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Letter to the Editor

Biomechanical Analysis of Integrated EMG and Displacement of Cop According to Mat Thickness during Pilates Teaser Maneuver

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Dear Editor-in-Chief

Pilates is an exercise developed by Joseph H. Pilates (1880 ~ 1967) in the early 1900s which performed continuously developing for various purposes, such as muscle strength and rehabilitation. The Pilates is classified that the abdominal, lower back, gluteus, and femoral muscles into the important muscle groups, which called Powerhouse (1). The muscles surrounding the core play a central role in body control and balance based on maintaining the stability of the lumbar spine as a source of force for the movement of the extremities (2, 3). In particular, core stability as a movement path of upper and lower body forces is a key factor in the operation of an integrated system of body movement (4).

In Pilates, teaser is a high-difficulty maneuver that can strengthen core muscles such as abdominis, gluteus, and deep neck flexor (5), the teaser maneuver is a motion that makes a 'V' shape by slowly lifting the upper and lower body from a lying position. Therefore, when performing the teaser maneuver, the core muscles are intensively used, and the balance of the upper and lower body must be maintained at the highest point, so it is the most efficient and high-level maneuver for improving body balance and stabilization through core stability. The teaser maneuver is performed on a mat, and generally, 0.6 cm, 0.8~1 cm, and 1.6 cm thick mats are used. However, biomechanical studies according to the thickness of the mat were not conducted.

Therefore, the purpose of this study was to compare the integrated electromyography (iEMG) and displacement of the center of pressure (CoP) according to mat thickness during teaser maneuver.

The participants in this study were 7 Pilates experts (32.82 ± 5.42 yr, 165.65 ± 2.24 cm, 54.84 ± 4.07 kg) with no history of musculoskeletal injury in the past 12 months.

This study was approved by Incheon National University Ethical Committee (No. 7007971-202010-001A).

To analyze iEMG and displacement of CoP according to mat thicknesses (0.6 cm, 1.5 cm, and 3.5 cm), one force plate (OR6-7-1000, AMTI Inc., Watertown, USA; sampling rate: 1000 Hz) and four channel of EMG (Trigno Avanti Sensor, Delsys Inc., USA; sampling rate: 2000 Hz) was used. The EMG was attached rectus abdominis, external oblique, quadriceps femoris, and spinal erector (6). All participants were performed the teaser maneuver for five seconds in each mat conditions. All data were processed by Matlab R2020a (MathWorks, USA). A Friedman analysis of variance (ANOVA) was performed with Wilcoxon signed-rank test using SPSS 24 (Armonk, New York, USA). A level of significance was set to α=.05.

As a results, the path length was significantly differences between 0.6 cm, 1.5 cm, and 3.5 cm conditions.

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The sway was significantly differences between 0.6 cm, 1.5 cm, and 3.5 cm. The external oblique was significantly differences between 0.6 cm, 1.5 cm, and 3.5 cm conditions. The quadricep femoris was not significantly differences between each condition. The rectus abdominis was significantly differences between each condition, and the erector spinae was not significantly differences between each condition (Table 1).

Table 1: Results of Displacement of CoP and integrated EMG during teaser maneuver

Parameters (unit)	***Mat Thickness (Mean±SD)***			***χ^2***	***Asymp. Sig.***
	0.6 cm	1.5 cm	3.5 cm		
Path Length (cm)	3.1999±.8362[c]	3.2957±.6705[b]	2.7855±.7194[b, c]	8.000	.018*
CE 95% Sway (cm^2)	.5565±.8400[c]	.4347±.6339	.0932±.0431[c]	7.143	.028*
External Oblique (μV)	.00133 ±.00076[a, c]	.00207 ±.00120[c]	.00252 ±.00197[a]	8.86	.012*
Quadriceps Femoris (μV)	.00846 ±.00643	.00898 ±.00615	.00930 ±.00713	3.71	.156
Rectus Abdominis (μV)	.00409 ±.00208	.00461 ±.00252[b]	.00485 ±.00257[b]	8.00	.018*
Erector Spinae (μV)	.00109 ±.00066	.00142 ±.00091	.00152 ±.00145	3.43	.180

Note. [a] = 0.6 cm vs. 1.5 cm, [b] = 1.5 cm vs. 3.5 cm, [c] = 0.6 cm vs. 3.5 cm *, a, b, c Significant difference at $P < 0.05$

In summary, mat thickness in Pilates teaser maneuver was affected the displacement of center of pressure and muscle activity with external oblique and erector spinae muscles. The results suggested that mat thickness in Pilates teaser maneuver may maximized stability, which is thought to activate the core muscles.

Conflict of Interest

The authors declare that there is no conflict of interests.

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