

Unilateral and Bilateral Force Production and Neuromuscular Excitation During Maximal Voluntary Isometric Contractions and Isokinetic Leg Extensions

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INTRODUCTION

- The bilateral deficit (BD) is defined by the force produced during a maximal bilateral (BL) contraction being less than the sum of the force produced by maximal unilateral (UL) contractions of the same muscles (1).
- It is unclear whether there are differences in the BD during maximal voluntary isometric contractions (IM) vs. maximal isokinetic (IK) leg extension muscle actions.

PURPOSE

The purpose of the present study was to examine differences in UL and BL force and muscle excitation during IM vs. IK muscle actions.

METHODS

Table 1. Study Criteria and Participant Characteristics

Participant Characteristics	<ul style="list-style-type: none"> $N = 11$ Age = 20.8 ± 1.7 yrs. Height = 179.3 ± 7.2 cm. Body Mass = 84.0 ± 16.2 kg.
Study Measures	<ul style="list-style-type: none"> Vastus lateralis Peak Force (Kg) EMG Amplitude (EMG-AMP, μV)
Statistical Analysis	<ul style="list-style-type: none"> Repeated measures ANOVA Criterion set at alpha level of 0.05 Effect sizes partial eta-squared (η^2_p) and Cohen's d

PROCEDURE

- Performed separate maximal, UL and BL, IM (6-second hold) and IK leg extensions at $180^\circ s^{-1}$ in random order on four separate days

