Design and Fabrication of a Device for Studying Neural Control of Unstable Grasp

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Introduction

- Fingertip forces during static grasp exhibit rich dynamics that cannot be attributed to signal-dependent noise alone [1,2].

- This device was designed to extend previous studies and uncover underlying neuromuscular mechanisms.

- A previous device, shown in Figure 1 below, had several limitations that the new design addresses.

Figure 1. Previous Device.

- The new design requirements were:

1. Center of mass in the center of the load cells
2. Ability for load cell arms to pivot freely
3. Adjustibility for different hand sizes

Methods

- The device was initially designed in SolidWorks®, shown in Figure 2.

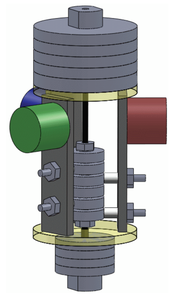

Figure 2. CAD Model of New Device.

- The material properties were input into the model to allow calculation of the center of mass for design requirement #1.

- Stainless steel ball bearings were used to allow the arms to pivot, shown in Figure 3. This fulfilled design requirement #2.

- The arms telescope by adjusting nuts on the supporting screws, Figure 3. This met design requirement #3.

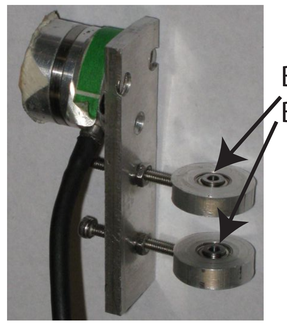

Figure 3. A Single Arm.

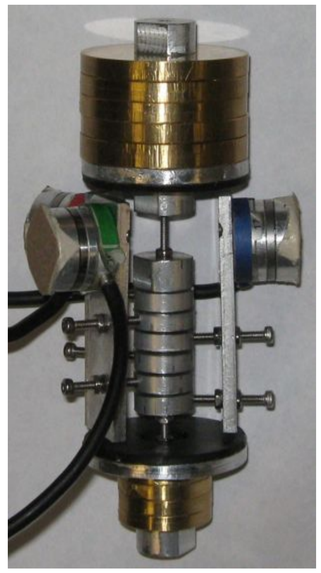

Figure 4. Final Device.

Discussion

- The new device enables us to test people with a wider range of hand sizes while not introducing artifacts from high-friction hinges or asymmetric mass distributions.

- This pivoting design makes it necessary for the finger forces to be directed at the center, as shown in Figure 5.

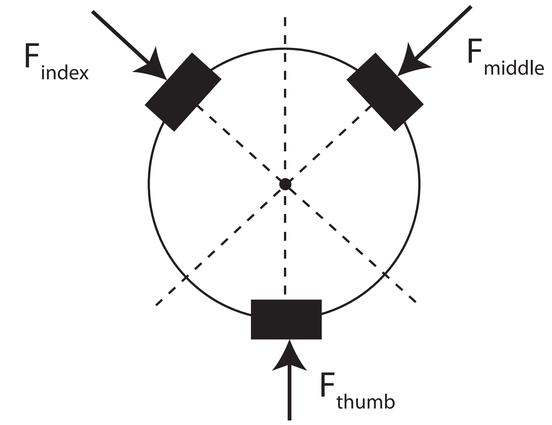

Figure 5. Force Direction Requirements for New Device.

- Future experiments will uncover new modes of nervous system function due to the more complex dynamics of this new device.

References:
[1] K. Rácz and F. Valero-Cuevas, "The grip force dynamics of static grasp reveals a control hierarchy," Proceedings of the Nineteenth Annual Meeting of the Society for the Neural Control of Movement, 2009.
[2] K. Jones, A. Hamilton, and D. Wolpert, "Sources of signal-dependent noise during isometric force production," Journal of Neurophysiology, vol. 88(3), pp. 1553, 2002.

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