Validation of a Testing Apparatus for the Assessment of Shoulder Joint Implants

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INTRODUCTION

- Shoulder replacement is an important surgery to reduce shoulder pain and increase shoulder movement (see Fig. 4)
- Testing shoulder joint implants is crucial for successful surgical outcomes
- Dr. Giles and a team of engineers have recently developed a mechanical apparatus for testing reverse shoulder joint implants (see Fig. 1)
- A standard was published by ASTM International which describes the model material for bone and how to conduct testing for shoulder joint implants [1]
- **The apparatus must be adjusted so that it conducts tests as described in the standard [1]**

METHODS

- The standard outlines the shoulder joint implant load, the period of the rotation, and the angle that the apparatus rotates the shoulder implant [1]
- Measurements of the loading to the shoulder joint implant were recorded with a Load Cell and plotted in MS Excel (see Fig. 2)
- Several videos were taken of the apparatus in motion to record the period and angle of rotation (see Fig. 3)
- The compressive load from the spring was adjusted to the ASTM standard
- A new motor program was coded to change the angle and period of motion as described in the ASTM standard

RESULTS

- The changes to the shoulder joint implant load, the period of rotation, and the angle of rotation now complies with the standard [1]
- The apparatus can be safely operated
- The apparatus can also be adjusted to adapt to new loads, periods, and angles

DISCUSSION & CONCLUSION

- **The apparatus now complies with the ASTM standard and can be used to test reverse shoulder joint implants**
- The next step is testing reverse shoulder joint implants in the model material and cadaveric human scapulae
- **More research is required to determine the optimal model material for testing reverse shoulder implants**
- The testing will be conducted in a study and the results will be published in a paper
- The implications of the study will support the choice of a model material for testing reverse shoulder joint implants

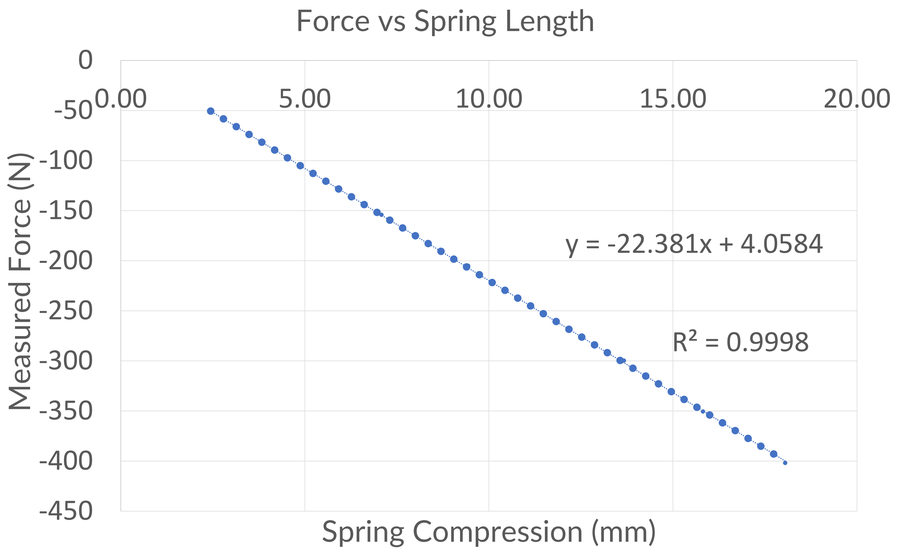
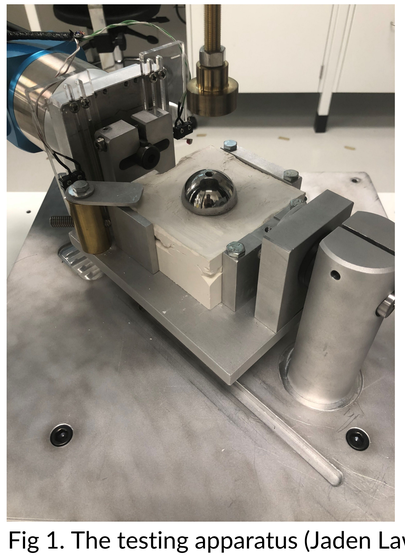