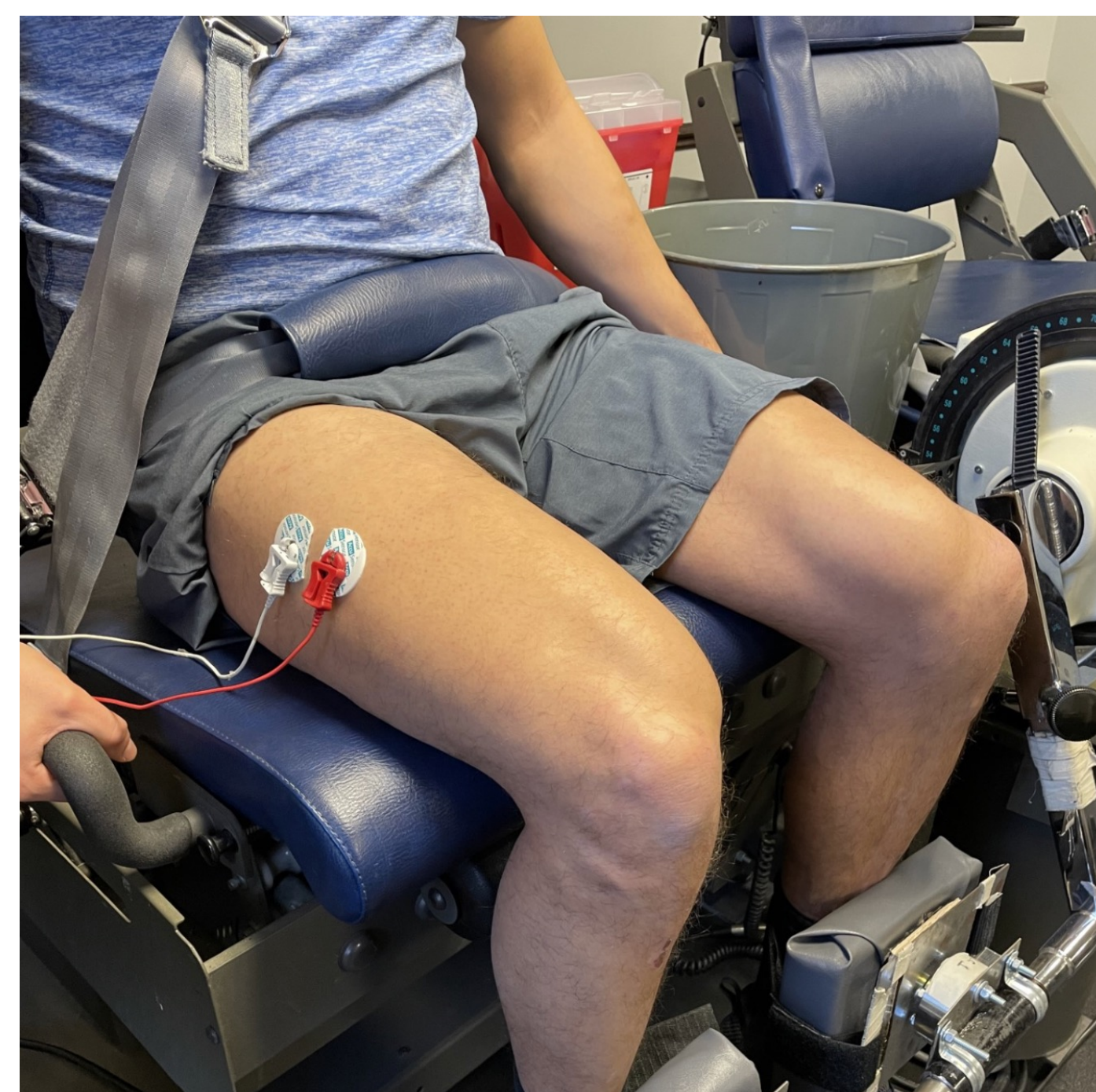


Figure 1. Image of the Bilateral Isokinetic and Isometric setup with EMG sensors on the non-dominant vastus lateralis.

