Submitted for publication 2018:

ASSH | American Society for Surgery of the Hand

Title: Improved Accuracy and Precision of Pilot Hole Measurement with a Novel Electronic Depth Gauge

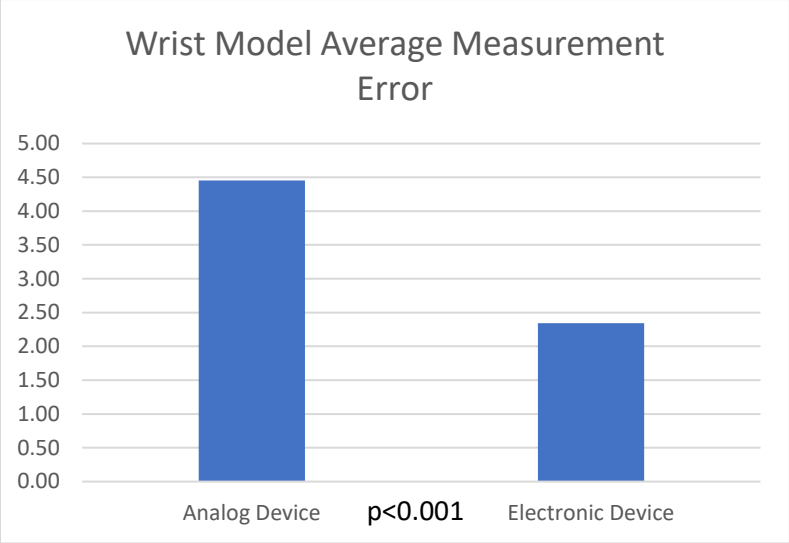
Hypothesis: A novel, electronic depth gauge more accurately and precise measures pilot holes than the traditional device.

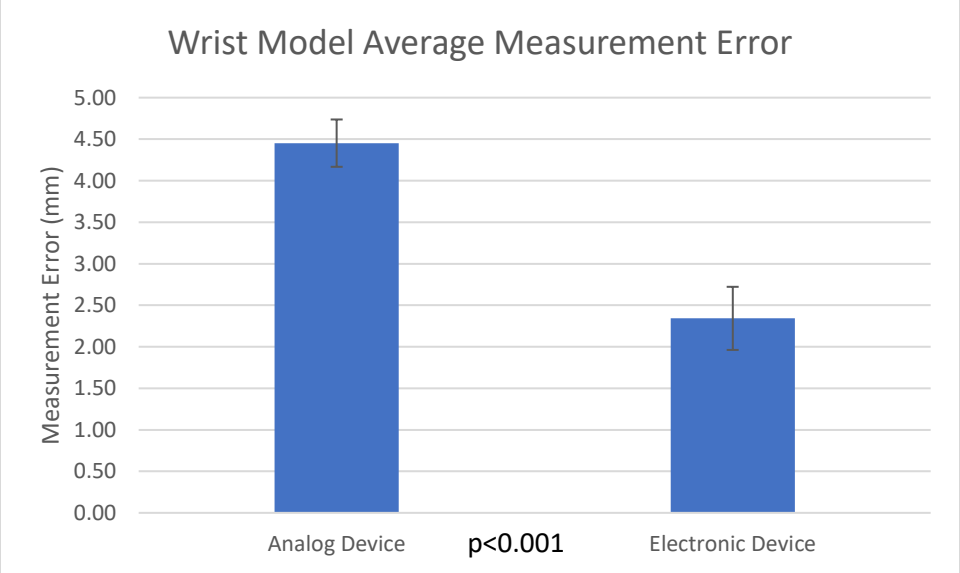
Method: Testing was performed using leg (distal femur), ankle (distal fibula), and wrist (distal radius) bone models encased in simulated soft tissue (Sawbones, Vashon Island, Washington). Pilot holes were drilled in each model in a simulated surgical exposure. Senior (n=5, PGY3-5) and junior orthopaedic residents (n=4, PGY1-2) and 4th year medical students on orthopaedic rotations (n=5) measured each hole using both the electronic device (EDGe Surgical, Chicago, IL) and a traditional analog depth gauge (n=476 measurements). Measurement error was calculated for each measurement and errors >4mm were tallied. One pilot hole was excluded from analysis because >85% of participants measured it incorrectly. All statistics were performed using RStudio software (RStudio, Boston, MA).

Results: The average measurement error was lower with the electronic than the analog device (2.3 vs 4.5 mm; $p<0.001$) in the wrist model. The electronic device yielded lower average measurement error among senior residents in the leg model (1.1 vs 2.8 mm; $p=0.001$), medical students in the ankle model (3.8 vs 7.0 mm; $p=0.04$), and medical students (3.2 vs 4.7 mm; $p=0.005$) and senior residents (1.7 vs 4.3 mm; $p<0.001$) in the wrist model. Major mismeasurement (>4mm) was more likely with the analog device. The difference was only statistically significant in the ankle (47.6% vs 28.6%, RR = 0.60, 95% CI 0.40-0.90; $p=0.01$) and wrist (52.4 vs 19.0%, RR = 0.36, 95% CI = 0.22-0.59, $p<0.001$) models. In the leg model, the same trend emerged, but the difference was not statistically significant (39.2% vs 25%, RR = 0.64; 95% CI 0.36-1.11; $p=0.11$).

Conclusion:

- The electronic depth gauge measures pilot holes for in bone models more accurately and precisely than the analog depth gauge in multiple sawbones models
- Measurement error was 2.2mm lower, on average, with the electronic depth gauge in a distal radius model than with the analog device
- Mismeasurement by 4mm or more – which could lead to complications including tenosynovitis and tendon rupture in the plating of a distal radius fracture – was significantly less frequent using the electronic depth gauge than the analog device
- In the distal radius model, the electronic depth gauge was 64% less likely to lead to a clinically significant mismeasurement that was incorrect by 4mm or more


Wrist Model Average Measurement Error
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Analog Device
p<0.001
Electronic Device


Wrist Model Average Measurement Error
Measurement Error (mm)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Analog Device
p<0.001
Electronic Device