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Comparison of Effects of Static Core Training and Additional Dynamic Core Training in Young Adults: An Experimental Study

Namjeong Cho[a], **and Hyunjoong Kim**[b*]

[a]Department of Physical Therapy, Kyungbuk College
[b]Department of Physical Therapy, Gwangju Health University

Objective: Core training is a key exercise for conditioning and fitness programs, injury prevention, and more. This study aimed to find out the effect of adding dynamic core training, which is frequently prescribed in clinical practice, on dynamic balance and muscle activity compared to conventional static core training.

Design: An experimental study

Methods: This study is an experimental pilot study of prospective parallel design. Six healthy young adults were allocated to static core training group (SCG; crunch and plank) and blended group (BG; crunch, plank, and dead bug exercise) for two weeks to perform core training. Dynamic balance and muscle activity (erector spinae, rectus abdominis) were measured for all participants before and after core training.

Results: All six healthy young adults enrolled completed the study. No significant difference was found before and after 6 sessions of core training in each group ($P > 0.05$). Likewise, no significant difference was found in the results of the difference comparison between groups ($P > 0.05$).

Conclusions: In conclusion, in this experimental study, no difference was found when dynamic core training was added. Although the results before and after core training did not show improvement in dynamic balance and muscle activity, a randomized controlled trial is needed considering the results of previous studies and the limitations of this experimental study.

Key Words: Muscle activity, Exercise, Postural balance, Core stability

Introduction

Core training is a key element in conditioning and fitness programs for athletes and non-athletes [1, 2]. Core training is important primarily for the purpose of performance improvement and injury prevention [3], because it provides stability around the trunk by providing a stable base for the distal extremity [4].

The core muscles consist of the diaphragm, abdominal external oblique, abdominal internal oblique, transverse abdominis, and pelvic floor muscles [5]. The most representative and traditional static core exercises are crunches and planks, also called stabilization exercises [6, 7]. In addition to static core training, dynamic core training is presented in various ways, and dead bug exercise (DBE) is an dynamic core training that is frequently prescribed as an alternative to crunch exercise [8]. Similarly, In physical therapy clinics, DBE is prescribed as an essential exercise for core stability and strength for patients with low back pain [9].

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Corresponding author: Hyunjoong Kim (**ORCID** https://orcid.org/0000-0001-6538-3872)
Department of Physical Therapy, Gwangju Health University
73, Bungmun-daero 419, Gwangju, Republic of Korea
Tel: **Fax:** +82-62-958-7785 **E-mail:** doong18324@gmail.com

improvement and injury prevention [3]. This is because it provides stability around the torso by providing a stable base to the distal extremity [4].

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Studies on the advantages of combining dynamic core training with existing core training in the clinical field are insufficient. Therefore, in order to verify the effect of blended core training, dynamic balance and muscle activity were compared and analyzed.

Methods

Study design

This study is a prospective parallel design experimental pilot study. The study was conducted until September 2022 and was conducted after planning the protocol in advance.

Participants

In this study, young healthy adults from a university were recruited. Eligibility criteria are healthy adults without back pain or other pathological problems within the last three months [10]. Before participating in the experiment, the purpose and procedure of the study were directly explained to the participants according to the ethical standards of the Declaration of Helsinki, and information on risks and inconveniences that could occur during the experiment and risk prevention measures were provided.

Intervention

Participants received a two-week intervention after baseline measurement. Intervention was performed three times a week, eight minutes of stabilization exercise per session. The static core training group (SCG) performed crunch and plank, and the blended group (BG) with dynamic core training performed crunch, plank, and DBE.

Static core training group

For the crunch, after bending the knee at 45° on the supine, fix the foot on the floor, pull the chin toward the chest, place the hand on the opposite shoulder, contract the abdominal muscle, and lift the trunk to the inferior angle of scapula. Returning to the original position while feeling the contraction of the muscles is counted as one round. Each motion was repeated 10 times for 30 seconds, and a one-minute break was provided to the subjects between measurements, and this was considered as one session (Figure 1)[11].

The plank exercise was performed by bending the elbow joint at 90° in the push-up position and

