

2012

# Shoulder-and Back-Muscle Activation During Shoulder Abduction and Flexion Using a Bodyblade Pro Versus Dumbbells

Joseph S. Parry  
*University of San Diego*

Rachel Straub  
*University of Southern California*

Daniel Cipriani  
*Chapman University, cipriani@chapman.edu*

Follow this and additional works at: [http://digitalcommons.chapman.edu/pt\\_articles](http://digitalcommons.chapman.edu/pt_articles)

 Part of the [Physical Therapy Commons](#)

---

## Recommended Citation

Parry, J. S., Straub, R., & Cipriani, D. J. (2012). Shoulder-and Back-Muscle Activation During Shoulder Abduction and Flexion Using a Bodyblade Pro Versus Dumbbells. *Journal of sport rehabilitation, 21*(3), 266-272.

This Article is brought to you for free and open access by the Physical Therapy at Chapman University Digital Commons. It has been accepted for inclusion in Physical Therapy Faculty Articles and Research by an authorized administrator of Chapman University Digital Commons. For more information, please contact [laughtin@chapman.edu](mailto:laughtin@chapman.edu).

---

# Shoulder-and Back-Muscle Activation During Shoulder Abduction and Flexion Using a Bodyblade Pro Versus Dumbbells

## **Comments**

This is a pre-copy-editing, author-produced PDF of an article accepted for publication in *Journal of Sport Rehabilitation*, volume 21, issue 3, in 2012.

## **Copyright**

Human Kinetics



**Shoulder and Back Muscle Activation During Shoulder Abduction and Flexion using a Bodyblade Pro versus Dumbbells**

Journal:	<i>Journal of Sport Rehabilitation</i>
Manuscript ID:	JSR-2011-0045.R3
Manuscript Type:	Original Research Report
Keywords:	electromyography, shoulder, biomechanics, injuries-and-accidents-rehabilitation, exercise training

SCHOLARONE™  
Manuscripts

Review

1 **Context:** The Bodyblade Pro is utilized for shoulder rehabilitation following injury. Resistance  
2 is provided by blade oscillations – faster oscillations or higher speeds correspond to greater  
3 resistance. However, research supporting its use is scarce, particularly in comparison to  
4 dumbbell training.

5 **Objective:** To compare muscle activity, using electromyography (EMG), in the back and  
6 shoulder regions during shoulder exercises with the Bodyblade Pro versus dumbbells.

7 **Design:** Randomized Crossover Study.

8 **Setting:** San Diego State University Biomechanics Lab.

9 **Participants:** Eleven healthy male subjects aged 19 to 32.

10 **Intervention(s):** Subjects performed shoulder flexion and abduction exercises using a  
11 Bodyblade Pro and dumbbells (5, 8, and 10 pounds) while EMG recorded activity of the deltoid,  
12 pectoralis major, infraspinatus, serratus anterior, and erector spinae.

13 **Main Outcome Measure(s):** Average peak muscle activity (% maximum voluntary isometric  
14 contraction) was separately measured for shoulder abduction and flexion in the range of 85° to  
15 95°. Differences among exercise devices were separately analyzed for the flexed and abducted  
16 positions using one-way repeated measures ANOVA.

17 **Results:** The Bodyblade Pro produced greater muscle activity than all the dumbbell trials.  
18 Differences were significant for all muscles measured (all  $ps < 0.01$ ) except for the erector spinae  
19 during shoulder flexion with a 10-pound dumbbell. EMG activity for the Bodyblade Pro  
20 exceeded 50% of the MVIC during both shoulder flexion and abduction. For the dumbbell  
21 conditions, only the 10-pound trials approached this effect.

22 **Conclusions:** Using a Bodyblade during shoulder exercises results in greater shoulder and back  
23 muscle recruitment than dumbbells. The Bodyblade Pro can activate multiple muscles in a

1 single exercise, and thereby minimize the need of multiple dumbbell exercises. The Bodyblade  
2 Pro is an effective device for shoulder and back muscle activation that warrants further use by  
3 clinicians interested in its use for rehabilitation.

4 **Keywords:** bodyblade, electromyography, shoulder rehabilitation

## 6 INTRODUCTION

7  
8 Shoulder injuries commonly occur in athletics, particularly in sports that involve overhead arm  
9 motions (i.e., baseball, softball, swimming, and tennis). As such, shoulder-strengthening  
10 programs are critical in restoring normal function following upper extremity injuries.<sup>1</sup> Shoulder  
11 strengthening programs are effective not only in restoring function, but also in reducing pain,<sup>2</sup>  
12 preventing injury, and improving athletic performance.<sup>3</sup>

13  
14 Clinicians utilize several devices – dumbbells, elastic bands, medicine balls, and machine  
15 weights – to increase strength in the shoulder musculature.<sup>4</sup> Dumbbell training is one of the  
16 more commonly used techniques to increase shoulder strength, and has been shown to  
17 significantly improve rotator cuff strength<sup>5,6</sup> and athletic performance.<sup>3</sup> Townsend et al.<sup>7</sup>  
18 evaluated 17 dumbbell exercises for the shoulder region using EMG and concluded that a  
19 minimum of four exercises was needed for an effective shoulder rehabilitation program.

