

1 Electromyographic Analysis of Scapular Stabilizers during the Use of
2 Bodyblade[®], Cuff Weights and Thera-Band[®] Resistance.

3 **Abstract**

4 Context: The scapular stabilizers are key to the normal mechanics
5 of the glenohumeral joint in overhead athletes. There are numerous ways
6 to overload these muscles.

7 Objectives: To assess muscle activity of the scapular stabilizers
8 while exercising with the Bodyblade[®] and other traditional training devices.

9 Design: Repeated measures analysis of surface EMG data
10 collected from the upper trapezius (UT), lower trapezius (LT) and serratus
11 anterior (SA) during shoulder flexion and abduction using Bodyblade[®],
12 cuff weight and Thera-Band[®] resistance.

13 Setting: Laboratory.

14 Participants: Thirty collegiate athletes from various sports (average
15 age 20 years).

16 Intervention: Participants performed 10 repetitions of shoulder
17 flexion and abduction using three devices.

18 Main Outcome Measures: For each movement, normalized root
19 mean square (NrmsEMG) were computed for each muscle during each
20 repetition under each training condition. Data were analyzed using 3
21 (condition) x 10 (repetition) repeated measures ANOVAs.

22 Results: During shoulder flexion and abduction, the normalized root
23 mean squared NrmsEMG of the UT, LT and SA were significantly greater
24 when using the Bodyblade[®] than the Thera-Band[®] or cuff weight. For all
25 conditions, NrmsEMG showed a gradual increase across repetitions.

26 Conclusion: The significantly greater NrmsEMG values produced
27 using the Bodyblade[®] suggest that this device has the potential for greater
28 activation of the scapular stabilizers than traditional resistance techniques.

1 **Figure Captions**

2 FIGURE 1. Scapular motions (adapted from Ludewig and Cook; *Phys*
3 *Ther* 2000; 80: 276-291). PT = posterior tipping; MR = medial rotation; UR
4 = upward rotation.

5 FIGURE 2. Subject performing shoulder flexion during Bodyblade®
6 condition.

7 FIGURE 3. Schematic diagram of collection system.

8 FIGURE 4. Position for isometric contraction used during normalization of
9 lower trapezius.

10 FIGURE 5. NrmsEMG of the upper trapezius, lower trapezius and
11 serratus anterior during shoulder flexion using the Bodyblade®, cuff
12 weights and Thera-Band® resistance. Bars show means and SD.

13 *significantly different than the cuff weight condition ($p < .05$). **
14 significantly different than the Thera-Band® resistance and cuff weight
15 conditions ($p < .05$).

16 FIGURE 6. NrmsEMG of the upper trapezius, lower trapezius and
17 serratus anterior during shoulder abduction using the Bodyblade®, cuff
18 weights and Thera-Band® resistance. Bars show means and SD. *
19 significantly different than the cuff weight condition ($p < .05$). **significantly
20 different than the Thera-Band® resistance and cuff weight
21 conditions ($p < .05$).

22 FIGURE 7. Sample of raw EMG tracings of the upper trapezius during
23 shoulder flexion for a single repetition across 5 seconds. (a) Thera-Band®,
24 (b) cuff weight and (c) Bodyblade®.

25 FIGURE 8. Graphs of the average NrmsEMG values for the UT (a), LT
26 (b), and SA (c) across repetitions during shoulder flexion.

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1 **Tables**

2 Table 1: Physical characteristics of 15 male and 15 female collegiate
3 athletes.

Means +/- Standard Deviations	N	Height (cm)	Mass (kg)	Age (yrs)	Dominant Shoulders
Female	15	168.6 ± 4.9	65.7 ± 6.6	20.0 ± 1.3	2 Left, 13 Right
Male	15	183.9 ± 4.7	85.0 ± 8.9	20.0 ± 2.0	1 Left, 14 Right
Sample	30	175.3 ± 9.1	75.3 ± 12.4	20.0 ± 1.7	3 Left, 27 Right

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5 Table 2. The number of male and female athletes from each sport.

Males	
Sport	N
Diving	2
Baseball	1
Football	9
Tennis	2
Discus	1
Females	
Swimming	12
Softball	3

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- 1 Table 3: Root mean square of the EMG (rmsEMG) across repetitions for
 2 the upper trapezius and serratus anterior during shoulder flexion.