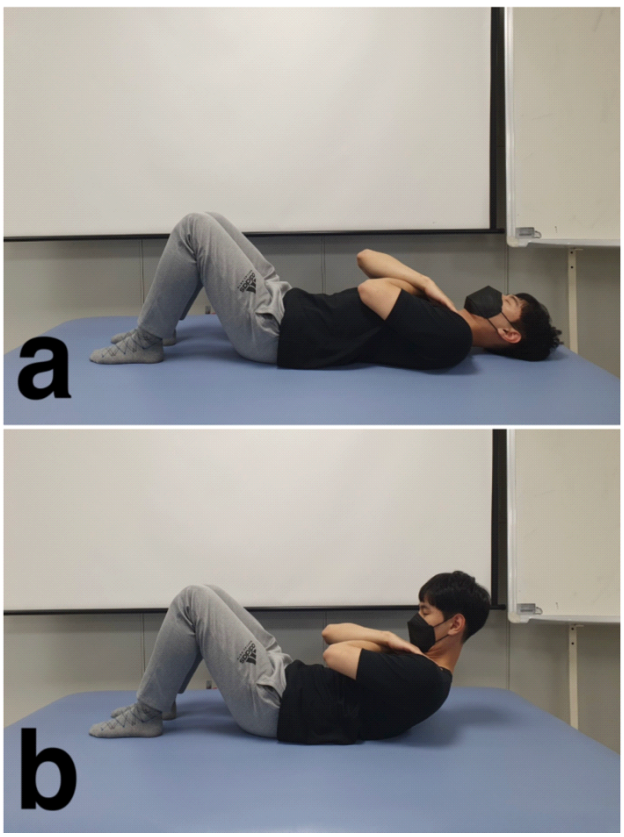

Figure 1. Crunch exercise. a: start position, b: Lift to superior angle of scapula.

Figure 2. Plank exercise.

maintaining the posture of supporting the floor with the forearm for 30 seconds (Figure 2)[12].

Blended group

In the blended group, DBE was additionally performed. DBE begins with the knee bent on the supine, the legs and arms lifted toward the ceiling, and the waist fixed to the floor after taking the starting position. Lower one lower extremity and the opposite upper extremity together toward the floor, then return to the original position. Then, lower the upper and lower extremity on the opposite side that were not lowered toward the floor in the same way [3, 9]. The crossing of the arms and legs was set to be once every three seconds, and 10 times was set as one set. A one-minute rest period was provided for each set to prevent muscle fatigue (Figure 3).

Outcomes

Muscle activity

In this study, surface electromyography (4D-MT V2.0, Relive, Republic of Korea) was used to measure muscle activity [13]. After wiping the attachment site (erector spinae, upper rectus abdominis, and lower rectus abdominis) with an alcohol pad, surface electrodes (2225H, Hurev, Republic of Korea) were attached and measured. In the mechanical characteristics, the maximum muscle activity value measured during exercise was confirmed and recorded.

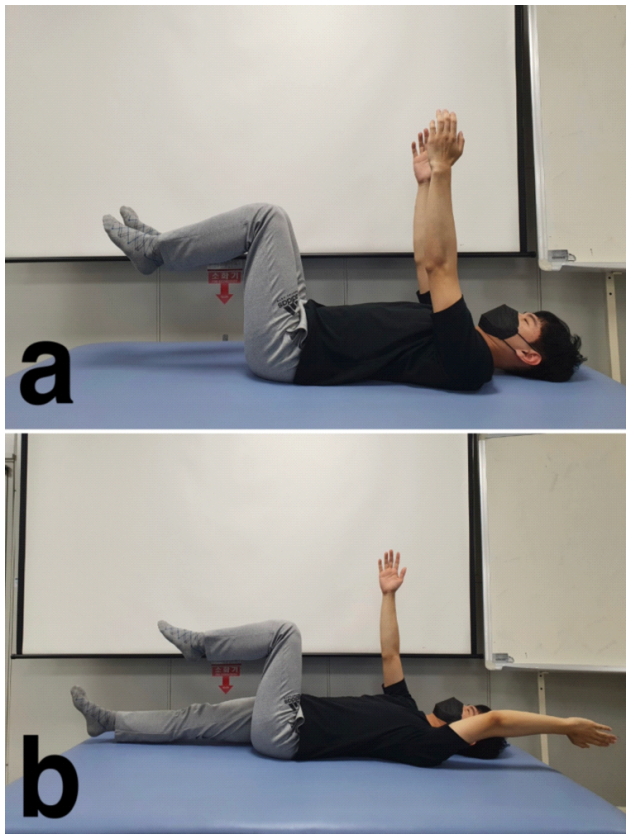

Figure 3. Dead bug exercise. a: start position, b: limbs crossed.

Dynamic balance

In this study, dynamic balance ability was confirmed using a dynamic balance measuring instrument (Good Balance®, Metier, Finland) [14]. The task was performed by placing both feet on the triangular platform and moving the trunk in the direction indicated by the computer, and the results were derived through this. The inter-rater reliability of the measuring instrument was reported to be 0.69 to 0.93 [15].

Statistical analysis

Statistical analysis in this study was performed using SPSS 29.0 version (IBM Corp., USA). Descriptive statistics were used for the general characteristics of the participants, and the Mann-Whitney U test was used to examine differences between groups. In addition, the Wilcoxon signed-rank test was used to find out the change within the group. The statistical significance level was set at 0.05.

