

# **Comparing the Functional Performance of Two Different BIOPAC® Hand-Held Dynamometers: Models SS25LA and SS25L**

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## **Introduction**

The University of Wisconsin School of Medicine and Public Health currently enrolls over 1100 students per academic year in its human physiology courses. The weekly laboratory component of these courses provides an excellent opportunity to measure noninvasive physiological data. This includes explorations of skeletal muscle that utilize Biopac® hand-held dynamometers and associated data analysis software. The continuing heavy use of this equipment has led to an anecdotal observation that two different models of hand dynamometers presently employed in the laboratory record different average force values. The purpose of this study was to quantify any difference between the two models of Biopac® dynamometers. If the two models register significantly different force measurements, then it will be difficult for the physiology students to reliably collect, analyze, and compare data between laboratory groups and weekly sessions.

## **Methods**

To limit variability between computer processors and A/D converters, the same PC-compatible computer and Biopac® converter (model MP36E-CE) were used throughout the duration of this study. The same test subject was also used in order to limit variability amongst student volunteers. Three different force measurements were recorded as described in the Biopac® Student Laboratory Manual (MANBSL4): *Lesson 2, Motor Unit Recruitment*. Specifically, one light, one medium, and one maximum clench force were collected for each individual hand-held dynamometer. For this study, 8 of the older models (i.e. purchased prior to academic year 2002) were randomly chosen (#SS25L, pictured below).



Similarly, 9 of the more recently purchased models were also randomly chosen (#SS25LA, pictured below).



