

Effect of Six-Week Resistance Training with Thera-Band and Combined Training on Static and Dynamic Balance in Breast Cancer Survivors: A Randomized Clinical Controlled Trial

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Abstract

Background: Balance impairment is related to breast cancer treatments, such as radiation therapy and chemotherapy. The aim of the present study was to investigate the effect of six-week resistance training with Thera-Band and combined training (training with Thera-Band and core stability training) on static and dynamic balance in breast cancer survivors.

Methods: In this randomized controlled trial, we divided 75 patients with breast cancer into three groups: 1) resistance training group (n=25, age= 46±5.82, BMI= 25.7±3.9), combined training group, (n=25, age= 48.9 ± 7.06, BMI=24.6 ± 3.5), and control group (n=25, age= 46±7.15, BMI= 25.17±3.7). Afterwards, we employed Single leg standing and Balance Error Scoring System (BESS) to measure the static balance; Four Square Step Test (FSST) and Timed Up and Go (TUG) were further used for dynamic balance in pre- and post-test. Exercise program was performed by two training groups for six weeks and three sessions per week. Resistance training with Thera-Band group performed 13 resistance trainings with Thera-Band. In combined group, resistance training was similar to Thera-Band group, but combined group were performed seven core stability trainings. We analyzed the data by two-way repeated measurements ANOVA using the software package SPSS V.22.

Results: Results showed that there were no significant interaction effects indicating an exercise specific development, depending on the type of exercise or control condition ($P>0.05$). Furthermore, there were no significant difference among the resistance training with Thera-Band, the combined exercise, and the control groups ($P>0.05$).

Conclusion: It can be concluded that the six-week resistance training with Thera-Band and combined training (training with Thera-Band and core stability training) has no positive effects on static and dynamic balance in breast cancer survivors. We recommend that more studies be conducted in this regard.

Keywords: Resistance training, Core stability training, Breast cancer

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Introduction

The advances in cancer treatment have increased the survival rates up to 89% at five years post diagnosis of breast cancer. On the other hand, cancer and its treatments have certain side-effects among the survivors.^{1,2} Reduced abilities to balance is one of such side-effects that has been less assessed and can occur in breast cancer patients. The balance impairment is related to breast cancer treatments, such as radiation therapy and chemotherapy.^{3,4} Silverman et al. (2006) reported that treatment by Taxane in breast cancer patients was able to significantly reduce static and dynamic balance.⁵ It seems that cancer treatment negatively impacts the vestibular system. This system is very important for postural control, and static and dynamic balance.⁶ Another major side-effect of breast cancer treatment is chemotherapy-induced peripheral neuropathy, affecting up to 40% of cancer patients.⁷ Moreover, chemotherapy-induced peripheral neuropathy can lead to inadequate proprioceptive feedback and increased balance disorder.⁸⁻¹⁰ It has been established that abnormal somatosensory feedback can impair the balance.¹¹ Treatments of breast cancer can influence the central nervous system (through changes in vestibular system) and neuromuscular system properties, resulting in reduced balance and gait performance.^{12,13} In general, breast cancer treatments have negative effects on the static and dynamic balance in women with breast cancer, exposing them to fall and bone fractures.

Traditionally, resistance exercise training was used for improving muscular endurance and strength and balance in older adults. For instance, Foley and Hasson (2016) demonstrated that traditional exercise training was able to significantly enhance mobility, muscular strength, upper-extremity flexibility, and balance in breast cancer survivors.¹⁴ However, core stability training and training with Thera-Band are novel approaches to exercise training for patients, particularly breast cancer cases. In a systemic review, Granacher et al. (2013) suggested that core strength training could be used as an

alternative to traditional balance and/or resistance training programs for older adults.¹⁵ Hosseini et al. (2012) reported that six-week progressive core stability/strength training improved the balance and functional performance and reduced fear of falling in older adults.¹⁶ Also, Marcovic et al. (2015) concluded that 8 weeks of core resistance training could improve balance ability and trunk muscle strength in healthy older women.¹⁷ However, the effect of core stability training on static and dynamic balance in breast cancer survivors is yet to be elucidated.