Rep	Upper Trapezius		Serratus Anterior	
	rmsEMG	Grouping	rmsEMG	Grouping
1	0.3480±0.2861	A	0.6188±0.3940	A
2	0.3695±0.3059	A, B	0.6703±0.4381	A, B
3	0.3951±0.3301	A, B, C	0.7134±0.4727	A, B, C
4	0.4103±0.3652	B, C, D	0.7157±0.4710	A, B, C, D
5	0.4243±0.3726	B, C, D, E	0.7506±0.4836	B, C, D
6	0.4377±0.3762	C, D	0.7767±0.5318	C, D
7	0.4530±0.3843	D, E	0.7923±0.5427	C, D
8	0.4657±0.4182	D, E	0.7850±0.5408	C, D
9	0.4656±0.4096	E	0.8161±0.5268	
10	0.4941±0.4230		0.8265±0.5688	

- 3 All repetitions with the same letter in the neighboring grouping column are
 4 not significantly different from one another ($p < .05$).

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- 1 Table 4. Root mean square of the EMG (rmsEMG) across repetitions for
 2 the upper trapezius, lower trapezius and serratus anterior during shoulder
 3 abduction.

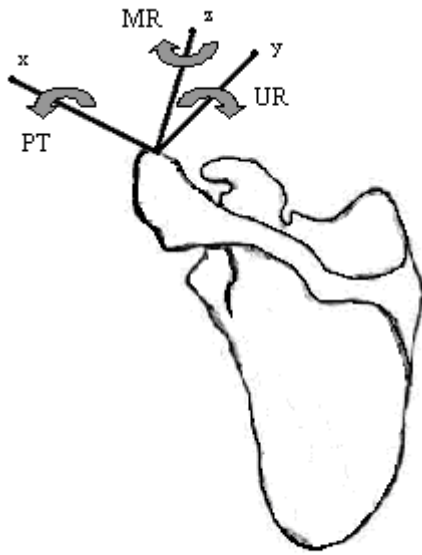
Rep	Upper Trapezius		Lower Trapezius		Serratus Anterior	
	rmsEMG	Grouping	rmsEMG	Grouping	rmsEMG	Grouping
1	0.5263 ±0.4253	A	0.3049 ±0.2686	A	0.4963 ±0.3569	A
2	0.5518 ±0.4302	A, B	0.3389 ±0.3300	A, B	0.5573 ±0.4480	A, B
3	0.5627 ±0.4164	A, B, C	0.3717 ±0.3931	A, B	0.5761 ±0.4295	A, B, C
4	0.5766 ±0.4350	A, B, C, D	0.3741 ±0.3840	A, B	0.6038 ±0.4473	A, B, C, D
5	0.5947 ±0.4842	A, B, C, D	0.3917 ±0.4143	A, B	0.6171 ±0.4702	B, C, D
6	0.6083 ±0.4755	B, C, D	0.4127 ±0.4370	B	0.6337 ±0.5219	B, C, D
7	0.6062 ±0.4666	B, C, D	0.4154 ±0.4211	B	0.6261 ±0.5138	B, C, D
8	0.6138 ±0.4773	B, C, D	0.4360 ±0.4439		0.6650 ±0.5635	B, C, D
9	0.6188 ±0.4772	C, D	0.4562 ±0.4977		0.6691 ±0.5222	C, D
10	0.6493 ±0.4923		0.4126 ±0.3558		0.7099 ±0.5764	

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- 5 All repetitions with the same letter in the neighboring grouping column are
 6 not significantly different from one another ($p < .05$).