RESULTS

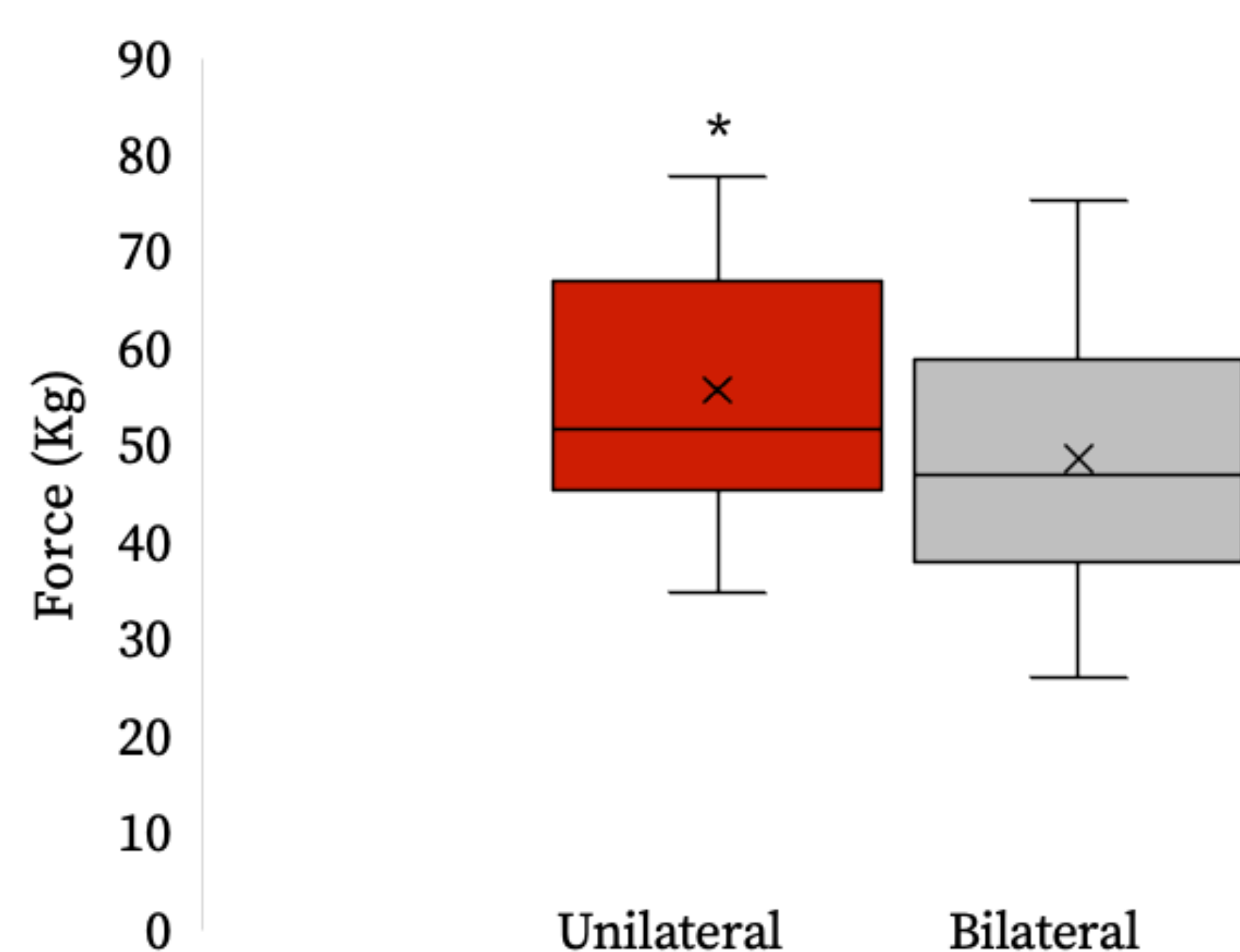


Figure 2. Mean \pm SD for Task \times Visit Interaction for Visit 1. *Indicates Unilateral force was greater than Bilateral force ($p < 0.05$).

