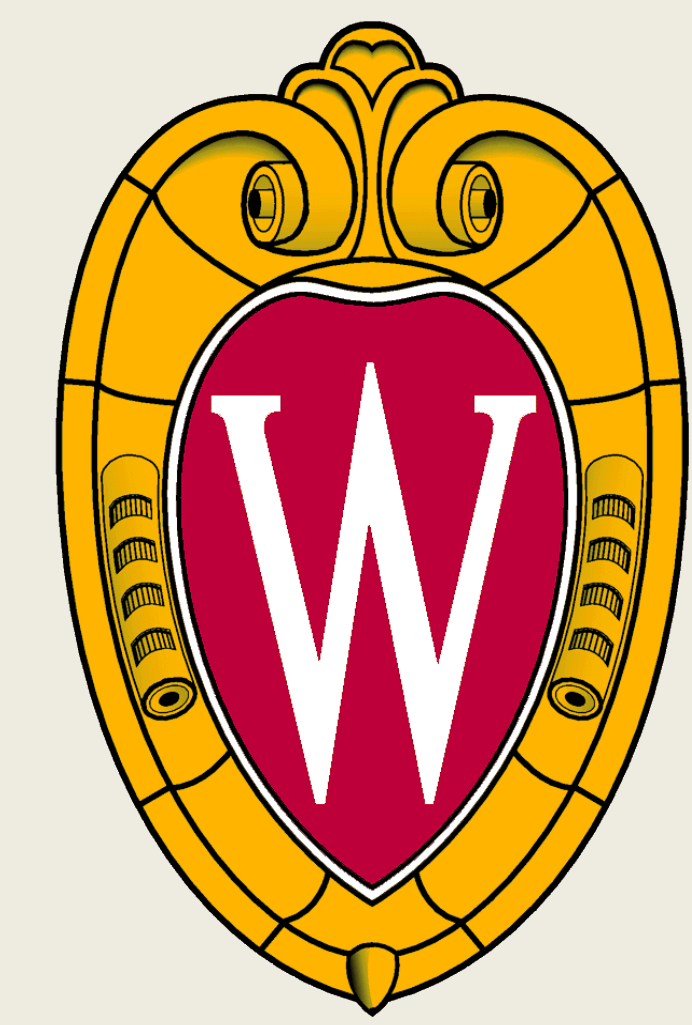


Ultrasonic Probe Holder

Neal Haas Peter Kleinschmidt Leon Corbeille
 Lein Ma Client: James H. Stein, MD¹
 Advisor: John G. Webster, Ph.D.²



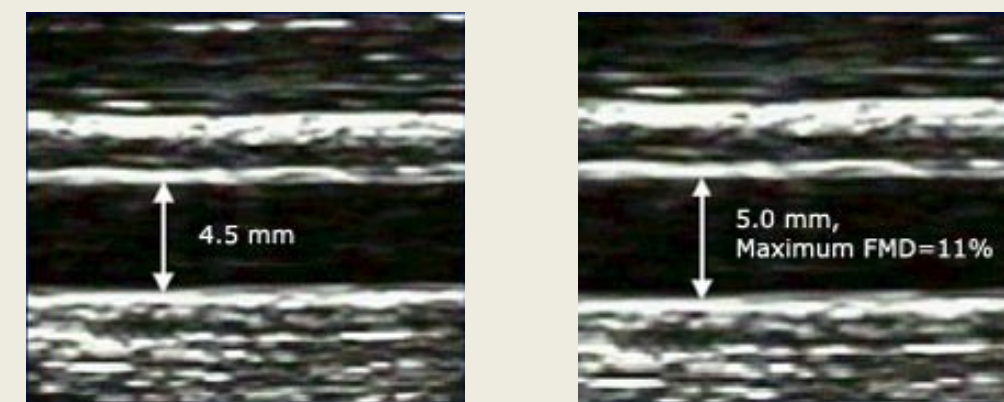
Background

Ultrasonography: Transducer measures sound wave reflections off tissues in the body to measure anatomy and physiology without invasiveness

- Our Application: Use Ultrasonography to image cross-sections of brachial arteries in the arm.
- Measure epithelial response to changes in pressure
- Information gained can be used in diagnosis and treatment of Atherosclerosis.
- Applications are present in both research and clinical settings.

