/prod/instron/>

# Design Matrix

	Compression	Spring Scale	Instron
Precision (30)	25	30	10
Cost (10)	8	8	2
Scope of Testing (30)	15	15	25
Imitation of Clinical Use (10)	5	8	4
Variability for Experimental Conditions (20)	12	15	10
<b>Total (100)</b>	<b>65</b>	<b>76</b>	<b>51</b>

# Exercise Regimen

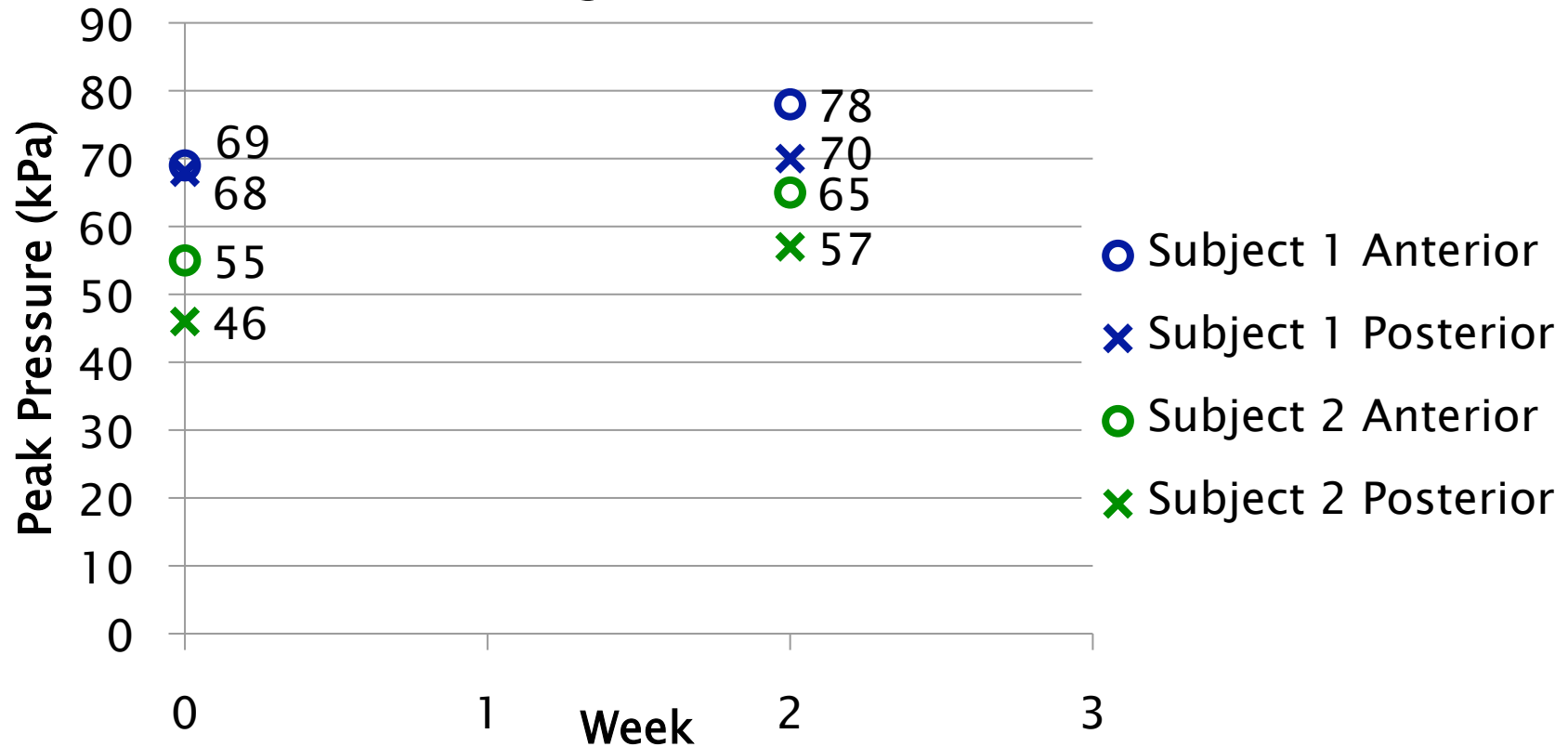
- ▶ 3 sets of 10 repetitions
  - Both anterior and posterior
- ▶ Frequency: 3 days a week
- ▶ Duration: 8 weeks
  
- ▶ 1<sup>st</sup> Week: 60% of maximum
- ▶ Other Weeks: 80% of maximum
- ▶ Maximum re-measured every 2 weeks



From "The Effects of Lingual Exercise in Stroke Patients With Dysphagia"