On the other hand, exercise with elastic, Thera-Band, has recently been proposed for older adults.¹⁸ Thera-Band is easy to use, convenient to carry, economical, and safe. Indeed, exercise with Thera-Band can ameliorate muscle strength and endurance in older adults.^{18,19} Yeun (2017) in a systemic review and meta-analysis, and Wonjong et al. (2013) showed that resistance training with Thera-Band was able to improve static and dynamic balance in older adults.^{18,20} The literature supports the effects of core stability training and exercise with Thera-Band on static and dynamic balance in older adult; however, the influences of these trainings on balance status in breast cancer survivors have not been sufficiently investigated. Therefore, the present study aimed to clarify the effect of six-week resistance training with Thera-Band and combined training (training with Thera-Band and core stability training) on static and dynamic balance in breast cancer survivors.

Methods

Patients

We recruited the patients from Isfahan Cancer Center, from January 2016 to August 2016. They were eligible if they (1) had surgery and removed lymph nodes, (2) were in stage 0-III of breast cancer, (3) completed all primary treatments (surgery, chemotherapy, and / or radiation therapy), (4) were 29-65 years, (5) currently used Danazol (10 mg/day), did not have psychological problems, shoulder and neck pain, sleep disturbances, or any problem in coping with physical and

Table 1. Progression in the exercise program of the combined group

Week	Session	Repetition	Set
1 and 2	1-6	10	2
3	7-9	15	2
4	10-12	10-12	2
5	13-15	10-12	3
6	16-18	10 -12	2

psychosocial performances. Exclusion criteria were orthopedic or chronic diseases preventing the completion of physical protocols, or chemotherapy or radiotherapy treatments at the beginning of the study. The patients then received a thorough explanation of the project, signed the consent form, and completed the physical activity readiness questionnaire. Patients were able to leave the study at will. This project has been registered in Iran Randomized Control Trial Center (IRCT) with the number of IRCT2016011426008N1.

Design and randomization

After surveying the 1200 profiles and documents of patients with breast cancer, 75 patients were selected and randomly divided into three groups: resistance training with Thera-Band

group (n=25, age=46±5.82), combined training group (resistance and core-stability training) (n=25, age= 48.9 ± 7.06), and control group (n=25, age= 46±7.15) (Figure 1). Of note, eight patients in the resistance training with Thera-Band group, six patients in the combined training group, and four patients in the control group did not complete the post-test.

Measurements

We employed Single leg standing (SL) and Balance Error Scoring System (BESS) to measure the static balance; Four Square Step Test (FSST) and Timed Up and Go (TUG) were further utilized for dynamic balance.

Regarding SL, all patients performed and completed three trials on each leg for 30 seconds. They stood on a 46×43×13 cm³ pad of medium

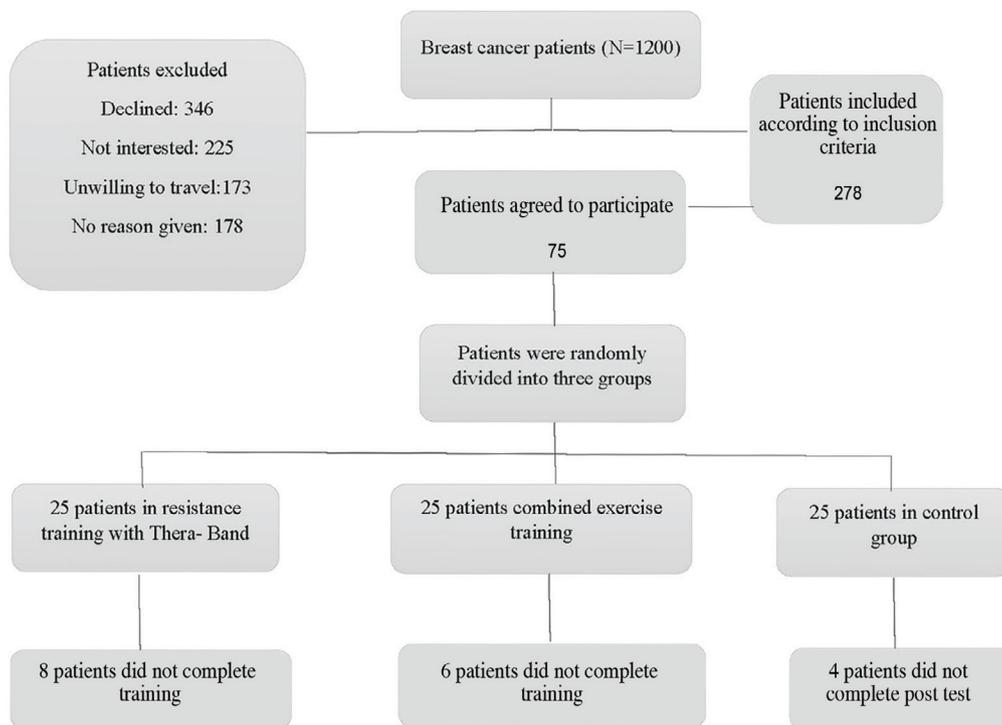
**Figure 1.** Flow diagram of patients.

