

Force Feedback During Robotic Assisted Paraesophageal Hernia Repair

Landon Cluts, MD and Albert W. Tsang, MD, FACS

University of Toledo College of Medicine, Department of Surgery and ProMedica Toledo Hospital,
Toledo, Ohio

Background:

- Since the Da Vinci surgical system was initially approved, no haptic feedback has been available. In 2024, force feedback instruments on the Da Vinci 5 were approved by the FDA. Preclinical studies indicated a decrease in force but were performed *ex vivo* or in a simulated setting

Aims:

- Evaluate the forces applied during robot assisted paraesophageal hernia repair using various levels of force feedback

Methods:

- Assessment of force during 36 robot assisted paraesophageal hernia repairs performed by a single surgeon at a single institution
- Force feedback settings of off, low, medium, and high determined by surgeon at the time of surgery
- Utilized fenestrated bipolar (operating instrument) and Cadiere forceps (fundus/esophagus retraction)
- Average force, in Newtons (N) monitored and standard deviation was calculated
- P-values calculated using two-tailed T-test
- Average console time for each setting was also recorded

Results:

- Setting:
 - No force feedback: 9
 - Low: 13
 - Medium: 9
 - High: 5
- Average console time (Minutes)
 - No force feedback: 58.43
 - Low: 52.00
 - Medium: 48.00
 - High: 42.00
- Fenestrated bipolar force (N)
 - No force feedback: 2.26
 - Low: 1.92 (p-value = 0.00019)*
 - Medium: 1.80 (p-value = 0.00002)*
 - High: 1.54 (p-value = 0.00004)*
- Cadiere forceps force (N)
 - No force feedback: 2.84
 - Low: 2.65 (p-value >0.05)
 - Medium: 2.36 (p-value = >0.05)
 - High: 1.66 (p-value = 0.00013)*

* = Statistically significant difference in force compared to when force feedback is off

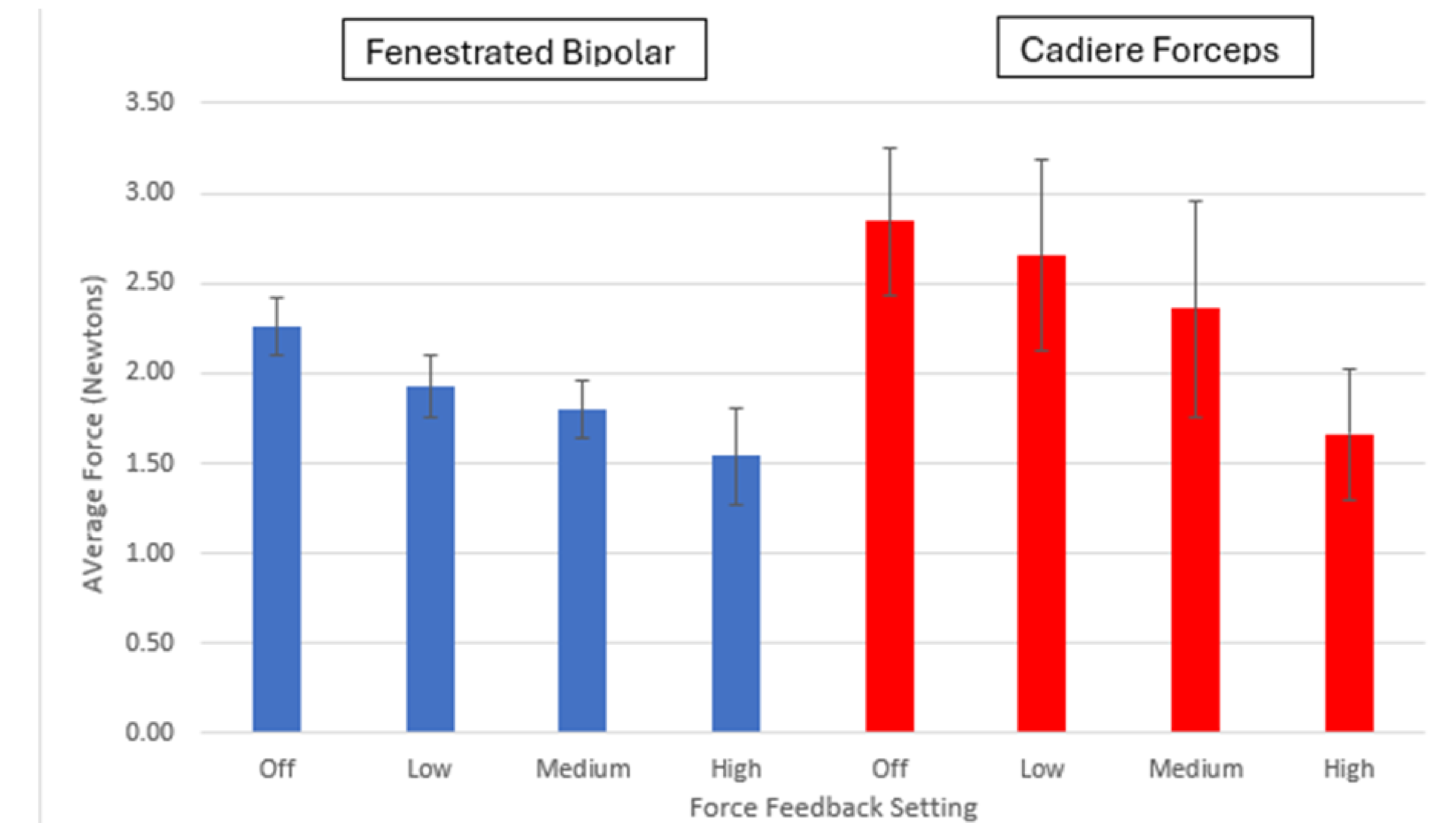


Figure 1: Comparison of the average force in Newtons applied to tissues between the bipolar forceps and Cadiere forceps when force feedback is off versus when it is set to low, medium, and high

Conclusion:

- Significant decrease in force applied by fenestrated bipolar at all force feedback levels in an *in situ* setting. The Cadiere only had significantly decreased force at the highest setting
- Potential use for experienced surgeons in decreases damaging forces to tissues

Limitations:

- Small number of cases, especially at the highest level of force feedback
- Further study to evaluate benefit of force feedback for novice surgeons as this study performed by a single, experienced surgeon