Results

Six participants were registered according to the eligibility criteria. The general characteristics (age, height, and weight) of SCG and BG are as follows. SCG: 22.67±1.53 years, BG: 22.00±2.65 years; SCG: 161.33±6.81 cm, BG: 160.67±14.36; SCG: 53.67±4.51 kg, BG: 62.00±18.74 kg.

Table 1 shows the results of dynamic balance and muscle activity in the SCG and BG. No significant difference was found before and after 6 sessions of core training in each group ($P > 0.05$). Likewise, no significant difference was found in the results of the difference comparison between groups ($P > 0.05$).

Discussion

In this experimental study, core training, which is essential as stabilization training for functional and performance improvement and injury prevention, was compared. For the effect on dynamic balance and muscle activity in healthy young adults, static core training (crunch exercise, plank exercise) traditionally prescribed in the field and dynamic core training combined with DBE, which is additionally widely used in clinical practice, were compared.

As for the results of dynamic balance and muscle activity, no significant difference was found between before and after each group and between groups ($P >$

Table 1. Comparison between groups before and after core training (n=6)

		SCG	BG	△
Dynamic balance				
Distance (mm)	Baselines	1486.56±297.79	1125.02±486.90	−422.67±324.99
	Pos-test	962.37±325.32	803.86±199.09	
	Z (P)	−1.604 (0.109)	−1.069 (0.285)	−0.655 (0.513)
AP (mm)	Baselines	1356.59±591.62	777.85±372.75	−523.67±551.33
	Pos-test	597.30±216.84	489.79±111.22	
	Z (P)	−1.604 (0.109)	−1.604 (0.109)	−1.091 (0.275)
ML (mm)	Baselines	1559.59±745.32	947.17±624.47	−719.14±703.10
	Pos-test	581.60±190.24	486.87±145.17	
	Z (P)	1.604 (0.109)	−1.069 (0.285)	−0.655 (0.513)
Time (sec)	Baselines	21.77±3.97	18.45±3.02	−0.32±9.23
	Pos-test	16.89±2.00	22.68±7.94	
	Z (P)	1.069 (0.285)	−0.535 (0.593)	−1.528 (0.127)
Muscle activity				
URA (μV)	Baselines	8.72±0.977	5.97±2.57	2.87±2.91
	Pos-test	11.14±0.98	9.30±5.51	
	Z (P)	−1.604 (0.109)	−1.604 (0.109)	−0.218 (0.827)
LRA (μV)	Baselines	6.44±1.46	3.93±1.47	1.79±1.45
	Pos-test	8.99±2.33	4.97±2.36	
	Z (P)	−1.604 (0.109)	−1.069 (0.285)	−1.091 (0.275)
ES (μV)	Baselines	4.09±0.62	3.45±1.78	1.14±2.31
	Pos-test	3.73±0.76	6.11±3.10	
	Z (P)	−0.535 (0.593)	−1.604 (0.109)	−1.528 (0.127)

Values are presented as mean±standard deviation.

AP: anterior-posterior, BG: blended group, ES: erector spinae, LRA: lower rectus abdominis, ML: medial-lateral, SCG: static core training group, URA: upper rectus abdominis.

0.05). Although no significant difference was found before and after core training, when the mean difference was interpreted, both dynamic balance and muscle activity showed positive improvements. This confirmed that the average difference in BG rather than SCG improved in dynamic balance and increased muscle activity (Table 1).

These results are consistent with the results reported in a systematic review and meta-analysis that improvement in dynamic balance through core training had a moderate effect size (effect size = 0.634) [16]. Also, in muscle activity, a significant increase in trunk muscles was reported after core training [17]. Furthermore, a meta-analysis of 21 studies also reported that core training greatly contributes to performance improvement [18]. In the results of this study, no significant improvement was found after core training, but previous studies reported so far have demonstrated the effect in a number of results. It is considered that the reason why there was no significant difference between the groups was rather that each group showed equal improvement. The slight predominance of the BG in the mean difference of the measured variables could be interpreted as the effect of the DBE. However, in a study of muscle activity through DBE, it was reported that the rectus femoris was more active than the abdominal muscles [9]. The results of these preceding studies are considered to require additional analysis.

This experimental study was designed with a small number of participants and low intensity training for comparison of core training, but had the following limitations. First, the generalizability of the effect is limited due to the small number of participants and non-parametric tests; Second, when trying to verify the effect of exercise, a period of at least six weeks was required, so two weeks was a relatively short period; Third, in this study, only dynamic balance and muscle activity were confirmed through core training, but many other outcome measures related to function were measured.

Conclusion

In conclusion, no difference was found between static core training and additional dynamic core training. Even in the results before and after core training, improvement in dynamic balance and muscle activity was not shown, but a randomized controlled trial considering the results of previous studies and the limitations of this experimental study is required.

Conflicts of interest

The authors declare no conflict of interest.

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