# Exercise Results

## Peak Tongue Pressures Over Time

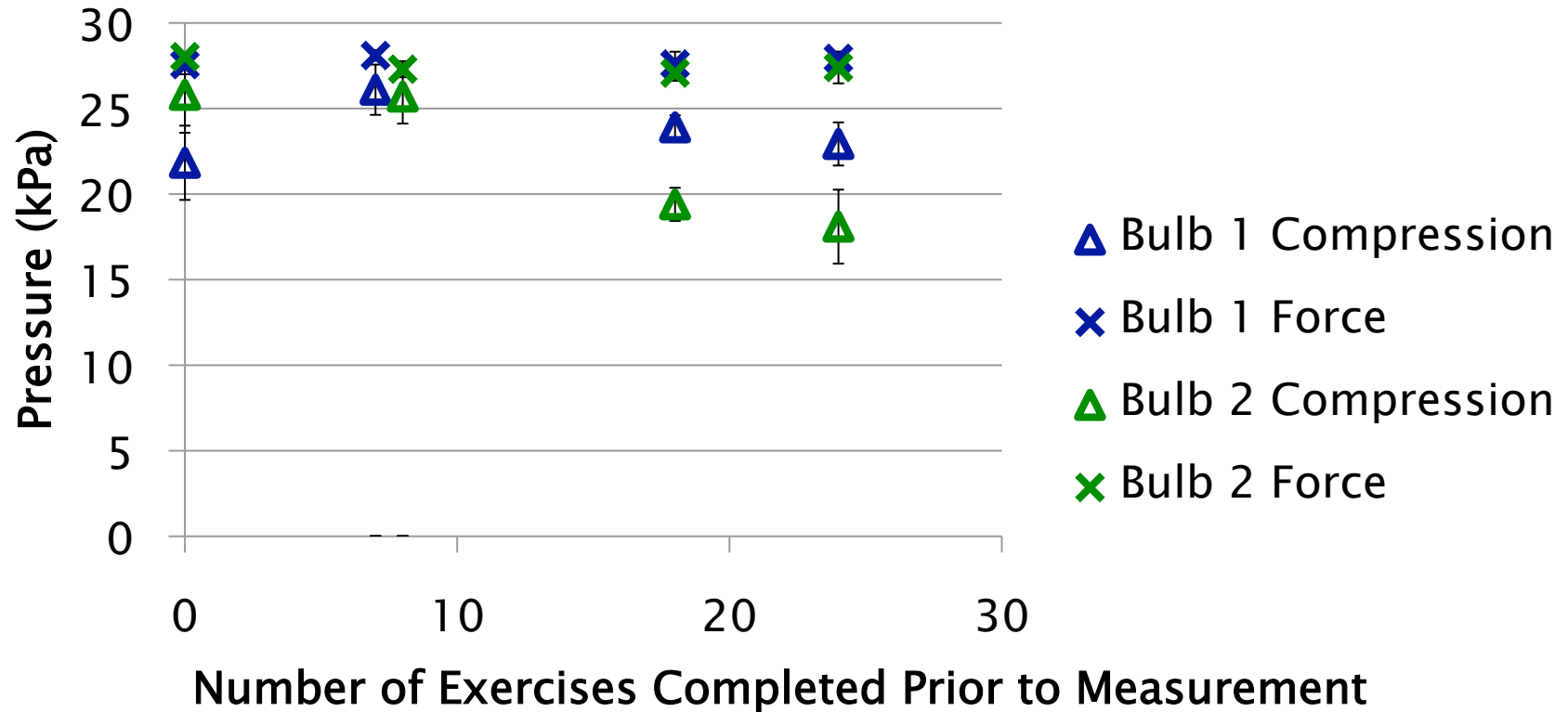


### Percent Increase in Peak Pressure

	Anterior	Posterior
Subject 1	113%	103%
Subject 2	118%	124%

# Testing

## Change in Pressure Measurements Over Time

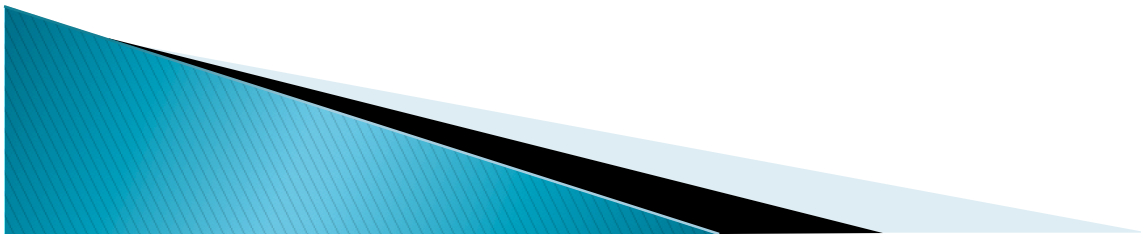


### Significant Change in Value

	Compression	Force
Bulb 1	Yes	No
Bulb 2	Yes	No

# Future Work

- ▶ Complete Exercise Regimen
- ▶ Testing
  - Pressures From Constant Force and Compression
  - Alternative Testing Conditions
  - Leak Test
- ▶ Alterations to Bulb Design
  - Material
  - Manufacturing Process





# Acknowledgements

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- ▶ Dr. JoAnne Robbins
- ▶ Jacqueline Hind
- ▶ Megan Smith
- ▶ Kelsey Banaszynski
- ▶ Dr. Erich Luschei
- ▶ Bill Lang



# References

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