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Virtual reality balance training versus core stability exercises on balance in patients with unilateral lymphedema

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Abstract---Purpose: The purpose of this study is to compare the effects between Wii fit balance board and core stability exercises on balance dysfunction in patients with unilateral lymphedema. Method: Sixty patients (women) aged 40-60 years with grade 1 or 2 lymphedema were randomly assigned into the following two groups. Group A received the Wii fit balanced exercises for three times per week for four weeks as total treatment duration in form of (Ski Slalom, Advanced Skiing, Ski Jumping followed by Header and Jump Rope).; Group B received core stability exercises for 4 weeks (3times/week) in form of {1- Abdominal bracing (10 repetitions x10 second holds), 2- Curl up (3 sets x 10 repetitions), 3- Supine bridge (3 sets x 10 repetitions), 4- Supine unilateral bridge (3 sets x 10 repetitions for each leg), 5- Plank (3 sets x 10 repetitions) and 6- Bird dog (3 sets x 10 repetitions for each limb)}. Balance was determined using time up and go (TUG) and Wii fit results by using the Wii fit balance board. Balance was measured before and 4 weeks after the treatment program. Results: The within-group analysis showed significant differences in TUG within Groups A and B before and after the treatment program ($p < 0.05$), significant differences in Wii fit within groups A before and after the treatment program ($p < 0.05$) and non-

significant differences in groups B before and after the treatment program ($p > 0.05$). The between-group analysis showed significant differences in TUG after treatment ($p < 0.05$), with non-significant differences observed in Wii fit after treatment ($p > 0.05$). Conclusion: Wii fit balance exercises are effective more than core stability exercises in the treatment of balance dysfunction in patients with unilateral lymphedema.

Keywords---core stability exercises, lymphedema, Wii fit balance board.

Introduction

Lymphedema involves abnormal accumulation of fluids and proteins in the intercellular space, chronic inflammation and edema.¹ The expanded limb volume in the impacted side contrasted with the typical arm makes it weighty and snugness causing restriction in fine adjusting development of the upper limb.² The awry stacking of the furthest points brings about COG removal towards the impacted side and expanded postural influence.³ Keeping up with balance is a complicated capacity including visual, vestibular and somatosensory contribution just as suitable muscle action to keep up with the body's COG over its base of support during static and dynamic undertakings.⁴

Core muscular structure incorporate muscles of the trunk and pelvis are liable for keeping up with stability of spine and pelvis.⁵ The core stabilization's mechanism incorporates three related subsystems which are passive, active and neural control. Nobody subsystem acts separate from one more to keep up with strength, a nonstop communication among the three subsystems is required. So a steady and strong center adds to more proficient utilization of the upper and lower furthest points as center is vital to practically all motor chains in our body. Along these lines, center strength boosts generally active chains of upper and lower limb work, which is fundamental to giving a strong base enough to apply or oppose power.⁶

The Wii Fit balance board is a balance assessment and treatment apparatus with high validity and the scientists suggested it as an elective instrument for evaluating balance capacity.⁷ Wii Fit exercises are intended to further develop balance, high-impact limit and strength and are shown on a TV screen as the client interfaces with the program utilizing a remote controller and equilibrium board.⁸

To the best of our knowledge, studies determining the effect of Wii fit balance board on one-sided post mastectomy lymphedema have not yet been conducted. Hence, the current study aimed to compare the effects between Wii fit balance board and core stability exercises on balance for one-sided post mastectomy lymphedema and contrast between them with decline the monetary and mental effect on people and their families care, as well as figuring out an exercise-based recuperation approach that has beneficial outcome in treating such cases which would upgrade the active recuperation field.

Methods

Design

This study was a randomized controlled trial conducted at the Physical Therapy Department at the National Cairo Institute in Egypt and in the Outpatient MG clinic from November 2020 to November 2021.

Ethical Approval

The protocol of this study was approved by the ethical committee of the Faculty of Physical Therapy, Cairo University, Egypt (No: P.T.REC/012/002691).

Subjects

Sixty female patients with unilateral post mastectomy lymphedema have participated in this study, with age ranged from 40-60 years were randomly assigned into two equal groups after they provided informed consent. Randomization was performed using a sealed envelope. Before the study started, a therapist gathered the 60 patients who met the inclusion criteria, and each patient was instructed to select one of the sealed envelopes. There were 60 sealed envelopes, and 30 of this enveloped group (A), 30 group (B). Hence, the total number for each group was obtained.

