Effect of I-balance Training on Balance Performances among Elderly with Diabetic Peripheral Neuropathy: A Case Study

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Abstract

Falls is a major concern for elderly with diabetes peripheral neuropathy (DPN). Declines in sensory function caused by neuropathy may lead to increased risk of falls among elderly and associated with poor balance performances. Walking and turning requires integrated multiple system that includes sensorimotor, functional, and attention functions. However, any alteration in this system will impaired the gait parameters. An elderly need a cost-effective training to restore their upper and lower extremities strength and balance performances in order to reduce the risk of falling. This case illustrate the effectiveness of I-balance training for elderly who experienced DPN with fear of falling.

Key words: *Balance training, diabetic peripheral neuropathy, elderly*

Introduction

Globally, there was about 136 millions of diabetes mellitus cases that involved an elderly more than 65 years old[1]. Surprisingly, this number keep on increasing and become one of the burden to the society. Those elderly who suffered from DM also had serious and significant complications such as diabetic peripheral neuropathy (DPN) due to their long term diabetes [2-4]. Nerve damage and apoptosis will be occurred due to glucose toxicity is a common cause of peripheral neuropathy [4-6]. Therefore, elderly who suffered from DPN may complaints of numbness and pain over their lower extremities [5-6].

Decline in this somatosensory function caused body inefficiently detect changes in balance performances among elderly, will predisposing them to high risk of falls [5-6]. Alteration in static and dynamic balance instability cause by impaired in joint sense of hip and ankle also became a major limitation for an elderly to maintain their balance performance, especially during daily activities [7-9]. A well-balanced in sensorimotor, functional, and attention functions during walking performance is needed for an elderly. Therefore, for rehabilitation purpose, those elderly needs a comprehensive balance training that includes dual task, attractive and mimic their functional activities.

The following case study demonstrates the effectiveness of I-balance training on balance performance among elderly with diabetic peripheral neuropathy.

Case Presentation

AF is a 67 years old man who had been diagnosed as diabetic peripheral neuropathy (DPN) and been refereed to physiotherapy. He complained of tingling sensation over his bilateral foot, since two months ago. His tingling sensation was aggravated during prolong walking and standing. Recently, the tingling sensation over bilateral foot getting worse and became constant. He also complained that sometimes he might off balance. Due to that, he had experienced a few incidence of fall. He also had underlying disease of hypertension,

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dyslipidemia and diabetes mellitus more than 5 years and under follow up with the doctor. He is a retired teacher, currently stayed in double-storey house with his wife, three son and one daughter. He loved travelling for vacation. Previous morbidity, he able to walk independently without any limitation or walking aids. He understand that the tingling sensation over his foot is due to his diabetic problem. He hope that he can able to walk as usual as before.

Physical examination

AF is a mesomorph-sized man came to the physiotherapy department by using walking stick accompany by his wife with slow gait. Based on his facial expression he look tired and sweaty as he claimed that he need to walk from car park to physiotherapy department approximately around 2 km and he stop a few times because his foot getting numbness.

On local observation, there is no swelling and no redness noted over bilateral foot. On palpation, there is no increase in temperature and tenderness. AF had sensation impairment based on vibration perception test at great tone using 128-Hz tuning fork done to him by qualified medical officer. He had decreased vibration perception over his great toe. There is no limited ankle range of motion based on measurement by goniometer. Unfortunately based on muscle length test, noted that AF has minimal muscle tightness over bilateral calf. Based on special test Tinel's sign performed to him, there is no nerve entrapment involvement in his case. On clearing test over proximal joint, which is knee and hip, there is no abnormal finding detected.

As this patient complaints he might off balance sometimes during prolong walking and standing, the Berg Balance Scale (BBS) had been used as outcome measure to evaluate balance in his first, second and third physiotherapy sessions. BBS is a performance based measure which consists of 14 items that included sitting balance, standing balance, step up on a stool, tandem step, standing on one leg any many more that are valid and practical for elderly[10].Total score for BBS is 56. The scores 41-56 means independent, 21-40 means walking with assistance and 0-20 means wheelchair bound [10].On first session's total score for AF is 40/56.

The second outcome measure for this patient is Timed Up and Go (TUG) test. This TUG test is used to assess mobility and predict risk of fall in elderly [11]. This test was carried out by patient sit on the chair, get up, walk for 3 meters and return back to the chair. Time taken by patient to complete this test was recorded. On first sessions total time taken for AF to complete this test is 18 seconds. This indicate that AF has high risk of fall.

