

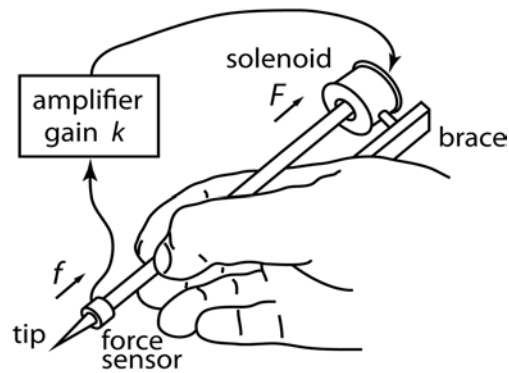


# Hand Held Force Magnifier with Magnetically Stabilized Bidirectional Distal Force Sensor

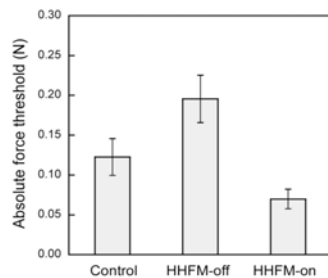
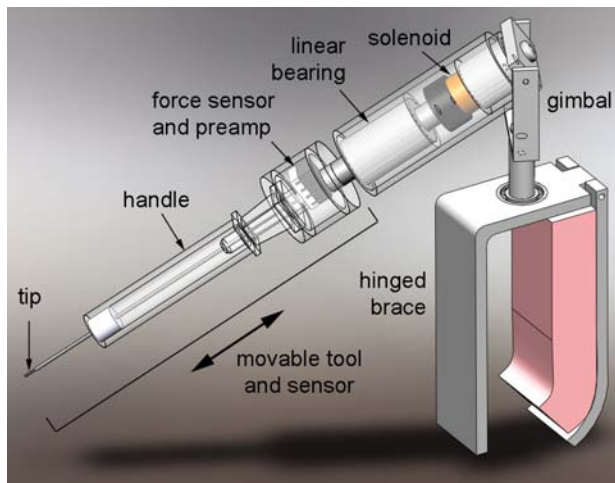


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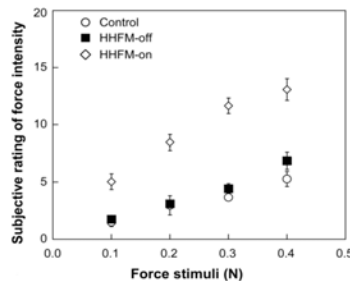
**Abstract:** A need exists for improvement in the perception of forces by the sense of touch when using tools to perform delicate procedures, for example in microsurgery, where surgeons routinely repair tiny blood vessels under a microscope that are far too delicate to be felt by the hand of the surgeon.



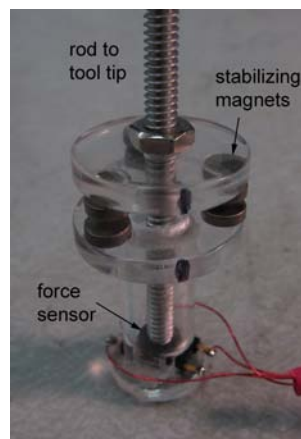
Hand Held Force Magnifier (HHFM): A sensor measures the force between the tip of a tool and its handle held by the operator's fingers. This measurement is used to create a proportionally greater force between the handle and a brace attached to the operator's hand, providing an enhanced perception of the force between the tip of the tool and a target.



Measured force detection thresholds show greater sensitivity with HHFM-on than HHFM-off or with a passive instrument (control).



Mean judged magnitude for the stimulus forces shows greater discrimination between small forces with the HHMF.



Magnet based pre-load force and stabilization system to permit both push and pull forces at the tip to be measured proximally within the handle. This simplifies tip design, while providing low hysteresis.

**Conclusion:** Previous research using a robotic arm to produce force magnification has advantages in terms of stability, especially when encountering extremely small forces, but these systems suffer from constraints on the range of motion. Magnifying forces using the HHFM may provide the surgeon with an improved ability to perform delicate surgical procedures while preserving the flexibility of a hand-held instrument. (patent pending)