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1 Figure 1

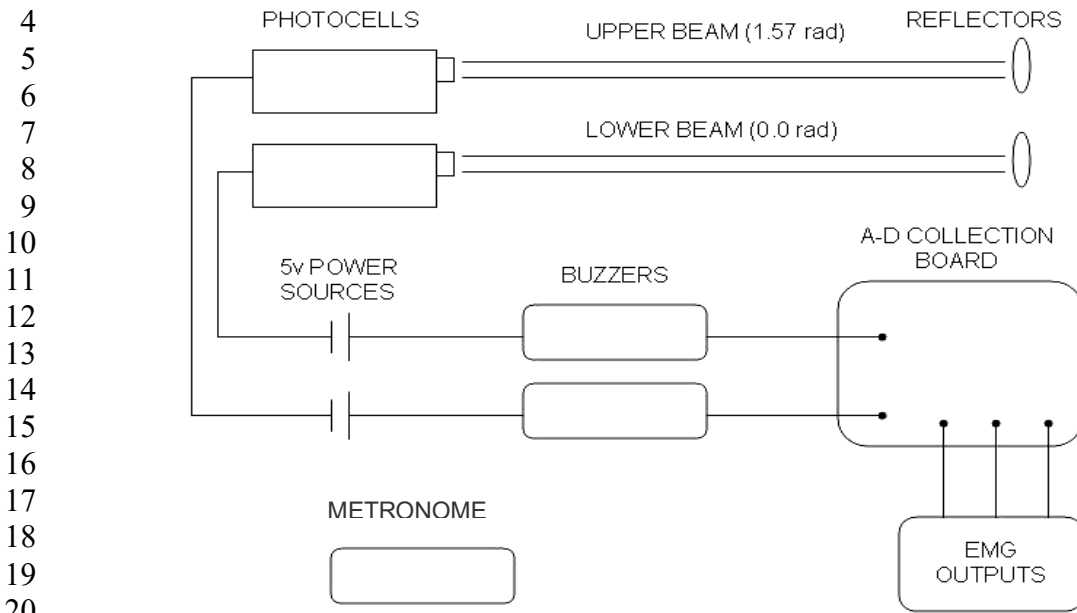


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3 Figure 2



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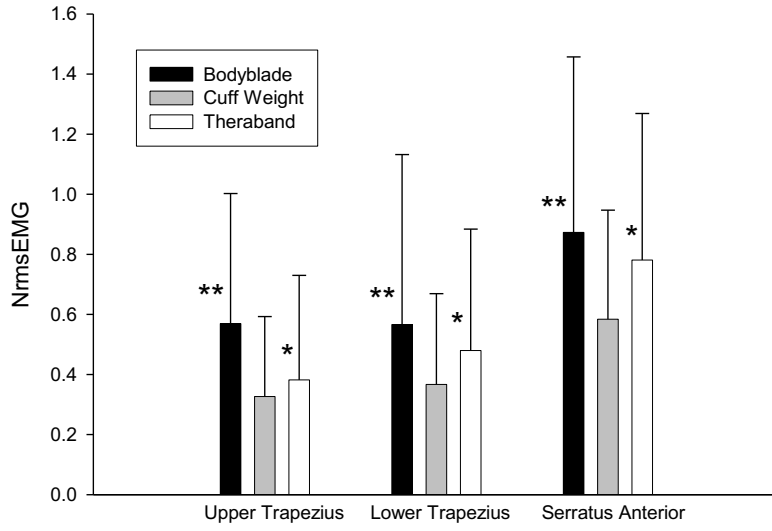
1 Figure 3
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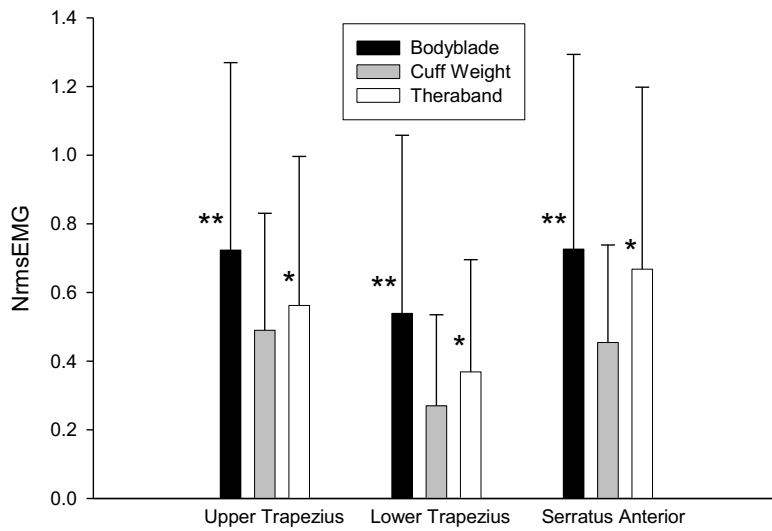
23 Figure 4
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1 Figure 5