The third outcome measure for this patient is 5-times sit to stand test. This test is used to measure lower limb strength [12]. First, patient need to sit on the chair, stand up and sit down for 5 repetitions. For the first session, AF scored 15.5 seconds. This indicate that AF had poor strength for his lower extremities. Refer Table 1.0 for summary of the findings.

Table 1.0 Summary of Findings Derived from AF's Physical Examination.

Assesment Variables (OM)	First session	Second session	Third session
Range of motion 13	Both ankle active full range of motion	SAP	SAP
Muscle length Test 14	Bilateral calf muscle tightness	-	-
Special Test			
Tinel's Sign Test 15	NAD	-	-
Sensation Test			

Cont... **Table 1.0 Summary of Findings Derived from AF's Physical Examination.**

128-Hz tuning fork (Confirmed by medical doctor)	Impaired	-	-
Balance and Mobility Performances			
Berg Balance Scale 10	40	47	50
TUG Test 11	18 secs	14.3 secs	11.5 secs
Lower Extremities Strength			
5-times sit to stand test 12	15.5 secs	13 secs	11.5 secs

* Note: Same as previous = SAP; NAD = No abnormality detected

Assessment Findings

The analysis of this patient problems were discussed according to International Classification of Functioning, Disability and Health (ICF) [16]. The impairments were (i) bilateral calf muscle tightness, (ii) impaired sensation and balance of bilateral foot, and (iii) reduced lower limb strengths. This may leads to difficulties to prolong standing and walking. Thus, resulted in interferes with his participation restriction, which is difficult for travel. His short term goals are to improve flexibility of calf muscle within 3 weeks, improve strength of lower limb within 6 weeks and improve balance performance within 7 weeks. His long term goal is to regain optimum functional activity.

Discussion

Stretching training

During the first session of physiotherapy, there was bilateral calf muscle tightness had been noted on AF. Therefore, AF had been prescribed a calf stretching exercise in his first session of physiotherapy. Stretching exercise helps in improving extensibilities of soft tissues[17].

Strengthening training

AF lower limb strength had been assessed using Five Times Sit to Stand Test (FTSS). Unable to complete the test less than 12 seconds is associated with increased risk of fall and weakness of lower extremities [18-19]. During first session of physiotherapy, AF take 15.5 seconds to complete his FTSS. This indicate that AF had reduced strength of lower limb. Thus, AF had been prescribed with sit to stand exercise as a strengthening exercise, for 15 repetitions, 3sets, 3 times per week. Strengthening exercise helps in improving muscle mass and increased in muscle strengthening [20].

Balance training

Balance and mobility performance for AF was assessed using Berg Balance Scale and Timed Up and Go (TUG) test. This test is used to evaluate balance and predict risk of fall. Balance is defined as the ability to remain or return the body's centre of gravity within the base of support [21]. Balance is a complex skill that requires the integration of multiple sensorimotor and cognitive processes. Most of elderly with DPN commonly had a muscle loss and osteoporosis. Thus, the balance training must be in simple and safe, easy to follow and low to moderate intensity. This is to avoid harmful and trauma to the elderly during exercise.

Lower resistance and low intensity exercise with involvement of all major muscle is a form of exercise recommended for elderly with DPN. In order to improve motivation for elderly to engage in exercise, the exercise program must be interesting and cost-effective. Collective form of exercise, exercise along with music and home based exercise found to increase adherence of elderly [22-23]. Moreover, involving dual tasks in balance training found to improved balance performance [24]. Therefore, the 'I-balance' training for AF seems to provide superior effects for improving overall strength and balance performance, and increase quality of life.

I-balance training module comprises of two phases. For beginning phase (i) Forward tandem walk, (ii) Reversed walking, (iii) Sideway walking and (iv)

3-meters turning walk, and (v) Clock reach. While for advance phase, (i) Forward tandem walk with head movement, (ii) Reversed tandem walk with counting backwards, (iii) Sideway walking with holding a glass of water, (iv) 3-meters turning walk with holding a glass of water and (v) Clock reach add on 1 pound weight cuff at wrist.

Conclusion

The 'I-balance' training programme found to be effective training in enhancing balance performances among elderly with DPN. This training programme involved dual and cognitive task training, turning mechanism and mimic daily functional activity. This I-balance may be incorporate with other strength and flexibility training act as multi-components in designing an exercise for elderly.

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