Table 2. Progression in the resistance training section (in both exercise groups)

Resistance increasing	1st and 2nd weeks	3rd and 4th weeks	5th and 6th weeks
Thera-Band Color	Training begins by the selected color (red or green)		
Thera-Band Length	When subjects used any new Thera –Band (color), they started an easy length and increased up according to Omni Scale		
Repetitions	8	10	12
RPE	3-5	6-9	10-12
Sets	2	3	4
Rest between sets (seconds)	90	60	45
Rest between each movement (minutes)	3	2:30	2

density foam with crossed hands over chest. Error scores for each patient in the right and left legs were recorded on a score sheet. If the subject had any errors including opening the eyes, raising the heel and toe on the ground, separating the hands from the chest and touching the legs, and placing the foot on the ground, the staff recorded the errors of the patients and put them on the score sheet. The most optimal time was recorded for the patients.

In BESS, all patients performed the test in three standing positions on both rigid (on the ground) and soft surfaces (foam) for 20 seconds comprised of two feet apart, standing on a non-dominant leg, and standing with tandem feet. The hands were placed in both positions on the wrists and the test was performed with closed eyes. We recorded the test time immediately after the patients closed their eyes. Six types of errors were counted and recorded for each subject, once they were done. If a patient simultaneously committed multiple errors, only one error was recorded.

For FSST, the subject is required to sequentially step over four canes with 90×90 cm dimensions on the ground. While the patient was facing the staff, he was asked to move forward, right, backward, left, and then, return to the same position, from home 1 to 2, 2 to 3, 3 to 4, and then, from 4 to 3, 3 to 2 and 2 to 1. They had to move the legs in a way that each house was touched by both legs. This test was repeated twice and the staff recorded the best time for each patient.

Concerning TUG, the staff put a non-armchair at a distance of three meters from an obstacle (end of the path). The patients were then asked

to perform the fastest possible and non-running ramp-up steps, walk through the specified three-meter path, rotate the obstacle, return three-meter paths, and sit on the chair. The time that the patients spent to run the path was recorded as a score. This test was repeated three times and performed with three-minute intervals between each repetition. The best time was recorded for each patient. In post-test, all measurements were repeated 48 hours after the last session of training by the same staff.

Exercise program

The progressive and supervised resistance training program with Thera-Band was designed as ACSM prescription for resistance training with Thera-Band group.²¹ The combined group also performed their training program similar to the resistance part of the resistance group with Thera-Band and core stability training for six weeks and three sessions per week.²² Resistance training with Thera-Band group performed 13 resistance trainings with Thera-Band, including leg curl, chest press, seated rows, leg extension, shoulder press, lat pull-down, elbow extension, biceps curl, thigh abduction, thigh adduction, leg press, seated calf press, and Lunge. They performed these exercises in 8 to 12 repetitions and two sets in the first and second weeks, 8 to 12 repetitions and three sets in the third and fourth weeks, and 8 to 12 repetitions and four sets in the fifth and sixth weeks. The combination program in the first three weeks consisted of eight resistance trainings with Thera- Band (thigh abduction, leg press, lat pull-down, leg extension, chest press, shoulder press, arm curl, and seated rows) and