20  
21 The Bodyblade Pro (Hymanson Inc., Playa Del Ray, CA) is an alternative shoulder-  
22 strengthening device that was introduced in 1991. The Bodyblade Pro is a 1.5 m (5 ft) 1.1 kg (2.5

1 lbs) oscillatory device used by physical therapists, athletic trainers and fitness professionals to  
2 strengthen the shoulder and core musculature.<sup>8</sup>

3  
4 Research supports the use of the Bodyblade. Rose et al.<sup>9</sup> found that a strength-training program  
5 using the Bodyblade Pro maintained shoulder strength in baseball players during the competitive  
6 season. The Bodyblade Pro has also been shown to produce significantly more muscle activation  
7 in the scapular stabilizers than either cuff weights or the Thera-band.<sup>10</sup> Additionally, the  
8 Bodyblade Pro appears to activate the trunk muscles<sup>11</sup> and may have the potential to enhance  
9 upper extremity proprioception.<sup>12</sup>

10  
11 Although the literature supports the use of the Bodyblade, studies comparing the effectiveness of  
12 this device to traditional dumbbells are lacking. As both the Bodyblade and dumbbells are  
13 typically used for a similar clinical purpose (i.e., strengthening the shoulder musculature), it is  
14 imperative to understand the differences in muscle effort between these two devices. To date, it  
15 appears that a complete shoulder rehabilitation program using dumbbells requires at least four  
16 exercises.<sup>7</sup> However, the Bodyblade Pro may be able to activate multiple muscles in a single  
17 exercise, and thereby minimize the need of multiple dumbbell exercises.

18  
19 Therefore, the purpose of this study was to examine the differences in muscle activation between  
20 the Bodyblade Pro and dumbbell during two commonly used shoulder exercises. Specifically,  
21 this study compared muscle activity in the shoulder and back between a 1.1 kg (2.5 lb)  
22 Bodyblade Pro and dumbbells of various resistances [2.3 kg (5 lb), 3.6 kg (8 lb) and 4.5 kg (10

1 lb)]. This study was conducted under the null hypothesis that there would be no differences in  
2 muscle activation between the different conditions.

3

## 4 **METHODS**

5

### 6 **Design**

7

8 Participants performed shoulder exercises using dumbbells and a Bodyblade Pro in a randomized  
9 crossover study. The dependent variable was mean EMG activity (%MVIC) for the following  
10 muscles: deltoid, pectoralis major, infraspinatus, serratus anterior, and erector spinae. This  
11 study had two independent variables: (1) condition [Bodyblade Pro (BPPro); Bodyblade Pro  
12 static (control); 5 lb dumbbell (Db5); 8 lb dumbbell (Db8); and 10 lb dumbbell (Db10)] and (2)  
13 position (shoulder flexion and shoulder abduction).

14

### 15 **Participants**

16

17 Eleven healthy males participated in this study (age =  $24.4 \pm 4.5$  years, height =  $175 \pm 9.0$  cm,  
18 and weight =  $78.6 \pm 9.7$  kg). A health history form was administered to each subject for  
19 screening purposes. Participants were excluded if they reported any of the following: (1) history  
20 of shoulder instability, (2) limitation in shoulder or elbow motion, (3) an existing shoulder injury  
21 (i.e., tendonitis, bursitis, sprain, strain, dislocation, or subluxation), or (4) receiving surgery or  
22 physical therapy on the dominant upper extremity in the past year. The researchers administered  
23 no exclusions based on sports participation, exercise level, or familiarity with the Bodyblade Pro.

1 All participants read and signed a consent form before testing. This study was approved by the  
2 Institutional Review Board at San Diego State University.

3

#### 4 **Apparatus**

5

6 Data were collected using a Noraxon Telemetry electromyography system (Noraxon, Scottsdale,  
7 AZ). Myoresearch XP version 1.06 (Noraxon, Scottsdale, AZ) software processed the data. All  
8 EMG signals passed through an 8-channel frequency-modulation transmitter. Electrically  
9 acquired data were pre-amplified with a gain of 500, bandpass filtered between 10 and 500 Hz,  
10 sampled at 1500 Hz, and converted from analog to digital using a 12-bit resolution. Myoelectric  
11 activity was detected using five surface electrodes (bipolar silver-silver-chloride) and one  
12 reference electrode (monopolar silver-silver-chloride). The electrodes had a surface area of 20  
13 mm and an interelectrode distance of 25 mm. A Logitech Quickcam Pro 5000 (Logitech,  
14 Fremont, CA), time synched with the EMG data, was used to capture video footage at 60 Hz.  
15 Bodyblade Pro trials were performed using a Bodyblade Pro with a mass of 1.1 kg (2.5 lbs)  
16 (Hymanson Inc., Playa Del Ray, CA, United States). Dumbbell trials were performed using 5 lb  
17 (2.3 kg), 8 lb (3.6 kg) and 10 lb (4.5 kg) generic weights.