The Study:

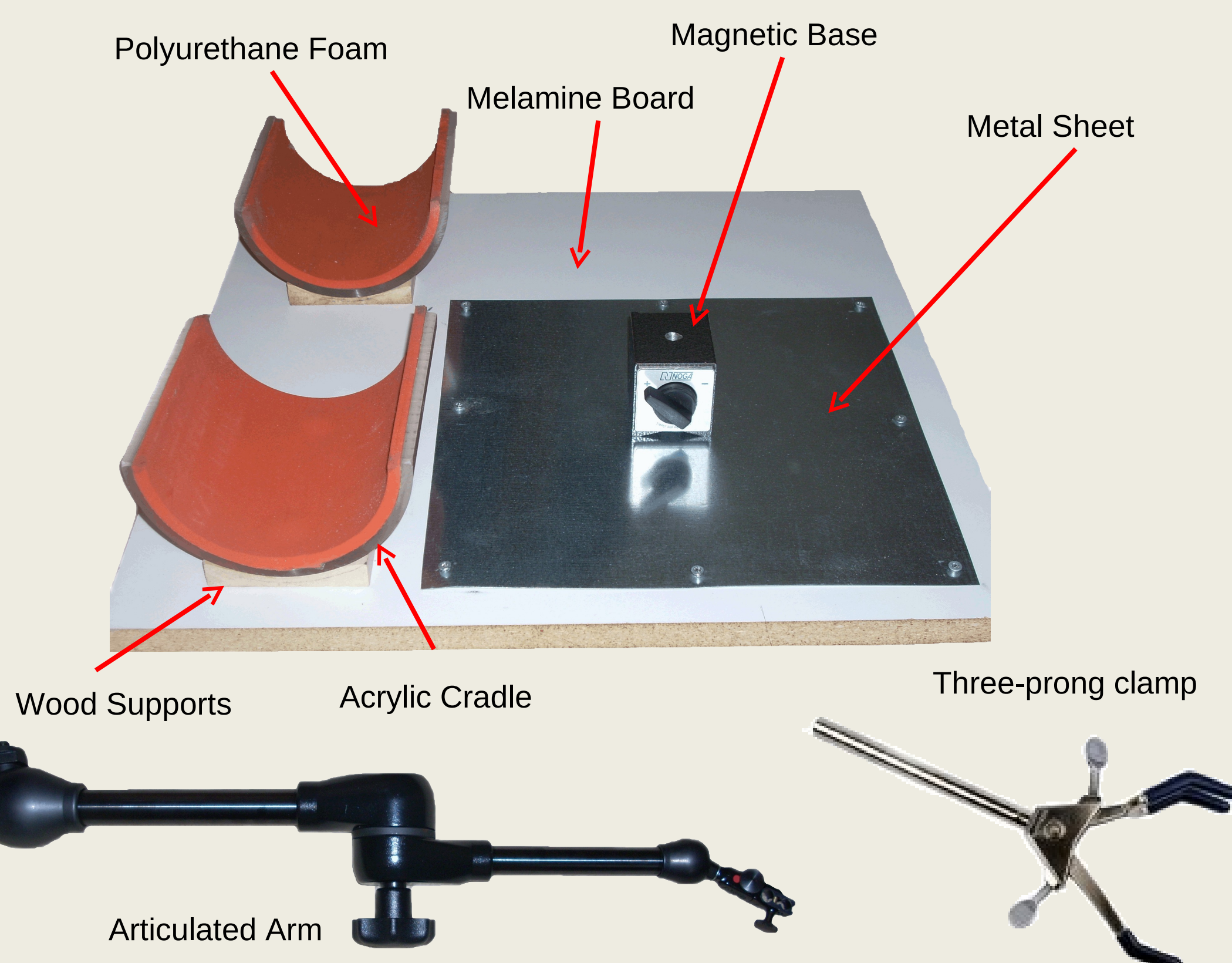
- Relaxed Patient with left arm extended and supinated.
- Image artery, constrict blood flow at the forearm, observe response of artery
- Release pressure and observe epithelial recoil