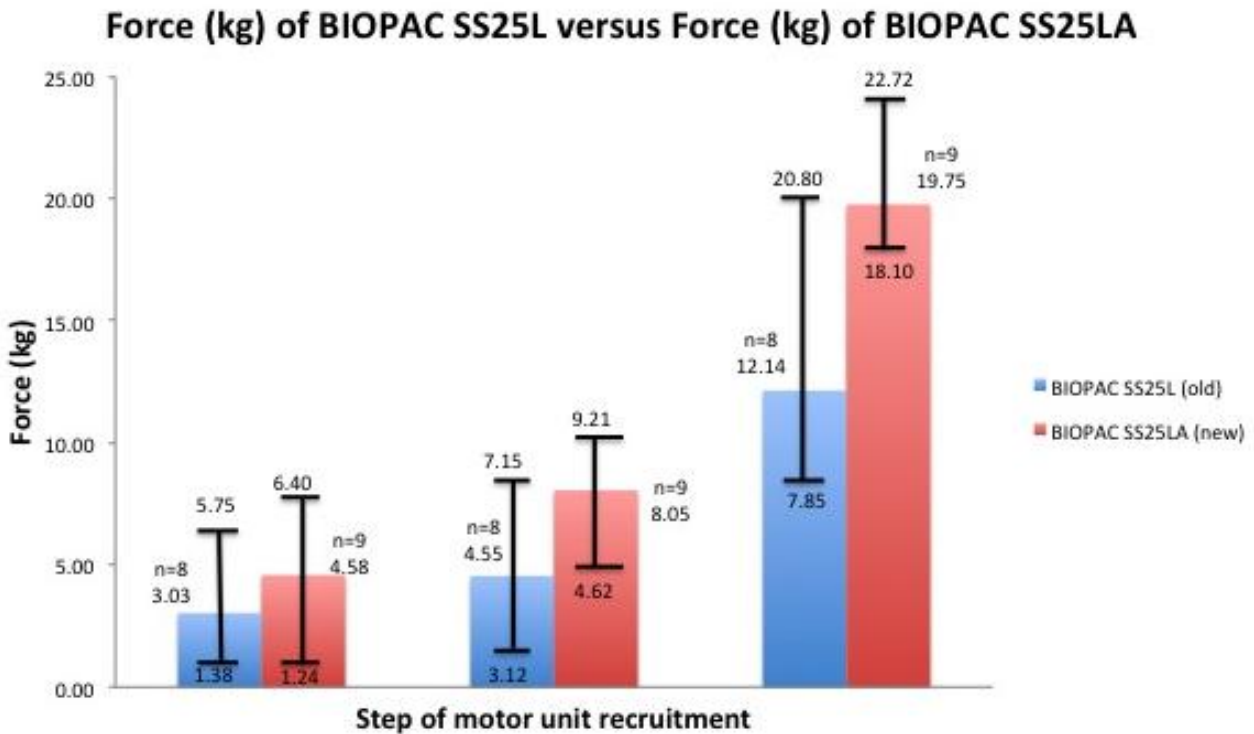
## **Results**

The force generated from light, moderate, and maximum clenches (i.e. alterations in the level of voluntary motor unit recruitment) was measured using both Biopac® SS25LA and SS25L hand-held dynamometers. A difference between the force values recorded by each type of model had been previously noted and thus further data was collected to quantify this difference. **Figure 1** plots the average force values for each model as well as the maximum and minimum values collected at all three levels of motor unit recruitment. The Biopac® SS25LA dynamometer was found to record consistently higher average readings than the Biopac® SS25L dynamometer. Specifically, the SS25LA recorded average force values of 4.58 kg, 8.05 kg, and 19.75 kg (light, medium, and maximum clench force, respectively) while the SS25L recorded average force values of 3.03 kg, 4.55 kg, and 12.14 kg (light, medium, and maximum, respectively).

Additionally, the range of forces was notably different between the SS25L and SS25LA models, particularly when measuring maximum clench force. As shown in **Figure 1**, using the SS25L, the light clench ranged from 5.75 to 1.38 kg, the moderate clench ranged from 7.15 to 3.12 kg, and the maximum clench ranged from 20.80 to 7.85 kg. Meanwhile the ranges that were recorded using the SS25LA included: light clenches from 6.40 to 1.24 kg, moderate clenches from 9.21 to 4.62 kg, and maximum clenches from 22.72 to 18.10 kg.

## **Discussion and Conclusion**

In summary this data supports the conclusion that the Biopac® SS25LA hand dynamometers record significantly different force values than do the SS25L hand dynamometers. Given the consistently lower force values when using the SS25L models, it is important that during future physiology laboratory sessions, students note which dynamometer model they are using that particular day. This will be especially important if they wish to compare data between groups and subsequent lab periods. It is also highly recommended that more SS25LA hand dynamometers be purchased to replace the older SS25L models before the beginning of the next academic year.



**Figure 1:** Measurements of force (kg) using the BIOPAC Hand-Held Dynamometers #SS25L (blue) and #SS25LA (red). Different steps (or levels of intensity) of motor unit recruitment were tested for each model (light, medium, and maximum clench force). Plotted are average force values (kg), the number of each model type tested (n=), and the bars show the range of values for each model.

**Table 1: Raw Data Collected for Each Dynamometer**

BIOPAC SS25L Hand dynamometer				BIOPAC SS25LA Hand dynamometer			
Hand dynamometer number	Light force (kg)	Medium force (kg)	Maximum force (kg)	Hand dynamometer number	Light force (kg)	Medium force (kg)	Maximum force (kg)
1	1.38	3.12	10.74	1	4.19	9.17	22.72
2	5.75	6.40	14.11	2	5.20	8.32	18.10
3	2.39	4.31	11.39	3	6.19	8.39	21.12
4	2.58	4.60	11.88	4	2.37	8.09	18.45
5	1.52	3.31	7.85	5	4.29	9.09	18.97
6	1.67	3.59	11.28	6	5.88	7.53	18.69
7	5.14	7.15	20.80	7	1.24	4.62	19.13
8	3.80	3.89	9.03	8	5.49	8.02	22.27
				9	6.40	9.21	18.31
<b>Average</b>	<b>3.03</b>	<b>4.55</b>	<b>12.14</b>	<b>Average</b>	<b>4.58</b>	<b>8.05</b>	<b>19.75</b>