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3 Figure 6



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Figure 7

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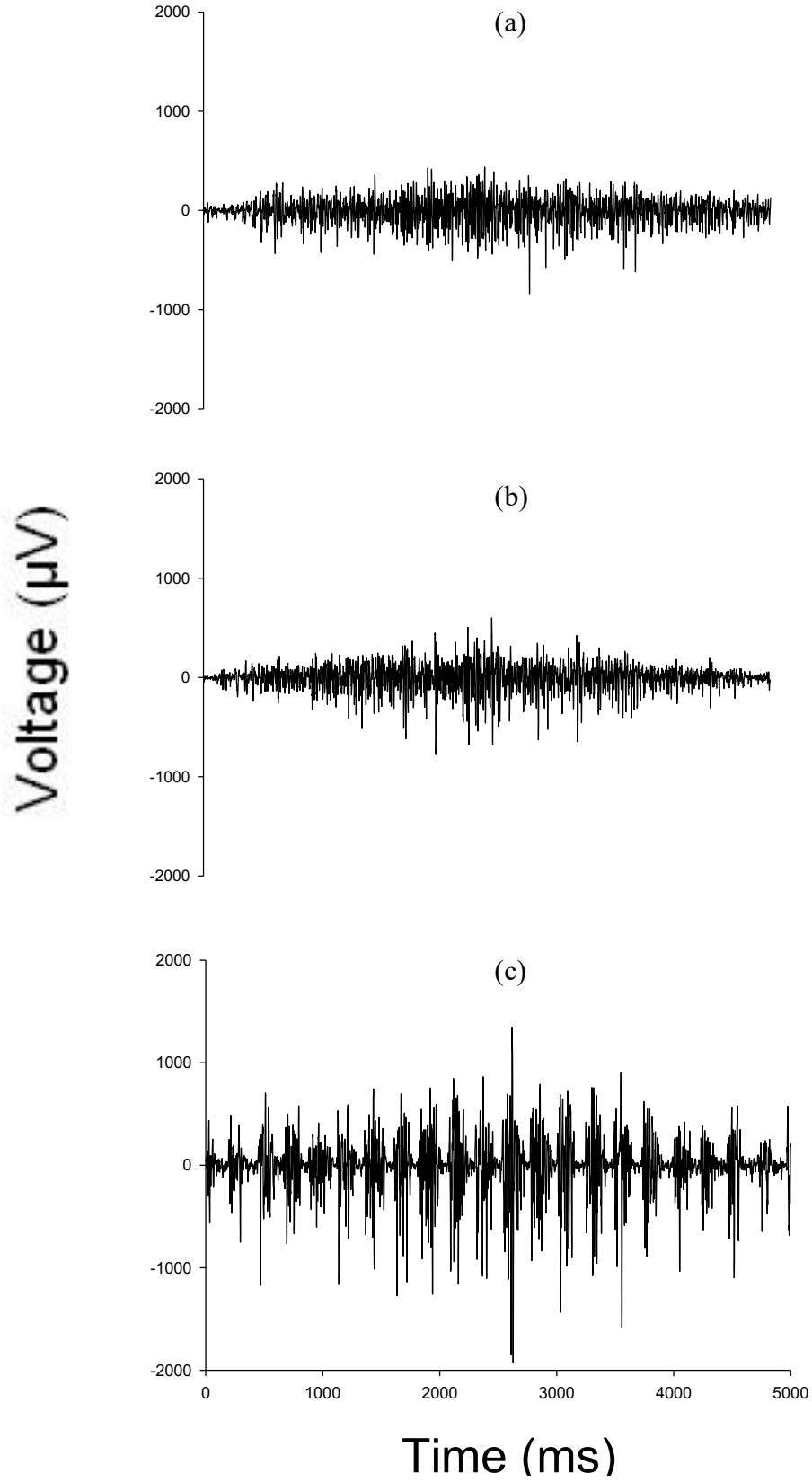


Figure 8