Motivation

- Sonographers will be able to perform other tasks/patient monitoring for more comprehensive studies
- Availability of holders to position and stabilize the probe in ultrasound studies could improve effectiveness of procedure
- Ergonomically improves job design for sonographer
- Probe holders would reduce work stress that may lead to an increased risk of work related musculo-skeletal disorders in sonographers
- With wrist held in deviated position for 5+ minutes, significant pressure on the Ulnar Nerve in the Carpal Tunnel.
- Many clinics currently limit studies to 1/hour due to strain on sonographers.

Previous Design



¹ Department of Cardiology – School of Medicine and Public Health
 University of Wisconsin – Madison

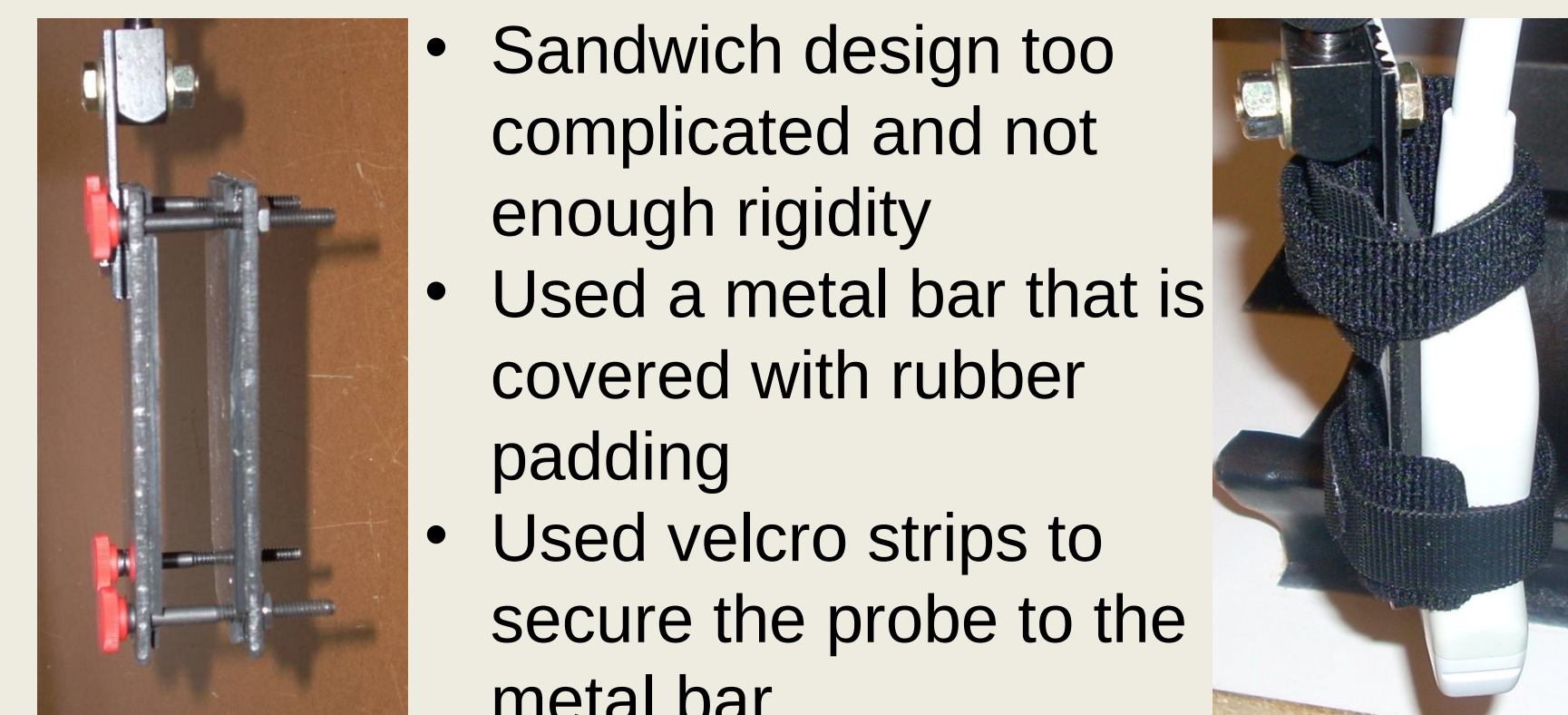
²Department of Biomedical Engineering – University of Wisconsin Madison