18

#### 19 **Procedures**

20

21 Each participant attended two sessions: the first for instruction, and the second for data  
22 collection. All sessions were conducted in the Biomechanics Laboratory at San Diego State  
23 University and occurred on the same day for each participant. During the first session the



1 researcher (a certified athletic trainer) verbally instructed and demonstrated the proper use of the  
2 Bodyblade Pro. Instructions were per the manufacturer's recommendation and directions.  
3 Participants then practiced with the Bodyblade until they were able to consistently oscillate the  
4 apparatus in the required shoulder positions, as instructed. All subjects demonstrated proficiency  
5 with using the Bodyblade Pro.

6

7 The second session was for data collection. Prior to electrode placement, the skin was shaved  
8 and cleansed with alcohol. Surface electrodes were placed on the following muscle bellies of  
9 the dominant limb: pectoralis major, infraspinatus, middle deltoid, serratus anterior, and erector  
10 spinae. Electrode placement was determined based on the recommendations by Cram and  
11 Kasman.<sup>13</sup> Pectoralis major electrodes were placed in the clavicular location, 2 cm below the  
12 clavical at an inferior angle in the anterior chest wall. Infraspinatus electrodes were placed in the  
13 infraspinous fossa, parallel and approximately 4 cm below the spine of the scapula. The  
14 posterior deltoid was palpated during shoulder extension to assure that the electrodes were not  
15 located over this muscle. Middle deltoid electrodes were placed on the lateral upper arm  
16 approximately 3 cm distal to the acromion, vertically in line with the fibers of the middle deltoid.  
17 Serratus anterior electrodes were placed inferior to the axilla, horizontal and level with the  
18 inferior angle of the scapula, while the subject maintained the shoulder in flexion. This position  
19 allowed simultaneous palpation of the latissimus dorsi; electrodes were placed medial to this  
20 muscle. Finally, erector spinae electrodes were placed at the level of L3, parallel to the spine and  
21 2 cm lateral from the spinous process. Correct placement was verified by examining the EMG  
22 for each muscle while under tension as described by Cram and Klasman.<sup>13</sup> The arm used to

1 throw a baseball was deemed the dominant limb. The reference electrode was placed over the  
2 ipsilateral acromion process.  
3  
4 After electrode placement, a maximal voluntary isometric contraction (MVIC) was obtained for  
5 each of the 5 muscles to use for amplitude normalization. Each MVIC was performed by having  
6 the participant resist the researcher's manual resistance for five seconds, as specified by Kendall  
7 for specific manual muscle testing.<sup>14</sup> The pectoralis major was tested by applying a horizontal  
8 abducted force to the distal forearm; the subject was supine with the elbow extended, the  
9 shoulder slightly medially rotated in 90° of flexion, and the humerus slightly horizontally  
10 adducted. While supine, the serratus anterior was tested by applying a force to the subject's fist  
11 into scapular adduction; the subject was supine in 90° of shoulder flexion with the elbow  
12 extended and the scapula abducted (i.e., protracted). The subject was then positioned prone, and  
13 the infraspinatus was tested by applying an internal rotation torque to the shoulder; the subject  
14 was in shoulder external rotation with 90° of shoulder abduction and 90° of elbow flexion.  
15 While prone, the erector spinae was resisted as the main researcher applied a force against the  
16 back while the subject extended the spine with the hands clasped behind the head and the legs  
17 fixed to the floor by a second investigator. Finally, with the subject in a seated position, the  
18 middle deltoid was tested by applying a force into shoulder adduction as the subject maintained  
19 90° of should abduction and 90° of elbow flexion. All muscle testing was performed by the  
20 same researcher, who had been formally trained in the Kendall technique and had used it  
21 clinically for approximately four years. Each MVIC test was performed three times for each  
22 muscle, and the average peak value was used for normalizing. Each participant was given one  
23 minute of rest between each MVIC.

1  
2 For the dumbbell trials, participants performed seven repetitions of shoulder flexion and seven  
3 repetitions of shoulder abduction with each weight (5, 8, and 10 lbs). All movements were  
4 performed standing with the feet shoulder width apart, the elbow at 0° of extension, and the  
5 forearm pronated. Subjects were instructed to raise the dumbbell to approximately 110° for both  
6 shoulder flexion and shoulder abduction. A standard goniometer was used initially in order to  
7 confirm that subjects achieved this end range of motion. The researcher provided verbal cueing  
8 to assure this approximate range of motion was achieved. The rate of each repetition was two  
9 seconds for the concentric phase and four seconds for the eccentric phase. Participants were  
10 guided with an audible metronome to maintain this pace.