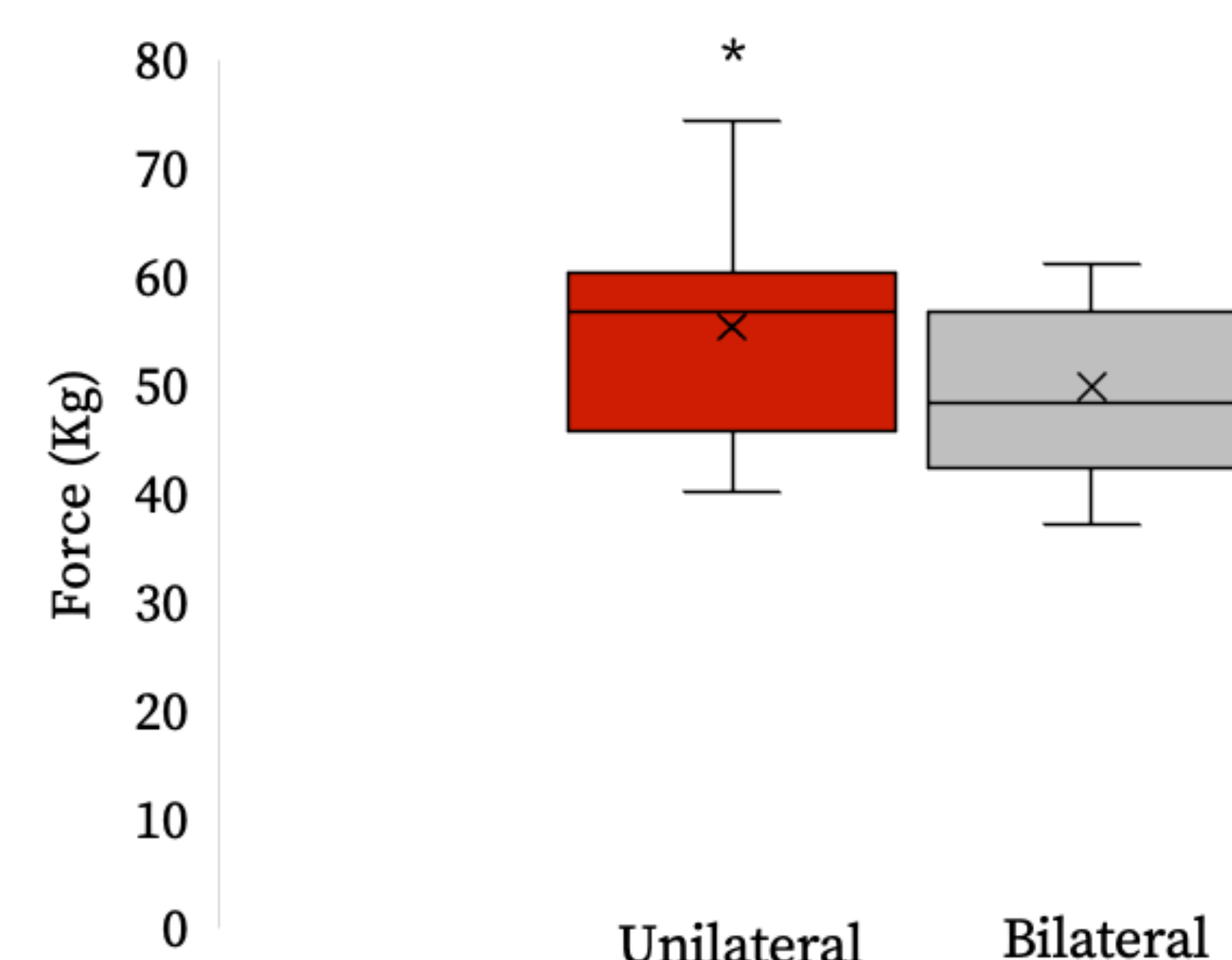


Figure 3. Mean \pm SD for Task \times Visit Interaction for Visit 3. *Indicates Unilateral force was greater than Bilateral force ($p < 0.05$).