Table 3. Patients' demographic characteristics

	Control group	Resistance training group	Combined training group
Age (year)	46 ± 7.15	46 ± 5.82	48.9 ± 7.06
Completed university	13	12	12
Employed full time (>34 hours per week)	7	9	11
BMI (kg/m ²)	25.17 ± 3.7	25.7 ± 3.9	24.6 ± 3.5
Months post-surgery	18.1	20.9	19.7

seven core stability trainings (half squat with arm movement, bicycle crunch, abdominal with adductor isometric contraction and arm movement, standing hip circumduction, alternative arm raise on the exercise ball, Swiss ball superman, oblique partial sit-up). The second three weeks comprised six resistance trainings (leg curl, chest press, seated rows, leg extension, shoulder press, and lat pull-down) and seven core stability trainings (chest press on Swiss ball with Thera-Band, squat with Thera-Band, standing hip circumduction, seated rows on Swiss ball with Thera-Band, isometric abdominal sitting on Swiss ball with arm and leg movement, biceps curl on Swiss ball with Thera-Band and sit-ups with lower limb movement). In the combined group, resistance training was performed by 10 repetitions and two sets in the first and second week, 15 repetitions and two sets in the third week, 10 and 12 repetitions and two sets in the fourth week, 10 and 12 repetitions and three sets in the fifth week, and 10 to 12 repetitions and two sets in the sixth week (Table 1). In both exercise groups, intensity was changed by PRE Burg scale and OMNI resistance exercise scale (OMNI RES) (table 2). Control group received usual treatments and no changed level of physical activity.

Data analysis

Data were described as mean (M) and standard deviation (\pm SD). Normal distribution was confirmed using the Shapiro Wilks test. Referring to the underlying data model, main effects and interactions were analyzed by two-way repeated measurements analysis of variance. Statistical calculations were conducted with the software package SPSS V.22 (IBM, Armonk, VA, USA). P -values $\leq .05$ indicated statistical significance.

Results

Table 3 shows the demographic characteristics of patients. Table 4 shows the test results in mean (\pm SD) for the four test instruments. Results showed that there were no significant effects indicating an exercise specific development depending on the type of exercise or control condition ($P > 0.05$). We did not observe any significant differences between the resistance training with Thera-Band, the combined exercise, and the control groups ($P > 0.05$).

Discussion

The present study revealed that six-week supervised resistance training with Thera-Band and combined training (resistance training with Thera-Band and core-stability training) had no significant effect on static and dynamic balance in breast cancer survivors.

To the best of our knowledge, there are no studies on the effectiveness of exercise training with Thera-Band or core-stability training on the balance status of women with breast cancer. Thus, it is difficult to compare the findings of this study with others. However, Foley and Hasson (2016) found that 12-week exercise training, including aerobic, resistance, balance, and flexibility training was able to improve balance in breast cancer survivors. The difference between our findings and theirs can be attributed to the different types and durations of exercise training.¹⁴ Reduced balance in women with breast cancer causes disturbances in the posture status and asymmetry of the trunk, which is a progressive condition. Biomechanically, mastectomy in women with breast cancer can reduce angles of the anterior pelvic rotation and increase forward trunk flexion.^{23,24} It has been confirmed that breast

Table 4. Exercise effects for the test instruments during pre- and post-tests

Test	Groups	Pre	±SD	Post	±SD	Effect	F-value	P-value
SL (second)	Thera-Band	10.2	±5.9	20.8	±9.8	group	0.077	0.926
	Combined	14.0	±11.8	19.8	±13.3	time	9.389	0.004
	Controls	16.0	±13.5	16.3	±14.0	group x time	2.756	0.074
BESS [number of error]	Thera-Band	37.2	±30.3	27.6	±11.0	group	3.156	0.051
	Combined	47.6	±20.5	33.9	±13.4	time	24.879	0.000
	Controls	60.2	±29.1	31.9	±12.4	group x time	2.841	0.067
FSST [second]	Thera-Band	8.8	±1.9	7.0	±1.2	group	2.537	0.089
	Combined	9.4	±2.2	7.2	±1.1	time	44.376	0.000
	Controls	10.2	±3.7	8.4	±2.1	group x time	0.252	0.778
TUG [second]	Thera-Band	6.5	±1.3	5.2	±0.5	group	1.351	0.268
	Combined	6.6	±1.0	5.4	±0.6	time	78.338	0.000
	Controls	6.7	±1.1	5.9	±0.8	group x time	0.976	0.383