11  
12 For the Bodyblade Pro trials, participants performed shoulder abduction and flexion without  
13 oscillations (control) and with oscillations. As in the dumbbell trials, all exercises were  
14 performed standing with the feet shoulder width apart, the elbow at 0° of extension, and the  
15 forearm pronated. For shoulder abduction, subjects raised the Bodyblade to 90° and (1) held the  
16 position without oscillations for 15 seconds (control), and (2) generated oscillations for 15  
17 seconds. The same procedure was repeated for shoulder flexion. The purpose of the control  
18 trials was to estimate the muscle effort required to move the Bodyblade Pro as a mass without  
19 performing oscillations.

20  
21 The manufacturer recommends that an individual resist Bodyblade Pro oscillations for 60  
22 seconds. However, pilot studies indicated that most novices begin to fatigue at approximately 15  
23 seconds. Therefore, we determined that 15 seconds was sufficient time to acquire EMG data

1 from the Bodyblade trials. A minimum rest period of one minute was given between trials to  
2 reduce muscular fatigue. Condition (dumbbell and Bodyblade) and position (shoulder flexion or  
3 shoulder abduction) were randomized to minimize a carry-over effect.

4  
5 EMG data were acquired for the middle five seconds of each Bodyblade Pro trial and for the  
6 middle three repetitions of each dumbbell trial. We used video to determine when the subject's  
7 shoulder was between 85° and 95° of abduction or flexion. This camera allowed us to identify  
8 gross approximations for joint positions during the exercise. In this way, all data were collected  
9 while the shoulder was moving through a similar arc of motion while performing either the  
10 dumbbell or Bodyblade Pro exercise.

11

## 12 **Data Processing**

13

14 The raw EMG signals from the MVIC and exercise trials were rectified and smoothed using the  
15 root-mean-square 100 ms window. The average peak activity during the middle three seconds of  
16 the MVIC was used as the normalizing value. The average peak EMG activity for each muscle  
17 for each trial was normalized to its respective MVIC, creating a percentage of the MVIC for each  
18 muscle and for each condition.

19

20 The assumption of normality was tested using the Kolmogorov-Shmirnoff test, and skewness was  
21 evaluated using z-scores. Absolute z-scores > 2.0 were classified as skewed. Muscle data  
22 digressing from normality (i.e., infraspinatus values in the flexed position; and infraspinatus,

1 pectoralis major, and erector spinae values in the abducted position) were transformed using the  
2 natural log. Transformed data were used for all statistical analyses.

#### 4 **Statistical Analysis**

5  
6 Separate one-way repeated measures ANOVAs were conducted for each muscle to compare  
7 muscle activity across the conditions (BPro, control, Db5, Db8, and Db10). This analysis  
8 protocol was conducted separately for shoulder flexion and abduction. Hence, a total of 10  
9 repeated measures ANOVAs were run, five for the flexed position and five for the abducted  
10 position. Prior to each ANOVA, Mauchly's test of sphericity was used to compare group  
11 variance across conditions. If sphericity was violated, Greenhouse-Geisser adjusted P values  
12 were used. In the event of a significant ANOVA, simple planned contrasts were used to compare  
13 the Bodyblade Pro condition (BPro) to each of the other exercise conditions (control, Db5,  
14 Db8, and Db10). Significance was established at  $p < 0.05$ , and all analyses were performed  
15 using SPSS statistical software (Chicago, IL).

#### 17 **RESULTS**

18  
19 Results of the one-way repeated measures ANOVA across exercise conditions were statistically  
20 significant for all muscles during shoulder flexion (deltoid,  $F = 18.08$ ,  $p < 0.001$ ,  $\eta^2 = 0.64$ ;  
21 infraspinatus,  $F = 20.25$ ,  $p < 0.001$ ,  $\eta^2 = 0.67$ ; serratus anterior,  $F = 30.614$ ,  $p < 0.001$ ,  $\eta^2 = 0.75$ ;  
22 pectoralis major,  $F = 12.23$ ,  $p < 0.001$ ,  $\eta^2 = 0.55$ ; and erector spinae,  $F = 4.60$ ,  $p < 0.01$ ,  $\eta^2 =$   
23  $0.32$ ). Simple planned contrasts revealed that the Bodyblade Pro (BPro) elicited significantly

1 greater muscle activity than the dumbbells (Db5, Db8, and Db10) or static Bodyblade Pro  
2 (control) for all muscles, except in comparison to the erector spinae during Db10 shoulder  
3 flexion (Table 1).