Abstract

Advanced atherosclerosis, an inflammation of the arteries, can lead to thrombosis and heart attacks or strokes. Vascular reactivity studies examines the brachial arteries' reaction to occlusion. An ultrasonic probe must be held in the correct orientation for prolonged periods of time. Since the images are influenced by motion artifact caused by slight movements of the sonographer's hands, a probe holder that stabilizes an ultrasonic probe in the correct orientation would improve the quality of the sonogram. A prototype was constructed that enables the probe to be moved in any direction by adjusting a string of ball and socket joints. Major motion can be achieved by loosening one knob and moving an articulated arm. Any sized probe can be attached to the device using velcro straps. The prototype also contains a comfortable arm rest that stabilizes the patient's arm. Future work includes testing the prototype to determine if the ease of use and effectiveness of the probe holder.

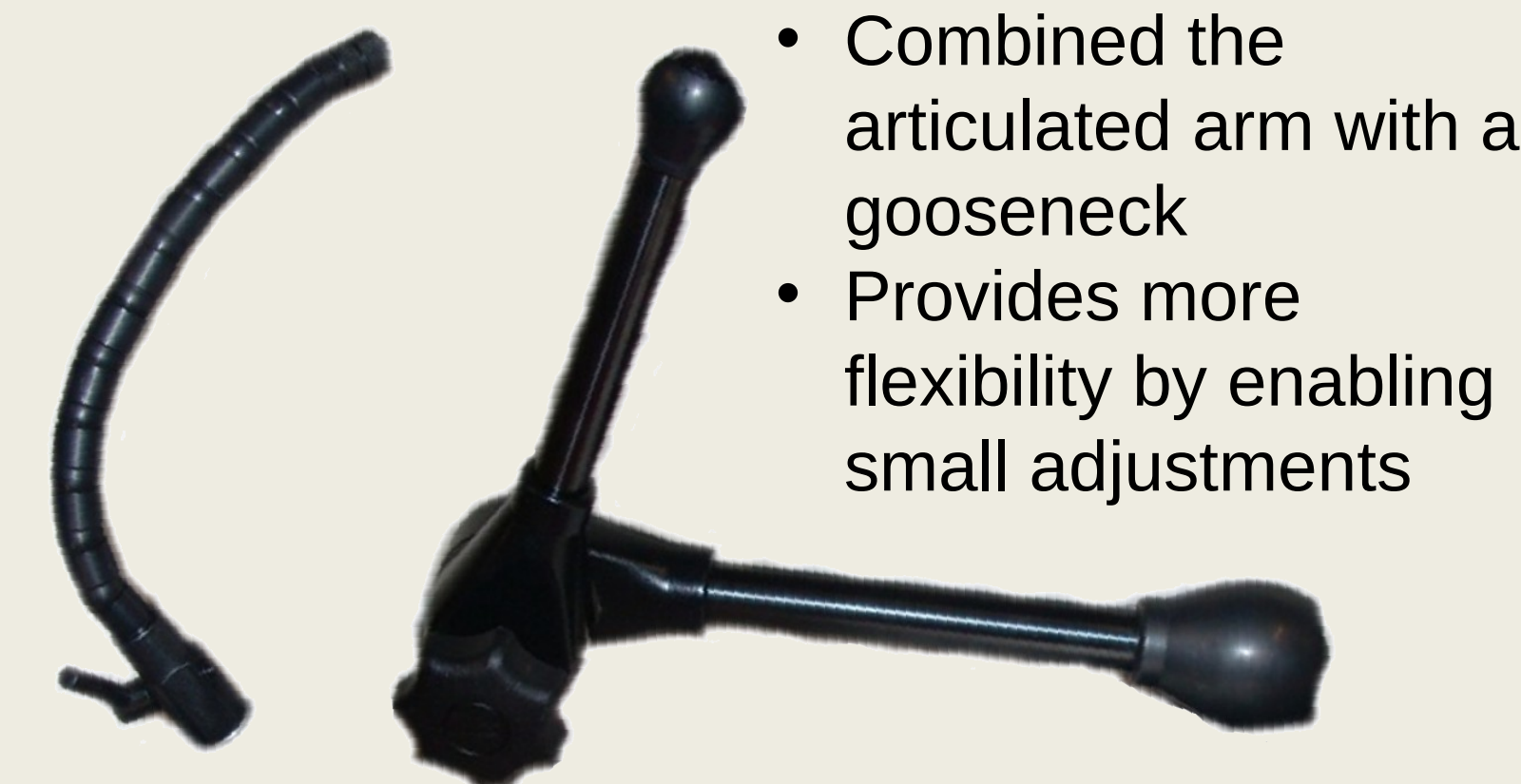
Redesign Elements

Clamping



- Sandwich design too complicated and not enough rigidity
- Used a metal bar that is covered with rubber padding
- Used velcro strips to secure the probe to the metal bar

Positioning



- Combined the articulated arm with a gooseneck
- Provides more flexibility by enabling small adjustments

Aesthetics

- Added black vinyl covering on arm cradles
- Painted metal components black



Final Design

- Elegant
- Sleek
- Washable
- Comfortable



Device in Use



Verification

- Research protocol submitted to institutional review board. Currently under pre-review

Test Plans

- **Ease of Use:**
 - Three Technicians will operate the device and rate its usability with direct feedback
 - Efficiency of use will be measured with set-up times and procedural times. Compare data to baseline of same procedure without device
- **Device Effectiveness:**
 - Obtain ultrasound data from healthy subjects (10).
 - Make acquisitions with and without the device for each test subject
