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Improvement in balance in patients with chronic low back pain using trunk balance exercises and Wii Fit™ balance exercises

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Abstract

Low back pain is a major public health problem all over the world. Many different therapeutic interventions are used in the management of low back pain. In the present study, two weeks interventions (10 sessions in all) with trunk balance exercises plus short wave diathermy plus flexibility exercises were given to 15 patients and two weeks interventions with Wii Fit™ balance exercises plus short wave diathermy plus flexibility exercises were given to another 15 patients with chronic low back pain. A total of 30 purposively selected confirmed cases of chronic low back pain aged 30-50 years were considered for the present study. The samples were collected from the DAV Institute of Physiotherapy and Rehabilitation, Jalandhar, India. The subjects were divided into two groups for intervention. Group A consisted of 15 subjects who were to perform the trunk balance exercises plus short wave diathermy plus flexibility exercises. Group B consisted of 15 subjects who were to perform the Wii Fit™ balance exercises plus short wave diathermy plus flexibility exercises. Statistically significant differences ($p < 0.013-0.001$) were found in balance (after treatment) between the patients treated with trunk balance exercises and Wii Fit™ balance exercises. Though patients treated with WiiFit™ balance exercises had the increment of 95.50% in one leg stand test (eyes open) as compared to 71.13% with trunk balance exercises and the increment of 111.57% in one leg stand test (eyes closed) in patient treated with Wii Fit™ exercises as compared to the increment of 102.08% in patient treated with trunk balance exercises. It might be concluded from the present study that, both the interventions, such as trunk balance exercises and Wii Fit™ exercises were proven equally effective for improving balance in patients with chronic low back pain, though Wii Fit™ exercises group was proven to be more effective.

Keywords: Balance, chronic lowback pain, trunk balance exercises, Wii-Fit™ balance exercises

Introduction

Low back pain is universal and has been referred to as a 'twentieth century healthcare disaster' [1]. The annual prevalence of low back pain ranges from 15-40%, with point prevalence averaging 30% [2]. Recent evidence showed that while age is a major determinant for balance, low back pain might account for up to 9% of the variance in balance [3]. Persons with chronic low back pain have been observed to have altered lumbosacral proprioceptive acuity, dysfunction in trunk muscle control and altered postural balance [4].

People with chronic LBP need more time and a greater number of postural adjustments to regain postural equilibrium [5]. Balance deficits in individuals with chronic low back pain have been demonstrated through increased displacement of the center of pressure while standing upright and greater medial-lateral postural sway [6, 7].

Chronic low back pain reduces muscle strength, endurance, flexibility and balance. Physiotherapy interventions include stretching, strengthening, core stabilization, mobilization, manipulation along with electrotherapy modalities like shortwave diathermy, ultrasound, TENS, IFT, traction and low level laser therapy can decrease pain and disability but has Limitations in increasing balance and motivation for exercise programs [8, 19].

Trunk balance exercises are balance exercises focusing on restoring balance by targeting the feedback control mechanism [20]. Evidence shows that treatment programs aimed at improving trunk muscle control through core balance exercises lead to significant improvements in pain and disability in patients with chronic low back pain [20].

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The majority of chronic low back pain (CLBP) studies have focused on the trunk solely. A measure of whole body performance is balance and by challenging the three balance systems their contribution to balance control can be studied. Vestibular input is challenged by tilting the head backwards (Brandt *et al.*, 1986) [21]; proprioception by changing the support surface compliance (eg. Metal versus foam); and visual input by open versus closed eyes [22]. Hence treatment can be focused on challenging the three balance system through the trunk balance exercises.

The Nintendo Wii console is an instrument of biofeedback-based exercise. As a wide range of balance impairments exists in chronic low back pain patients, The exercises should be targeted to improve the balance for which Wii Fit™ balance board can be used [22]. Recently, the Nintendo Wii Fit™ exercises program has been used for therapeutic effect in various populations such as stroke [23], cerebral palsy [24], Down syndrome [25], Parkinson's patients [26] and elderly [27] and shown to improve cognitive function, balance ability, and visual perception in various populations by focusing on maintaining centre of balance.

Very few literature is available on the effectiveness of trunk balance exercises and Nintendo Wii Fit™ balance exercises in controlling balance in patients with chronic low back pain: Thus, the present study was planned. The objective of this study was to see and compare the effects of trunk balance exercises and Wii Fit™ balance exercises in terms of balance in patients with chronic LBP.

Materials and Methods

Subjects

The present cross-sectional study was based on purposively selected 30 confirmed cases of chronic low back pain aged 30-50 years. The samples were collected from the DAV Institute of Physiotherapy and Rehabilitation, Jalandhar, India. The subjects were divided into two groups for intervention. Group A consisted of 15 subjects who were to perform the trunk balance exercises plus short wave diathermy plus flexibility exercises. Group B consisted of 15 subjects who were to perform the Wii Fit™ balance exercises plus short wave diathermy plus flexibility exercises. The study was approved by the Institutional Ethics Committee.

Interventions Given to Group-A

In this group, trunk balance exercises plus short wave diathermy plus flexibility exercises were given.

Trunk Balance Exercises

A total of 15 patients performed the trunk balance exercises kneeling on a pillow with rotation of the trunk, head and upper limbs to 1 direction, Kneeling on a pillow, moving of the upper limbs in flexion and extension, In quadruped position, extend opposite upper and lower limbs and in supine

position, lift the pelvis up with one limb hip and knee extension. Each exercise was challenged by maintenance for 30 seconds hold, total of 5 minutes for each exercise plus changing the support base (couch or pillow), closing eyes and then head and limbs movements [20].