4  
5 Results of a one-way repeated measures ANOVA across exercise device conditions were  
6 statistically significant for all muscles during shoulder abduction (deltoid,  $F = 26.17$ ,  $p < .001$ ,  $\eta^2$   
7  $= 0.72$ ; infraspinatus,  $F = 22.98$ ,  $p < .001$ ,  $\eta^2 = 0.69$ ; serratus anterior,  $F = 11.843$ ,  $p < 0.001$ ,  $\eta^2 =$   
8  $0.54$ ; pectoralis major,  $F = 11.32$ ,  $p < 0.01$ ,  $\eta^2 = 0.53$ ; and erector spinae,  $F = 26.17$ ,  $p < 0.001$ ,  $\eta^2$   
9  $= 0.72$ ). Simple planned contrasts revealed that the Bodyblade Pro (BBPro) elicited significantly  
10 greater muscle activity than the dumbbells (Db5, Db8, and Db10) or static Bodyblade Pro  
11 (control) for all muscles (Table 2).

## 13 **DISCUSSION**

14  
15 The purpose of this study was to compare the muscle activity of four shoulder muscles (deltoid,  
16 serratus anterior, pectoralis major, and infraspinatus) and one back muscle (erector spinae), when  
17 performing shoulder exercises with a Bodyblade Pro and three dumbbell conditions using  
18 weights of 2.3 kg (5 lb), 3.6 kg (8 lb) and 4.5 kg (10 lb). The results of our study provide  
19 evidence that performing shoulder abduction or flexion exercises with the Bodyblade Pro  
20 produces significantly greater muscle activity in the deltoid, serratus, pectoralis major,  
21 infraspinatus, and erector spinae than lightweight dumbbells. The only exception was in the  
22 erector spinae during shoulder flexion – the Bodyblade produced greater muscle activity in the

1 erector spinae than all the dumbbell conditions, but was only statistically significant when  
2 compared to the three and five pound conditions.

3  
4 Townsend et al.<sup>7</sup> concluded that dumbbell training produced significant shoulder muscle activity,  
5 defined as muscle activity exceeding 50% of a maximal voluntary isometric contraction (MVIC).  
6 Similar criterion were used by Tucker et al.,<sup>15</sup> who classified muscle activity as significant  
7 (>50% MVIC), moderately strong (35% to 50% MVIC), moderate (20 to 35% MVIC), or  
8 minimal (0% to 20%). Therefore, we elected to define significant activity as greater than 50%  
9 MVIC.

10  
11 When looking at the average peak EMG, we found that the Bodyblade Pro produced substantial  
12 muscle activity in all five muscles in both shoulder flexion and abduction, as muscle activity  
13 exceeded 50% of MVIC for all conditions. The 10-pound dumbbell produced significant activity  
14 during abduction in the serratus, infraspinatus, and deltoid; and significant activity during flexion  
15 in the serratus and erector spinae. The eight-pound dumbbell produced significant activity  
16 during abduction in the serratus, infraspinatus, and deltoid; but only significant activity during  
17 flexion in the infraspinatus. Both the five-pound dumbbell and control trial failed to produce  
18 significant muscle activity in any muscle during flexion or abduction, when using this criteria of  
19 50% of MVIC. Therefore, it appears that the Bodyblade Pro, despite being only 1.1 kg (2.5 lbs),  
20 has the greatest potential to elicit this requisite muscle activity, as it produced significant activity  
21 in all five muscles in both shoulder flexion and abduction. It should be noted that the EMG  
22 values of our study were based on peak values, and not on average sustained values. The ability  
23 of the dumbbells to elicit comparable muscle activity required at least 10 pounds, and even at

1 this weight was still unable to reach the amount of muscle activity obtained with the Bodyblade  
2 Pro.

3  
4 Our results indicated that the Bodyblade Pro produced the greatest EMG activity, relative to  
5 MVIC, in the serratus and infraspinatus. These muscles stabilize the scapula and facilitate  
6 humeral motion by providing a stable base for the prime movers of the humerus (i.e., the rotator  
7 cuff, deltoid, and long head of the biceps brachii), which can then offer dynamic stability to the  
8 glenohumeral joint.<sup>16</sup> Similar to our study, Lister et al.<sup>10</sup> examined EMG activity in the serratus  
9 anterior and trapezius muscles during abduction and flexion while using the Bodyblade, cuff  
10 weights, and theraband resistance. The authors found that the Bodyblade Pro elicited greater  
11 EMG activity in the scapular stabilizers compared to the Thera-band and cuff weights. Caution  
12 is advised when evaluating the infraspinatus results of our study. Data from several of our  
13 subjects far exceeded that of others, requiring us to log transform the data for analysis.  
14 Nevertheless, the extreme data resulted in %MVIC values that exceeded 100%. While it is not  
15 unusual for dynamic EMG to exceed values obtained from static activities, resulting in  
16 normalized values exceeding 100%, the infraspinatus was the only muscle in our study to  
17 demonstrate such extremes.