Fig 2. An Excel graph trendline fit to several spring force measurements (Jaden Law, 2022)



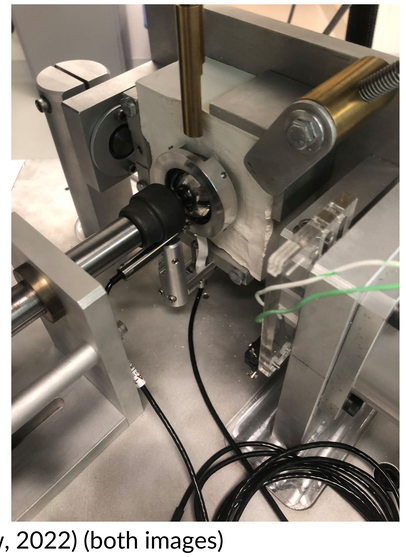


Fig 1. The testing apparatus (Jaden Law, 2022) (both images)

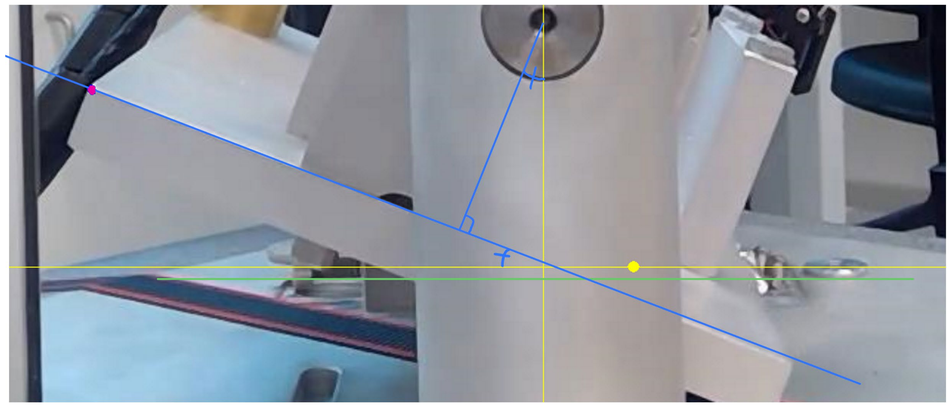


Fig 3. Illustration for determining the angle of rotation (Jaden Law, 2022)

Fig 4. An x-ray of a patient who received reverse shoulder replacement surgery [3].

DEFINITIONS

- Reverse shoulder replacement: replaces the ball with a disk-shaped implant and fixes a metal ball to the socket
- ASTM International: An international organization that creates standards for industries in the fields of science, engineering, medicine, trade, etc. [2]
- Model material: the material outlined in the ASTM standard [1]
- Period: the time it takes for the implant to rotate back and forth
- Load Cell: a metal block-shaped sensor used to measure compressive/tensile forces

ACKNOWLEDGEMENTS

Dr. LillAnne Jackson, Dr. Joshua Giles, LTSI Team, CAC

This research was supported by the Valerie Kuehne Undergraduate Research Awards, University of Victoria, Supervised by Dr. Joshua Giles. Created by Jaden Law on August 24, 2022.

REFERENCES & ATTRIBUTION

[1] ASTM International, “Standard Test Methods for Dynamic Evaluation of Glenoid Loosening or Disassociation”, 2018. [Online] Available: https://www.astm.org/f2028-17.html

[2] ASTM International, “Detailed Overview”, 2022. [Online] Available: https://www.astm.org/about/overview/detailed-overview.html

[3] CC BY-2.0, “My shoulder joint!”, Rhian de Kerhiec, https://www.flickr.com/photos/34764035@N00/44223597402

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