Interventions Given to Group- B

In this group, Wii Fit™ balance exercises plus short wave diathermy plus flexibility exercises were given.

Wii Fit™ Balance Exercises

For the Wii Fit™ balance training, the Nintendo standardized video games were used. The subjects stood on the Wii Fit™ balance board and shifted their weight in medial, lateral, anterior or posterior directions according to balance game. In soccer heading, the participants moved their head from side to side. In ski slalom, shifted their body weights form side to side. In ski jump and tightrope walk, the participants had jumps by bending and extending their knees to avoid dynamic obstacles. In penguin slide, the participants balanced their weight form side to side. All the games were played in respected order for 5 min per game. Balance games in the 1st week were- soccer heading, ski slalom, ski jump, tightrope walk. In 2nd week soccer heading was replaced with Penguin slide [28].

One Leg Stand Test

One leg stand test measures the time (in seconds) a person is able to maintain balance standing on one leg, separately with eyes open and eyes closed. The average of the 3 trials was recorded for each with eyeopen and eyes closed. At least 5 minutes of rest were allowed between each trial set to avoid fatigue. The One Leg Stand Test can be used to test postural balance in patients with chronic low back pain, as the reliability of the test was acceptable [29].

Statistical Analysis

Standard descriptive statistics (mean±standard deviation) were determined for the variables. One way ANOVA was tested followed by Bonferroni post-hoc test. Data were analyzed using SPSS (Statistical Package for Social Science) version 20.0. A 5% level of probability was used to indicate statistical significance.

Results

Table 1 showed the descriptive statistics of OLST (EO) in patients treated with trunk balance exercises and Wii Fit™ balance exercises. One way ANOVA showed statistically significant between-group differences ($p<0.001$) among them. The descriptive statistics of OLST (EC) of both the groups were shown in table 2. Once again, statistically significant differences ($p<0.001$) were found among them.

Table 1: Descriptive statistics of one leg stand test (eyes open) scores (in %) in patients treated with trunk balance exercises and Wii-Fit™ balance exercises

Conditions	Group - A			Group - B		
	Mean	SD	F-value	Mean	SD	F-value
Day-1	25.98	8.280	94.64 ($p<0.001$)	19.13	10.676	112.36 ($p<0.001$)
Day-5	35.86	9.356		29.49	13.450	
Day-10	44.46	10.719		37.40	15.937	

Table 2: Descriptive statistics of one leg stand test (eyes closed) in patients treated with trunk balance exercises and Wii-Fit™ balance exercises

Conditions	Group – A			Group - B		
	Mean	SD	F-value	Mean	SD	F-value
DAY-1	5.78	4.664	13.30 ($p<0.001$)	3.11	2.217	59.01 ($p<0.001$)
DAY-5	8.89	4.987		4.49	2.264	
DAY-10	11.68	7.114		6.58	2.308	

Discussion

Chronic low back pain (CLBP) is increasingly recognized as a complex syndrome with multifactorial etiology [29]. Many different therapeutic interventions are used in the management of low back pain. For clinicians, researchers and policymakers, it is important to be able to determine the most appropriate treatment. In the present study, two weeks interventions with balance exercises such as trunk balance exercises and Nintendo Wii-Fit™ balance exercises were given to all the patients with chronic low back pain. Statistically significant differences ($p<0.001$) were found between trunk balance exercises and Nintendo Wii-Fit™ balance exercises in one leg stand test (eyes open) -after treatment (table 1), showing the balance increment of 95.50% in patient treated with Wii-Fit™ balance exercises. Whereas, highly significant differences ($p<0.001$) also were found between in one leg stand test (eyes open) before and after treatment, showing the balance increment of 71.13% in patients treated with trunk balance exercises. So far one leg stand test (eyes closed) score was concerned, highly significant differences ($p<0.001$) were found between before and after treatment, showing the balance increment of 111.57% in patients treated with Wii Fit™ exercises as compared to increment of balance up to 102.08% in patients treated with trunk balance exercises. Therefore, both the exercises, such as trunk balance exercises and Wii Fit™ balance exercises were proven equally effective for improving balance in patients with chronic low back pain, though Wii Fit™ balance exercises took the upper hand (due to their greater increment percentage both in eyes open and eyes closed position).

In the Trunk Balance exercises, the first mechanism possible for this difference may be increased sensitivity at the receptor level in visual (closing eyes), somatosensory (pillow placement) and vestibular sensory levels (tilting head) [29]. Along with these, there is sufficient evidence to demonstrate that the balance or postural stability is improved when the sensory information is manipulated or reduced [21].

Mechanism for increase in balance in Wii Fit™ balance exercises is that these programs reduce postural sway by providing specific immediate visual feedback and visual input as a feed-forward mechanism. At the same time these games improve dynamic balance and trunk control through right and left transfer of body weight and perturbations [30, 31].

The limitations of the present study were small sample size and study limited to 10 intervention sessions only plus absence of a follow-up beyond the termination of the intervention period. More extensive study is required to validate the data.

Conclusion

It might be concluded from the present study that, both the intervention, such as trunk balance exercises and Wii-Fit™ balance exercises were proven equally effective for increasing balance in patients with chronic low back pain, Wii-Fit™ balance exercises was more effective, hence such interventions can be considered as part of rehabilitation in chronic low back pain.

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