18  
19 The trunk or core muscles also play a role in dynamic stabilization for upper extremity activities  
20 (i.e., stability during different positions, velocities, and loads). A strong core reduces the amount  
21 of force placed on the shoulder and elbow during throwing activities, and consequently reduces  
22 injury.<sup>17</sup> We evaluated a component of the core by measuring erector spinae activation and  
23 found that the Bodyblade Pro produced the greater muscle activity during shoulder flexion and



1 abduction, when compared with the dumbbells. However, the higher erector spinae activity was  
2 not statistically significant when compared to shoulder flexion with a 10-lb dumbbell.

3

4 In regards to muscle activity, we found that the erector spinae reached 62.4% MVIC when using  
5 the Bodyblade during shoulder flexion. These results conflict with those of Moreside et al.,<sup>11</sup>  
6 who found that erector spinae activity reached only 27% MVIC during flexion with a Bodyblade  
7 Pro. The lack of agreement between our results and those of Moreside et al. could be explained  
8 by the following differences in methodology: (1) exercise position – we evaluated shoulder  
9 flexion during a vertical position, and Moreside et al. used a horizontal position; (2) exercise  
10 technique – we had subjects perform shoulder flexion using one arm, and Moreside et al. had  
11 subjects use both arms. The use of both arms in the Moreside study may have caused subjects to  
12 reach a greater degree of back extension to maintain their balance, and consequently reduced  
13 muscle activity; and (3) MVIC measurements – we manually resisted back extension as  
14 described by Kendall et al.,<sup>14</sup> while Moreside et al. manually resisted a combination of trunk  
15 movements (i.e., extension, side bending, and rotation).

16

### 17 **Theoretical Implications**

18

19 The Bodyblade Pro and dumbbell exercises are different activities, particularly in terms of the  
20 velocity of the movement. The literature indicates that changing the movement velocity alters  
21 the pattern of concentric and eccentric muscle activity: increasing velocity enhances concentric  
22 activity and decreases eccentric activity, while decreasing velocity has the opposite effect in that  
23 eccentric activity is enhanced.<sup>18</sup> Based on our results, we speculate that the Bodyblade Pro

1 produces primarily concentric contractions due its high movement velocity. It is likely that the  
2 muscles of the shoulder do not eccentrically contract to slow the movement of the blade, but  
3 rather contract concentrically to change the blade's direction, at a very high velocity. Further,  
4 the high velocity requirement of the Bodyblade likely caused the corresponding EMG values to  
5 be elevated in comparison to the dumbbell movements.

6

### 7 **Clinical Implications**

8

9 The dumbbell exercises examined in this study are commonly used by athletic trainers and  
10 physical therapists in the early stages of shoulder rehabilitation.<sup>7</sup> The results of our study  
11 suggest that the Bodyblade activates multiple muscles within the shoulder and back during  
12 simple single plane shoulder motions (i.e., shoulder flexion and shoulder abduction). This might  
13 be beneficial in terms of exercise efficiency, although further research is required to evaluate this  
14 notion. Caution however is advised when using this device during early stages of shoulder  
15 rehabilitation; the high-speed movement may elicit muscle activity that exceeds the early ability  
16 of the shoulder.

17

18 Whether the Bodyblade produces an eccentric muscle contraction, which is essential for  
19 movement deceleration, remains inconclusive. The absence of the eccentric component may  
20 initially limit post exercise muscle soreness, and thereby benefit those in the early stages of  
21 rehabilitation. While this may seem beneficial, eccentric training is critical to long-term injury  
22 prevention.<sup>2</sup> [Therefore, clinicians should be aware of this potential limitation of the Bodyblade](#)  
23 [to target eccentric action of shoulder and back muscles.](#)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23

## Limitations

There are several limitations of this study that must be acknowledged. Comparing activities that differ substantially in speed of movement (i.e., a BodyBlade that oscillates rapidly and dumbbells that are moved in controlled fashion) is risky. Therefore, selecting a Bodyblade rather than dumbbells due to its ability to elicit higher peak EMG may not be appropriate, as the higher movement velocity of the Bodyblade innately results in higher peak EMG.

The time window of data collection was not equivalent between the conditions. All activities were evaluated during the same short arc of motion, but more data point were acquired from the Bodyblade trials (5.0 seconds versus 2.0 seconds for the dumbbell trials). Consequently, the average peak value in the Bodyblade conditions was based on more data points. Using only peak EMG is also a concern, as it fails to account for the average activity of the muscles during a sustained repetition. However, we chose peak values in order to understand the maximal muscle effort required while using the Bodyblade, particularly because of its use in early shoulder rehabilitation.

