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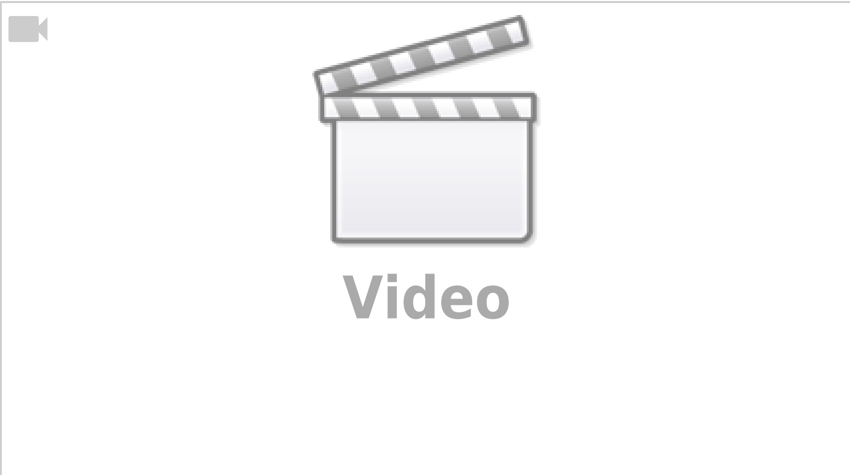

Knowledge of tool-tissue interaction is mostly taught and learned qualitatively because a means to quantify the technical aspects of neurosurgery is currently lacking. Neurosurgeons typically require years of hands-on experience, together with multiple initial trials and errors, to master the optimal force needed during the performance of neurosurgical tasks. This pilot study aimed to develop a novel force-sensing bipolar forceps for neurosurgery and obtain preliminary data on specific tasks performed on cadaveric brains.

A novel force-sensing bipolar forceps capable of measuring coagulation and dissection forces was designed and developed by installing strain gauges along the length of the bipolar forceps prongs. The forceps were used in 3 cadaveric brain experiments and forces applied by an experienced neurosurgeon for 10 surgical tasks across the 3 experiments were quantified.

Maximal peak (effective) forces of 1.35 N and 1.16 N were observed for dissection (opening) and coagulation (closing) tasks, respectively. More than 70% of forces applied during the neurosurgical tasks were less than 0.3 N. Mean peak forces ranged between 0.10 N and 0.41 N for coagulation of scalp vessels and pia-arachnoid, respectively, and varied from 0.16 N for dissection of small cortical vessel to 0.65 N for dissection of the optic chiasm.

The force-sensing bipolar forceps were able to successfully measure and record real-time tool-tissue interaction throughout the 3 experiments. This pilot study serves as a first step toward the quantification of tool-tissue interaction forces in neurosurgery for training and improvement of instrument handling skills [1].

[1]

Gan LS, Zareinia K, Lama S, Maddahi Y, Yang FW, Sutherland GR. Quantification of Forces During a Neurosurgical Procedure: A Pilot Study. World Neurosurg. 2015 Aug;84(2):537-48. doi: 10.1016/j.wneu.2015.04.001. Epub 2015 Apr 7. PubMed PMID: 25862106.