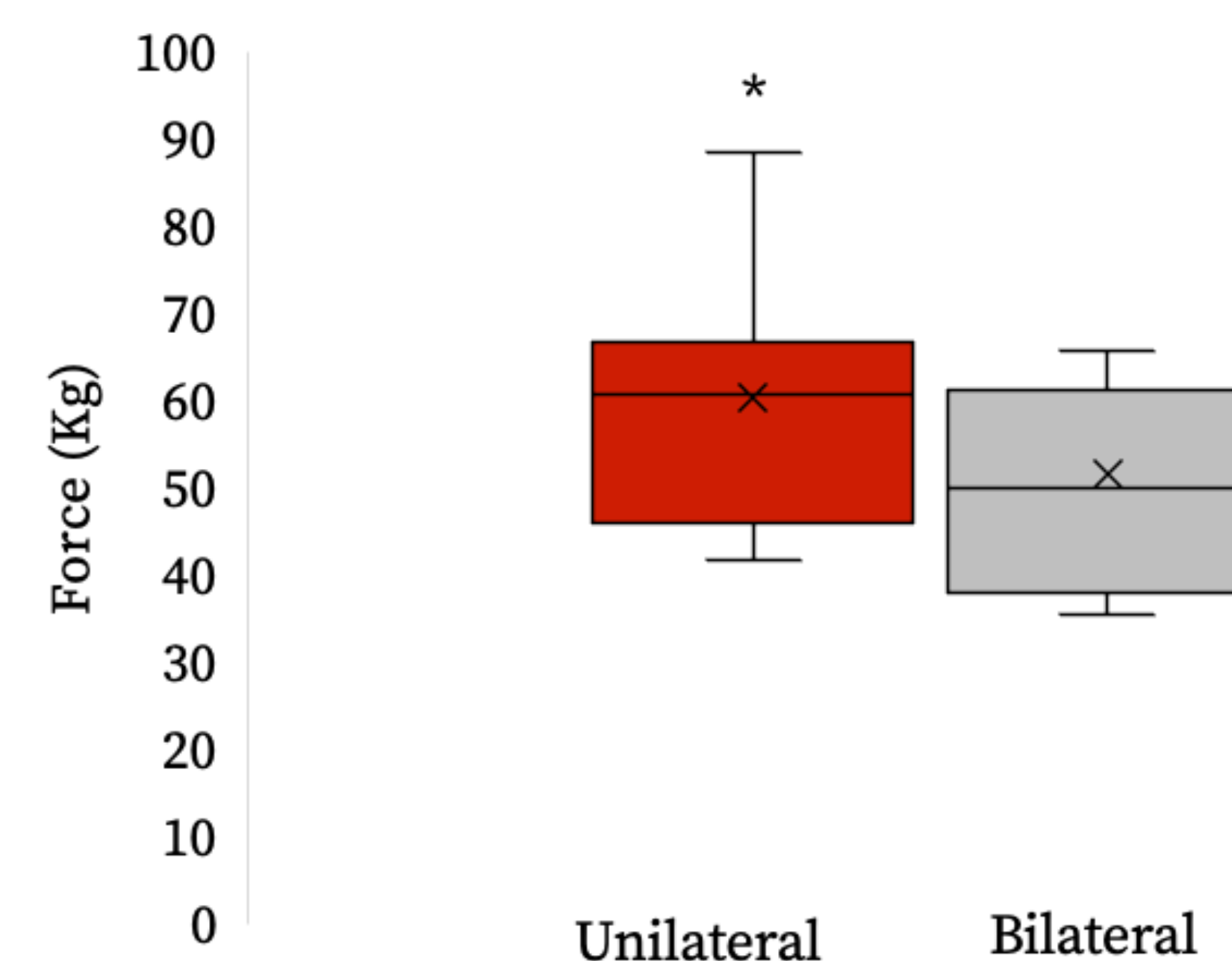


Figure 4. Mean \pm SD for Task \times Visit Interaction for Visit 4. *Indicates Unilateral force was greater than Bilateral force ($p < 0.05$).