The mass of the dumbbells was selected arbitrarily, based on clinical experiences. These lighter weights are common in the early stages of shoulder rehabilitation. It is not clear how the Bodyblade activity would compare with dumbbells of more substantial mass. In terms of range of motion of the exercise, this study only examined the effects of the Bodyblade in a limited arc of motion, similar to an isometric type exercise. The effects of this device on muscle activity

1 during upper extremity movements with a full arc of motion cannot be inferred from these  
2 results.

3  
4 Finally, the ability to generalize this study's results to individuals other than healthy young males  
5 is limited. The Bodyblade Pro is predominantly used for patients with a shoulder dysfunction,  
6 yet we used a healthy population to explore the effect of this device on shoulder muscle activity  
7 in comparison to dumbbells. We would expect that similar results would occur in older adults,  
8 females, and injured subjects. Nevertheless, we can only safely conclude that the Bodyblade  
9 produces significant EMG activity in the glenohumeral region of young healthy adults, and that  
10 such results would be clinically important for clinicians [implementing the Bodyblade as a tool in](#)  
11 [a shoulder exercise program for young athletes.](#)

### 13 **Future Suggestions**

14  
15 As the current body of literature on the Bodyblade is limited, future studies are needed. The  
16 present study only examined the influence of the Bodyblade on muscle activity, in a limited arc  
17 of motion. The validity of other claims by the manufacturer (e.g., strength improvement, pain  
18 relief, aerobic benefits, and improved proprioception) remain unknown. As such, studies to  
19 determine if the Bodyblade can improve strength, aerobic capacity, and proprioception are  
20 warranted. Additionally, since the Bodyblade Pro is primarily used for rehabilitation, evaluating  
21 its effects in an injured population is warranted.

### 23 **CONCLUSION**

1

2 The Bodyblade Pro appears to be an effective device for activating the shoulder and back  
3 musculature for rehabilitative purposes. The inherent movement pattern of the Bodyblade –  
4 specifically its high velocity – produced greater muscle activity in all five muscles compared to  
5 standard lightweight dumbbells. Further research is needed to evaluate the exact nature of  
6 muscle contraction created when using the Bodyblade, and to determine its effects in an  
7 unhealthy population. Nevertheless, we believe that the Bodyblade Pro is a rehabilitation tool  
8 worthy of future research.

9

10

## REFERENCES

1. Prentice WE. *Rehabilitation Techniques for Sports Medicine and Athletic Training*. New York, NY: McGraw Hill;2004.
2. Lachowetz T, Drury D, Elliot R, Evon J, Pastiglione J. The effect of an intercollegiate baseball strength program on the reduction of shoulder and elbow pain. *J Strength Cond Res*. 1998;12(1):46-51.
3. Treiber FA, Lott J, Duncan J, Slavens G, Davis H. Effects of theraband and lightweight dumbbell training on shoulder rotation torque and serve performance. *Am J Sports Med*. 1998;26(4):510-515.
4. Baechle TR, Earle RW. *Essentials of Strength Training and Conditioning*. Champaign, IL: Human Kinetics;2000.
5. Giannakopoulos K, Beneka A, Malliou P, Godolias G. Isolated vs. complex exercise in strengthening the rotator cuff muscle group. *J Strength Cond Res*. 2004;18(1):144-148.
6. Malliou PC, Giannakopoulos K, Beneka AG, Gioftsidou A, Godolias G. Effective ways of restoring muscular imbalances of the rotator cuff muscle group: a comparative study of various training methods. *Br J Sports Med*. 2004;38(6):766-772.
7. Townsend H, Jobe FW, Pink M, Perry J. Electromyographic analysis of the glenohumeral muscles during a baseball rehabilitation program. *Am J Sports Med*. 1991;19(3):264-272.
8. Hymanson B. Why Bodyblade Pro? BodyBlade Pro Website. <http://www.BodybladePro.com/>. Accessed September 17, 2006.

9. Rose T, Perez L, Miller AL. Strength and functional outcomes of training with the Bodyblade Pro with high school baseball players. *Med Sci Sports Exerc.* 1996;28(5):190.
10. Lister JL, Rossi GD, Ma F, Stoutenberg M, Adams JB, Tobkin S, Signorile JF. Scapular stabilizer activity during Bodyblade, cuff weights and thera-band use. *J Sport Rehabil.* 2007;16:50-67.
11. Moreside JM, Vera-Garcia FJ, McGill SM. Trunk muscle activation patterns, lumbar compressive forces, and spine stability when using the Bodyblade Pro. *Phys Ther.* 2007;87(2):153-163.
12. Schulte RA, Warner C. Oscillatory devices accelerate proprioception training. *Biomechanics.* May 2001;85-91.
13. Cram J, Kasman G, Holtz J. *Introduction to surface electromyography.* Gaithersburg, Maryland: Aspen Publishers; 1998.
14. Kendall FP, McCreary EK, Provance PG. *Muscles, Testing and Function: with Posture and Pain.* 4<sup>th</sup> ed. Baltimore, MD: Williams & Wilkens;1993.
15. Tucker WS, Armstrong CW, Swartz EE, Campbell BM, Rankin JM. An electromyographic analysis of the cuff link rehabilitation device. *J Sport Rehabil.* 2005;14:124-136.
16. Blackburn TA, Guido JA. Rehabilitation after ligamentous and labral surgery of the shoulder: guiding concepts. *J Athl Train.* 2000;35(3):363-381.
17. Aguinaldo AL, Buttermore J, Chambers H. Effects of upper trunk rotation on shoulder joint torque among baseball pitchers of various levels. *J Appl Biomech.* 2007;23:42-51.

