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Letter to editor

Is Muscular Activity Level during Abdominal Bracing Trainable? A Comparison Study between Bodybuilders and Non-Athletes

Dear Editor-in-Chief

Co-contraction of abdominal muscles (abdominal bracing) is considered an effective exercise technique for improving spinal stability, and is often recommended and/or included in rehabilitation and/or fitness programs (Maeo et al., 2013b). Abdominal bracing has been shown to induce higher activation in deep abdominal muscles such as transversus abdominis and internal oblique muscles, which are considered to be the key abdominal muscles that contribute to the stability of the spine (Vera-Garcia et al., 2010), even compared to dynamic exercises involving trunk flexion/extension movements (Maeo et al., 2013b). On the other hand, it has also been revealed that none of the abdominal muscles can be fully activated during abdominal bracing, even with maximal effort. For example, muscular activity level during abdominal bracing, expressed as the value relative to its maximum (e.g. % EMGmax), was 18 – 25% for rectus abdominis (RA), 27 – 34% for external oblique (EO), and 52 – 65% for internal oblique (IO) muscles. (Maeo et al., 2013b; Vera-Garcia et al., 2010). To our knowledge, however, no study has focused on its trainability, and whether muscular activity level during the task can be increased remains unclear. To discuss the efficacy of abdominal bracing as a training modality for improving muscle function, this issue should be clarified since exercise intensity, in this case muscular activity level, largely contributes to training outcome (Fry, 2004). Recently, Maeo et al. (2013a) demonstrated that bodybuilders, who frequently perform voluntary co-contraction with maximal effort in their training program (Schwarzenegger and Dobbins, 1999), can activate their elbow flexors and extensors simultaneously during maximal voluntary co-contraction task greater than control subjects (non-athletes), which can be attributed to long-term adaptation to the task. In the training routines of bodybuilders, they often perform abdominal bracing with maximal effort as one of their major exercises (Schwarzenegger and Dobbins, 1999). Considering this, it is hypothesized that the activation levels of abdominal muscles during abdominal bracing can also be increased, if the abdominal braining is performed for a long period as an exercise regimen. The present study aimed to clarify this by comparing the data obtained from bodybuilders and non-athletes.

Ten male bodybuilders and twelve male non-athletes participated in this study. The means and SDs of age, body height, and body mass in the subjects were 38.8 ± 7.8 yrs, 1.67 ± 0.04 m, and 68.7 ± 6.0 kg for bodybuilders, and 20.2 ± 1.1 yrs, 1.69 ± 0.04 m, and 63.1 ± 5.7 kg for non-athletes, respectively. The experience of bodybuilding in the bodybuilders was 16.5 ± 8.4 yrs. All bodybuilders were ranked at the elite level by their successful performance in domestic competitions. Firstly, the participants performed a static maximal voluntary contraction (MVC) task for each muscle for normalization. After a process of sufficient warming-up and a rest period, the subjects were encouraged to exert maximal force against manual resistance for 5 s two times with at least 3 min between trials. The positions and tasks for MVC were adopted on the basis of a previous report (Maeo et al., 2013b) and the criteria for success in the MVC trial were the same as described elsewhere (Maeo et al., 2013a). In brief, the subjects performed MVC trunk flexion and trunk lateral flexion (bending right). After the completion of MVC tasks, the subjects performed abdominal bracing task with maximal effort for 5 s two times with at least a 3-min interval (Maeo et al., 2013b).

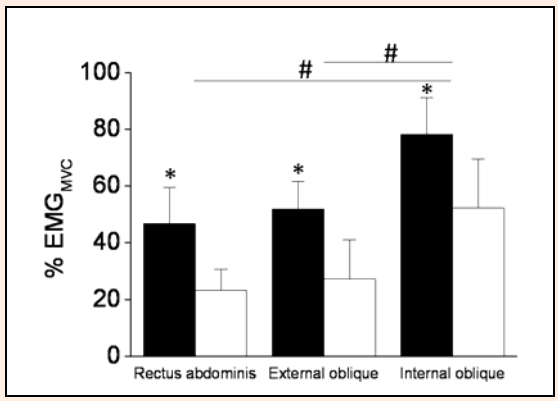

Figure 1. The % EMG_{MVC} values during the abdominal bracing task in bodybuilders (closed bar) and non-athletes (open bar). Values are means ± SDs. * indicates that the % EMG_{MVC} value of bodybuilders is significantly ($p < 0.05$) higher than that of non-athletes. # indicates that the % EMG_{MVC} of IO muscle is significantly ($p < 0.05$) higher than that of other muscles in both groups.

In the MVC and abdominal bracing tasks, the surface EMG activities of RA, EO, and IO muscles of the right side were measured. We followed the previous guidelines for electrode locations (Maeo et al., 2013b), and used the same measurement device and the process of data analysis (Maeo et al., 2013a) as described elsewhere. Briefly, the EMG (RMS) data during the middle 3 s of maximal effort (5 s) for both MVC and abdominal bracing tasks were analyzed in each muscle and averaged across two trials (Maeo et al., 2013a), and EMGs of each muscle during the abdominal bracing task are expressed as the value relative to those during MVC of each muscle (% EMG_{MVC}) (Maeo et al., 2013b). For all muscles, the highest EMG amplitude obtained during trunk flexion or trunk lateral flexion was adopted as the maximum value.

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Two-way (2 groups × 3 muscles) repeated measures ANOVA was used to test the effects of group and muscle and their interaction on muscular activity level during abdominal bracing. Statistical significance was set at $p < 0.05$. All data were analyzed using SPSS software (SPSS Statistics 20; IBM, Japan).

% EMG_{MVC} values during the abdominal bracing task had a significant ($P < 0.001$) main effect of group and muscle without their interaction. The % EMG_{MVC} values were significantly higher in bodybuilders than in non-athletes in all muscles (RA: 47 ± 13% vs. 23 ± 8%, EO: 52 ± 10% vs. 27 ± 14%, IO: 78 ± 13% vs. 52 ± 17%), with a significantly higher value in IO than in the other muscles for both groups (Figure 1).

As hypothesized, the % EMG_{MVC} values during abdominal bracing were significantly higher in bodybuilders than in non-athletes in all abdominal muscles. This suggests that muscular activity level during abdominal bracing can be enhanced by continuing abdominal bracing training for a long period. Also, in line with a previous report (Maeo et al., 2013b), % EMG_{MVC} value was significantly higher in IO than in the other muscles for both groups. It is well documented that deeper muscles located around the spine, such as IO and transversus abdominis muscles, are selectively activated to stabilize the spine during abdominal bracing (Vera-Garcia et al., 2010). Thus, the higher % EMG_{MVC} value in IO may be attributable to the characteristics of the abdominal bracing task in terms of selective recruitment of muscles. In the current result, however, it was also revealed that even bodybuilders could not fully activate all of their abdominal muscles during abdominal bracing. As possible factors limiting maximal activation in antagonistic muscles during co-contraction including abdominal bracing, the influences of inhibitory systems occurring at both central and peripheral sites, such as dual-task interference and Ia reciprocal inhibition as well as recurrent inhibition might be considered (Maeo et al., 2013a, b, c, d). Unfortunately, owing to the limited data available from this study, we cannot identify whether, or to what extent, these inhibitions influenced muscular activation levels in both bodybuilders and non-athletes. Further investigation is needed to clarify this.

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