SD: Standard deviation

surgery increases the kyphotic status and changes the posture in the sagittal level, resulting in progressive decline in balance status even years after surgery.²⁵ It seems that the exercise programs of the current study could not change the factors affecting the static and dynamic balance, including the anterior rotation angle and the tendency for trunk forward flexion. Therefore, the level of reliance was not changed and the static and dynamic balance was not improved after six weeks of training. However, further biomechanical studies are required to confirm this claim.

On the other hand, it has been reported that chemotherapy agents can disturb the vestibular systems,⁶ increase neuropathy, and reduce muscle strength in breast cancer survivors, resulting in reduced balance.²⁶ Since balance is affected by the whole body, we should consider exercises that engage the whole body and emphasize the improvement of the proprioceptive receptors. Moreover, Marsh et al. (2004) reported that balance improvement required alterations in joint receptors, rearrangements in the central nervous system and sensory integrity, and changes in motion responses improving the balance status.²⁷

In addition, it has been proven that there exists a relationship between balance status and ankle muscle strength.²⁸ In the present study, ankle muscle strength probably did not increase in either training groups, hence no improvement in static and dynamic balance. It seems that the exercise

training program in both intervention groups could not change the recruitment of fast twitch motor units, muscle coordination, ankle muscle strength and motor system function; these factors are necessary for maintaining and / or increasing the static and dynamic balance status and should be considered by future studies.

The optimal dose-response ratio to reach the positive effects of exercise on static and dynamic balance in breast cancer survivors is not clear.²⁹ Lesinski et al. (2015) reported that there were no evidence-based recommendations for effective training program, including frequency, intensity, type, and time (FITT) on balance status. On the other hand, they mentioned that an effective program of exercise training for older adults included a period of 11-12 weeks, frequency of three sessions per week, total number of 36-40 sessions, 31-45 min single sessions, and a total duration of 91-120 min of balance training per week.³⁰ Because balance impairment is progressive in breast cancer survivors, more physiological or/and biomechanical changes may be required over more sessions, times, intensities, or periods of exercise program. Future studies can clarify the optimal dosage of exercise with Thera-band or combined training for women with breast cancer.

Other mechanisms for the insignificant effects of exercise on static and dynamic balance in the present study are related to open and closed kinetic

chain movements. Kim and Yoo (2017) revealed that closed kinetic chain movements could be more useful than open kinetic movements for improving proprioceptive sense and increasing the balance.³¹ In closed kinetic chain movements, cocontraction of multimuscles and joints can increase joint stability and, in turn, improve the balance.³² Since the patients completed their treatments and one of their side-effects is reduction in bone mineral density and increased risk of fracture, in the current study, open kinetic chain movements were employed more than closed kinetic chain movements.

Statistically, we had type II error in the present study. First, the sample size was small because it was quite challenging to recruit and maintain breast cancer patients over the study period. Second, the time effect of the independent variables (six weeks and 18 sessions of exercise training versus longer periods of exercise training) on the dependent variables (static and dynamic balance) was short, which is probably one of the reasons why these variables were not significant in the present study.

One of the limitations of our research was that we did not have any control over the balance training which was done by patients outside of the exercise sessions. Indeed, the age range of patients was very wide (29-65 years) in the current study. Iverson et al. (2008) revealed that age was correlated with BESS, being consistent across ages until 50 years.³³ Another limitation was that the present study was un-blinded because patients were told test scores after each effort in the pre- and post-test. This can explain the improvements in static and dynamic balance in all patients of three groups, even in the control group without any training. Therefore, we recommend that future researchers conduct similar projects with larger sample sizes and longer exercise periods, control over outside balance exercise, limited patient age, and blinded design.

Conclusion

It can be concluded that six-week resistance training with Thera-Band and combined training

(resistance training with Thera-Band and core-stability training) has no positive effects on static and dynamic balance in breast cancer survivors, hence the necessity for future studies.

Conflicts of Interest

None declared.

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