18. Potvin JR. Effects of muscle kinematics on surface EMG amplitude and frequency during fatiguing dynamic contractions. *J Appl Physiol.* 2007;82:144-151.

For Peer Review



**Table 1. Peak EMG Activity of Shoulder and Back Muscles (%MVIC) during Shoulder Flexion for Different Device Conditions**

Device	Average Peak Muscle EMG (%MVIC)*				
	Deltoid	Infraspinatus <sup>§</sup>	Serratus Anterior	Pectoralis Major	Erector Spinae
BBPro	61.32 ± 18.18	189.10 ± 233.02	71.89 ± 16.94	71.41 ± 21.73	62.40 ± 23.40
Control	19.79 ± 5.60 <sup>†</sup>	18.53 ± 5.53 <sup>†</sup>	25.29 ± 9.31 <sup>†</sup>	45.24 ± 38.54 <sup>†</sup>	41.10 ± 10.30 <sup>†</sup>
Db5	33.08 ± 11.27 <sup>†</sup>	44.24 ± 29.54 <sup>†</sup>	34.95 ± 11.00 <sup>†</sup>	43.57 ± 33.89 <sup>†</sup>	45.10 ± 16.34 <sup>†</sup>
Db8	36.94 ± 13.08 <sup>†</sup>	50.55 ± 29.40 <sup>†</sup>	42.69 ± 9.50 <sup>†</sup>	41.62 ± 32.65 <sup>†</sup>	43.33 ± 12.90 <sup>†</sup>
Db10	40.57 ± 15.91 <sup>†</sup>	49.13 ± 26.72 <sup>†</sup>	50.50 ± 13.74 <sup>†</sup>	44.79 ± 32.23 <sup>†</sup>	53.81 ± 29.30

Abbreviations: MVIC, maximum voluntary isometric contraction; BBPro, BodyBlade Pro; Control, static Bodyblade Pro; Db5, 5 lb dumbbell; Db8, 8 lb dumbbell; Db10, 10 lb dumbbell.

\*Values are average Peak ± SD.

<sup>†</sup>Significantly lower than BBPro condition ( $p < 0.05$ ).

<sup>§</sup>Values log transformed for statistical analysis.

**Table 2. Peak EMG Activity of Shoulder and Back Muscles (%MVIC) during Shoulder Abduction for Different Device Conditions**

Device	Average Peak Muscle EMG (%MVIC)*				
	Deltoid	Infraspinatus <sup>§</sup>	Serratus Anterior	Pectoralis Major <sup>§</sup>	Erector Spinae <sup>§</sup>
BBPro	89.09 ± 27.82	236.80 ± 271.94	83.08 ± 22.56	65.84 ± 32.92	57.32 ± 37.34
Control	31.25 ± 9.31 <sup>†</sup>	41.45 ± 32.66 <sup>†</sup>	33.81 ± 20.81 <sup>†</sup>	37.53 ± 37.18 <sup>†</sup>	39.03 ± 44.19 <sup>†</sup>
Db5	44.89 ± 10.61 <sup>†</sup>	48.25 ± 25.89 <sup>†</sup>	41.47 ± 12.00 <sup>†</sup>	38.50 ± 37.34 <sup>†</sup>	40.03 ± 42.25 <sup>†</sup>
Db8	57.04 ± 15.27 <sup>†</sup>	59.86 ± 30.24 <sup>†</sup>	53.35 ± 18.54 <sup>†</sup>	38.43 ± 36.25 <sup>†</sup>	35.47 ± 39.03 <sup>†</sup>
Db10	65.63 ± 20.16 <sup>†</sup>	70.03 ± 34.22 <sup>†</sup>	57.99 ± 17.32 <sup>†</sup>	40.26 ± 36.88 <sup>†</sup>	43.63 ± 43.60 <sup>†</sup>

Abbreviations: MVIC, maximum voluntary isometric contraction; BBPro, BodyBlade Pro; Control, static Bodyblade Pro; Db5, 5 lb dumbbell; Db8, 8 lb dumbbell; Db10, 10 lb dumbbell.

\*Values are average Peak ± SD.

<sup>†</sup>Significantly lower than BBPro condition (p < 0.05).

<sup>§</sup>Values log transformed for statistical analysis.