 - Clinical Data Efficacy: Present data to technicians and clinicians to distinguish and rate quality of data between studies with and without device. Use numerical rating.
- **Analysis:**
 - Identify any design flaws from usability feedback.
 - Determine degree of procedural/diagnostic improvement from clinical data efficacy study
 - Provide cost-benefit analysis of increased set-up time vs. procedural/diagnostic improvements.

Discussion/Future Work

- Preliminary testing has been very promising with the final design.
 - The device was effective in maintaining image quality
 - Probe was well stabilized and did not show signs of shifting during the study.
 - The device is usable. Still, with the device it does become a different technique which will require practice for any technician to master.
- After completing IRB review, the full verification protocol will be implemented.
- While the concept of this device is not novel in the field, the design is unique.
- There may be a limited market interest in the device so pursuit of publication and/or intellectual property protection may be made.

References

Corretti, M. C., Anderson, T. J., Benjamin, E. J., Celermajer, D., Charbonneau, F., Creager, M. A. et al. (2002). Guidelines for the ultrasound assessment of endothelial-dependent flow-mediated vasodilation of the brachial artery: A report of the international brachial artery reactivity task force. *Journal of the American College of Cardiology*, 39(2), 257-265.

Harrison, D. G., Freiman, P. C., Armstrong, M. L., Marcus, M. L., & Heistad, D. D. (1987). Alterations of vascular reactivity in atherosclerosis. *Circulation Research*, 61(5) (Supplement II), 74-80.

Keir, P. J., Wells, R. P., Ranney, D. A., & Lavery, W. (1997). The effects of tendon load and posture on carpal tunnel pressure. *The Journal of Hand Surgery*, 22(4), 628-634.

Korcarz, C. (2009). *Personal Interview*

Acknowledgements

- Dr. James H. Stein - Client
- Prof. John G. Webster - Advisor
- Prof. Frank Fronzak
- Dr. Claudia Korcarz