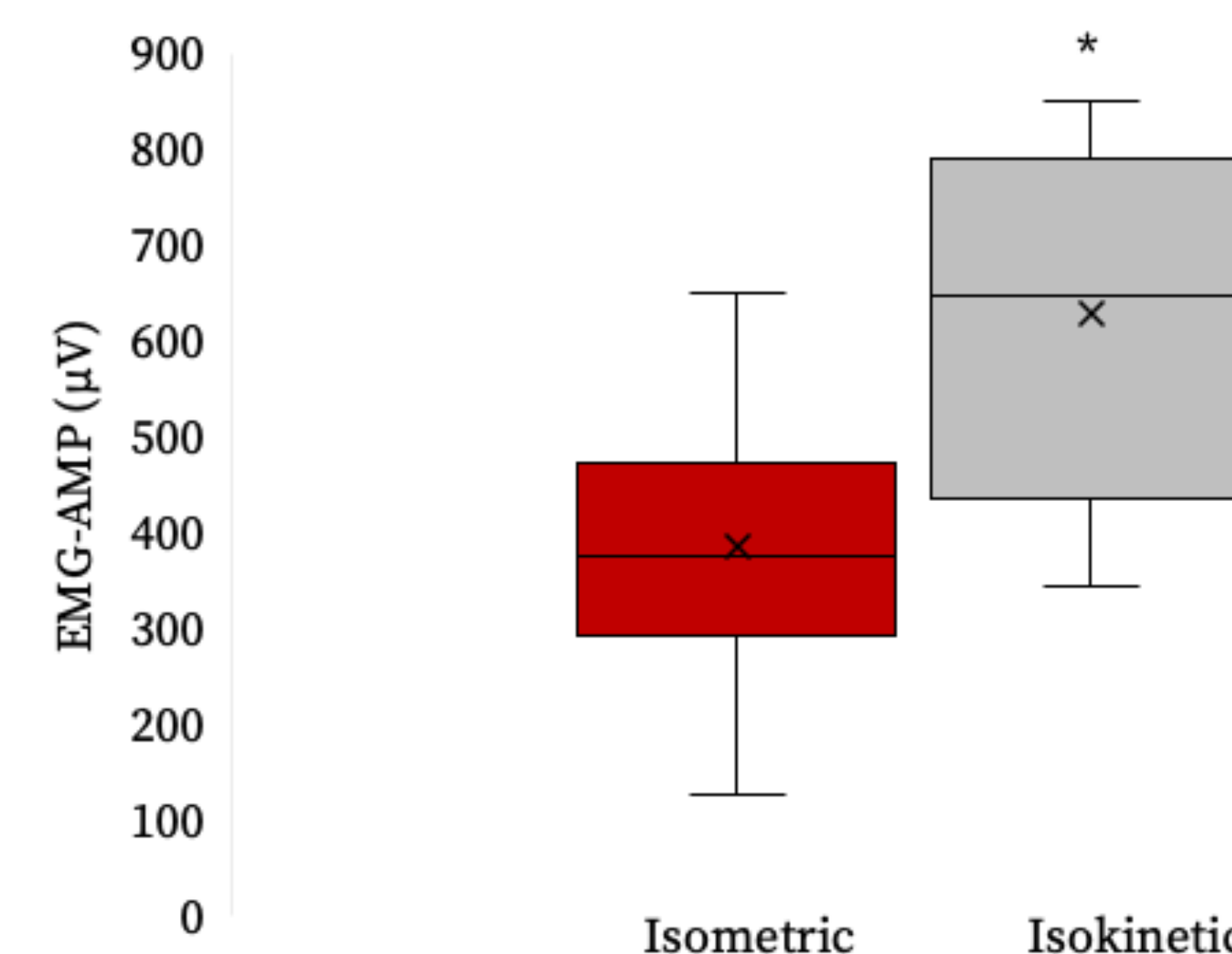


Figure 5. Mean \pm SD for EMG-Amplitude. *Indicates Isometric was less than Isokinetic ($p < 0.05$).

- Peak force, no significant 3-way interaction, but a *significant Task \times Visit interaction* ($p = 0.001$, $\eta^2_p = 0.404$).
 - Post-hoc analysis for the Task \times Visit interaction demonstrated that UL (Visit 1: 55.85 ± 14.23 kg; Visit 3: 55.43 ± 9.61 kg; Visit 4: 60.41 ± 13.75 kg) was significantly greater than BL (Visit 1: 48.76 ± 14.55 kg; Visit 3: 50.00 ± 8.16 kg; Visit 4: 51.69 ± 11.26 kg).*

- EMG-AMP, there were no significant 3- or 2-way interactions, but *significant main effect for Modality* ($p = 0.001$, $\eta^2_p = 0.896$).
 - Post-hoc analysis for Modality demonstrated that the IM EMG-AMP ($385.2 \pm 167.6 \mu V$) was statistically different than IK EMG-AMP ($628.7 \pm 211.7 \mu V$) ($p < 0.00$, $d = 1.46$).*

CONCLUSION

- Results demonstrated that regardless of IK or IM modalities, the UL tasks elicited greater force than the BL tasks, thus suggesting a BD for both modalities. The BD, however, was not associated with differences in muscle excitation.
- In recreationally trained individuals, practitioners should consider that UL modalities may elicit greater force than BL modalities.
- Novice or untrained individuals, whose initial strength gains are attributed to neural adaptations, may receive similar benefits from UL and BL training modalities.

REFERENCES

1.) Oda, S., & Moritani, T. (1994). Maximal isometric force and neural activity during bilateral and unilateral elbow flexion in humans. *European Journal of Applied Physiology and Occupational Physiology*, 69(3), 240-243. doi:10.1007/BF01094795