All subjects received their complete decongestive therapy in form of exercises, manual lymph drainage (MLD), bandaging and skin care as a routine physical therapy. Group A received the Wii Fit balance board program. Group B received the core stability exercise. The inclusion criteria were as follows: (1) Patients aged 40 to 60 years. (2) Patients had undergone modified radical mastectomy with axillary lymph node dissection. (3) The inter limb volume difference was at least 5%, which was calculated by the truncated cone formula. (4) Patients with stage I or stage II lymphedema, according to the International Society of Lymphology classification system.⁹ (5) Patients Weights were ranged from (60kg – 90 kg) and heights from (150cm – 175 cm). The exclusion criteria were as follows: (1) Patients with visual or hearing impairment. (2) Patients with Previous breast cancer surgery on the present or contralateral side. (3) Patients with Active or metastatic cancer focus. (4) Patients with Upper extremity ROM limitation before the surgery. (5) Bilateral lymphedema. (6) Patients with Venous thrombosis.⁹

Material

Evaluation

All assessments were performed by a therapist before and after the treatment programmed. Balance was measured using the Wii fit balance board which (Mac OS X v10.4, Nintendo, Japan) and time up and go (TUG) test before and after four weeks of treatment. The time of measurement was about 10 min. In this study, each patient was instructed to stand on the Wii fit balance board that measure the COP results for all cases before and after four weeks of treatment. The balance board estimated the level of pressure contributed by the left and right

half of the body. In a perfect world, each side of the body will contribute half of the strain applied onto the board; along these lines, the ideal COP proportion is 50/50 or 1.00. ¹⁰ The Wii fit balance board is considered a valid and reliable tool in the assessment of balance. ¹¹ Also balance was measured by TUG test where the time is taken when the patients ascend from an easy chair, walk 3 meters as quick as could really be expected, cross a line on the floor, turn, walk back and sit down once more. Subjects who take longer than 14 seconds to finish the TUG have a higher danger for falls. ¹² The time of measurement was about 10 min.

Interventions

Wii fit balance board. Composed of Hardware which comprised of a regular PC, a 10" LCD screen and a Wii Fit balance board. The correspondence between this device and the screen was set up by means of Bluetooth convention. Along these lines, the activities run on a PC and the framework utilized the WBB as interface ¹³ as shown in Figure 1. A platform has sensors that action weight and center point of gravity ¹⁴ as shown in Figure 3. The software is Darwiin Remote (Mac OS X v10.4, Nintendo, Japan). The average displacement of the center of gravity was determined to assess the equilibrium status. The force plate has 4 strain gauges and can measure the tension got from changes in posture and was associated with a PC screen. ⁷ The center of gravity point can be shown on the screen to give a client visual input and to gauge the equilibrium status. The four sensors yet to be determined board can detect weight changes and show the distribution of body weight. The 4 sensors measure weight and the information can be added to get the body loads of individual clients. The information can be sent to a PC utilizing Bluetooth ⁷ as shown in Figure 2. The Wii fit balance board exercise. For each session, group A received the Wii fit balanced exercises for three times per week for four weeks as total treatment duration in form of (Ski Slalom, Advanced Skiing, Ski Jumping followed by Header and Jump Rope) as shown in Figure 3.



Figure 1. Wii Fit balance board



Figure 2. The top of the balance board



Figure 3. The patient playing with the system

The core stability exercise. For each session, group A received the following core exercises three times per week for four weeks as a total treatment duration: 1- Abdominal bracing (10 repetitions x 10 second holds), 2- Curl up (3 sets x 10 repetitions), 3- Supine bridge (3 sets x 10 repetitions), 4- Supine unilateral bridge (3 sets x 10 repetitions for each leg), 5- Plank (3 sets x 10 repetitions) and 6- Bird dog (3 sets x 10 repetitions for each limb). Every exercise was followed by an equal period of relaxation depending on the participant's demonstrated ability. Facilitation techniques were used (pelvic floor contraction, visualization, palpation or identifying substitution patterns like pelvic tilt). Progression: Advance if subjects were able to perform 30 repetitions with 8 s hold. ¹⁵

Results

Statistical analysis was performed using nonparametric tests for within group differences (Wilcoxon Signed Rank Test) and between groups differences (Mann-Whitney U Test). Information was introduced as median and interquartile range (IQR). Chi-square test was utilized for testing between group differences in impacted side and stage of Lymphedema. Wii fit balance score was dissected as one variable (Right/Left) as a symmetry index (balance of weight bearing increment as score approaches one).

Patient characteristics

As shown in Table 1, descriptive and analytical statistics showed no statistically significant difference between the two groups in age, BMI, side of injury, stage of lymphedema, time after operation (0.74, 0.49, 0.78, 0.284, and 1, respectively).

Table 1
General and baseline characteristics of patients in the two groups

Demographic and clinical data	Group A	Group B	p-value
Age (years)	52.5(7.5)^	52 (7)^	0.74
BMI (Kg/m ²)	27.25 (3.75)^	27 (3)^	0.49
Side of Injury (count Rt/Lt)	16/14	15/15	0.78
Stage of Lymphedema			
Stage I (count)	13	9	0.284
Stage II (count)	17	21	0.284
Duration after Operation (Month)	3 (2)	3(2.5)	1

(^): median (IQR)

As shown in Table 2, there were no statistically significant differences between the two groups in TUG pre-treatment values ($p > 0.05$).

Table 2
Descriptive and analytical statistics of TUGT pre in both groups

	Group A	Group B	Test statistic value	p-value
Timed up and go test pre	27(3.25)^	27(3.5)^	418	0.64

(^): median (IQR)

As shown in Table 3, Groups A and B showed statistically significant difference between pre- and post-treatment values of TUG test ($p < 0.05$).

Table 3
Pre- and post-treatment values of TUGT in group A and B

TUGT (PRE-POST)	Pre Median (IQR)	Post Median (IQR)	% of change	Test statistic	P-value
Group A	27(3.25)	16.5(4)	39	-4.9	0.000*
Group B	27(3.5)	20.5(3.5)	24	-4.5	0.000*

(*): significant at $P\text{-value} < 0.05$.

As shown in Table 4, there were statistically significant differences between the two groups in post-treatment in the TUGT values ($p < 0.05$).

Table 4
Post-treatment values of TUGT in both groups

TUGT Post (study vs. control)	Median (IQR)	Test statistic	P-value
Group A	16.5(4)	821	0.000*
Group B	20.5(3.5)		

As shown in Table 5, there were no statistically significant differences between the two groups in Wii fit pre-treatment values ($p > 0.05$).

Table 5
Descriptive and analytical statistics of WF pre in both groups

	Group A	Group B	Test statistic value	p-value
Wii balance test pre	1.44(1.22)^	0.991(1.27)^	420	0.66

(^): median (IQR)

As shown in Table 6, Group A showed statistically significant difference between pre- and post-treatment values of Wii fit score ($p < 0.05$). Group B showed no statistically significant difference between pre- and post-treatment values of Wii fit score ($p > 0.05$).

Table 6
Pre- and post-treatment values of WF in group A and B

Wii Balance score	Pre Median (IQR)	Post Median (IQR)	% of change	Test statistic	P-value
Group A	1.44(1.22)	1(.3)	30.6	-2.6	0.009*
Group B	0.991(1.27)	1.07(0.82)	8	-1.7	0.094

(*): Significant at $P\text{-value} < 0.05$

As shown in Table 7, there were no statistically significant differences between the two groups in post-treatment in the Wii fit values ($p > 0.05$).

Table 7
Post-treatment values of WF in both groups

Wii Balance score post (study vs. control)	Median (IQR)	Test statistic	P-value
Group A	1(0.3)	470	0.76
Group B	1.07(0.82)		

Discussion

This study was conducted to determine and compare the effects between the Wii fit balance board and core stability exercise on the balance dysfunction of unilateral lymphedema. According to our results, there was a statistically significant difference in TUG and that the Wii fit improve balance more than core stability exercise without statistically significant difference between them. Our results were consistent with the results of Verhagen et al.¹⁶ The all-out region over which the center of pressure moved was diminished after the augmented experience preparing, proposing that the equilibrium capacity of the subjects had moved along. The deviation of the COG relies upon proprioceptive data, the vestibular framework and visual signs. For an individual to keep up with balance without influencing in a standing position, the COG of the body should stay inside the foundation of help laid out by the development of the COG.¹⁷

To the best of our knowledge, this is the first study to assess the effects of Wii fit balance board on balance of unilateral lymphedema. Moreover, according to the current study, the Wii fit balance board showed improvement on balance of unilateral lymphedema and this finding is consistent with that of McManus et al.¹¹ who confirmed that the Validity and reliability make the Wii Fit program a reasonable choice for such patients. Moreover, there is a rising utilization of virtual activities as another physiotherapeutic asset with serious level of adequacy with respect to patients in regards to such activities.¹³ Additionally, the Virtual reality preparing is a protected and valuable device for improving the sensorimotor elements of patients.¹⁸ This finding is consistent with the finding of Cho et al.¹⁹ who expressed that there was a huge improvement in TUG in patients with augmented reality training.

Similarly, the Nintendo Wii fit program addresses an available, fun and efficient strategy which can assist with working on the equilibrium.¹⁹ Furthermore, consequently, the possibility of carrying out this preparing program at home is high. This permits potential for long haul adherence to a preparation program outside of the review and may prompt longer maintenance of any improvement from the instructional courses.²⁰ Additionally, the Positive changes on personal satisfaction after practice preparing with Wii Fit program.²¹ Similarly, The Wii Fit balance board is not difficult to control, as of the development regulator in playing computer games. This mental experience might have been reflected in the aftereffects of progress.²²

Contrary to our results, there were assessed twelve healthy older adults as they were divided into two groups. The experimental group completed training using Nintendo's Wii Fit game three times a week for 3 weeks while the control group continued with normal activities. Four clinical measures of balance were assessed before training, 1 week after training, and 1 month after training: Berg Balance Scale (BBS), Fullerton Advanced Balance (FAB) scale, Functional Reach (FR), and Timed Up and Go (TUG). Results showed that there was no significant improvement in FAB, FR, or TUG for either group. This contradiction may be due to expanding their training time and their sample size.²³

Conclusion

Wii fit balance exercises are effective more than core stability exercises in the treatment of balance dysfunction in patients with postmastectomy unilateral lymphedema.

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