Effectiveness of Otago Exercise Program on Reducing the Fall Risk in Elderly: Single Case Report

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Abstract

Objectives- To find out the effectiveness of Otago exercise on reducing the fall risk in elderly

Design- Single case study

Setting- Out Patient Department and at home

Participants- A single individual with fall risk participated in this study

Methodology- Interventions used in this study included Otago Exercise Program which included strengthening exercise, balance re-training and walking. The interventions were given for 8 weeks. The outcome measures were 30 Second Chair Stand Test, Four-Stage Balance Test, Timed Up and Go test and Berg Balance Scale. The outcome measures were taken on first day, last day of 4th week and 8th week.

Results- The scores of 30 Second Chair Stand Test, Four-Stage Balance Test, Timed Up and Go test and Berg Balance Scale were improved

Conclusion- Otago exercise program can be used for elderly with fall risk.

Keywords- fall risk, otago exercise, 30 Second Chair Stand Test, Four-Stage Balance Test, TUG.

INTRODUCTION

The major problems in the elderly are falls and they are considered one of the “Geriatric Giants”. Recurrent falls are an important cause of morbidity and mortality in the elderly and are a marker of poor physical and cognitive status. Most often the cause of fall is multifactorial. Falls and their sequelae are potentially preventable and hence the risk factors for falls plays an important role in the elderly.1,2 According to the World Health Organization global report on fall prevention in older age, risk factors for falls involve biological, environmental, behavioral, and socio-economic factors. In Indian adults older than 70 years, intrinsic causes for falls and recurrent falls are the most likely factors. Biological (intrinsic) risk factors include sex, race and age-related declines in strength, balance, vision, cognition, and chronic diseases. The most common predictors of falls are abnormalities of gait or balance and a history of fall in the past year. Compared with elderly without a history of falls, elderly with a history of fall have decreased lower limb strength, impaired balance and functional mobility, decreased balance confidence, and more co morbidities.2,3 A recent study has shown that the risk of falling increases in proportion to the severity of chronic musculoskeletal pain, the number of joint groups affected, and the amount of interference with daily activities.3 Fear of falling is mentioned frequently as an adverse outcome of falling, little is known about it. The individuals at risk of developing fear of falling can be identified and fear of falling proves to be an independent factor in functional decline.2 The intervention by American Geriatric Society guidelines for prevention of falls are exercises, environmental modification, medications, assistive devices, behavioral and education program other interventions included are bone strengthening medications, cardiovascular intervention, visual intervention, footwear intervention.5,6,7

A CDC Compendium of effective fall interventions are Stay Safe, Stay Active, The Otago Exercise Program, LiFE (Lifestyle approach to reducing Falls through Exercise, Erlangen Fitness Intervention, Senior Fitness and Prevention (SEFIP), Adapted Physical Activity Program, Tai Chi, Australian Group Exercise Program etc. 8,9

The Otago Exercise Program (Otago) is an individually tailored, home-based, balance and strength fall prevention program. The program was developed by Professors John Campbell, MD, FRACP, and Clare Robertson, PhD, researchers at the University of Otago in Dunedin, New Zealand and the New Zealand Falls Prevention Research Group, in response to the frequency and severity of fall injuries among elderly in New Zealand. Otago is a leg muscle strengthening and balance retraining program delivered at home.10

The Otago exercise program was selected because of following reasons firstly it is a home- based and individually tailored fall prevention program. As
the socioeconomic status of the patient living in rural area in low or middle class, they cannot afford the travelling expenses as the hospital is far away from their homes. Secondly as these are old persons, they may need assistance or some family members with them while coming for taking treatment.

CASE DESCRIPTION
The patient 74 year old male was referred for the complaint of fear of fall by physician. The case was attended by Physiotherapist.

Patient history: Patient lives at home with 69 year old wife, 2 sons married. He had complained restriction of activities, low confidence and fear of falling since 15 days. There is history of one fall in the past year at home, but didn’t have any bleeding or fracture. He has history of hypertension since one year and type 2 diabetes four years which was controlled by diet and medications. Personal history was patient had no Addictions, sleep was unaltered, bowel and bladder were unchanged. The socioeconomic status according to modified kuppuswamy scale was lower middle class. The environmental history consisted of cemented house, 3 rooms, 5 stairs at entrance, slippery and uneven surfaces, Indian toilet. Vision was checked by an ophthalmologist, it was normal. Patient uses no mobility aids.

Assessment of risk factors of falls: The intrinsic risk factors included age-related declines in strength and balance. The most common predictors of falls in this patient were abnormalities balance and a history of fall in the past year. Behavioral risk factors included risky behaviors such as hurrying, sedentary lifestyle, and multiple medications. Socio-economic risk factors included low education, low income, inadequate housing, and limited access to health care services. Environmental (extrinsic) risk factors included physical environmental features in the home or community that may posed hazards, such as slippery or uneven surfaces, steps, and poor building design.

Physical Examination: Physical examination was performed on eight day of the symptoms. On examination the ROM of hip, knee and ankle were within normal limits. Manual Muscle Testing of hip, knee and ankle were 3+. The superficial and deep sensations were intact. Fall risk was assessed using short form Falls Efficacy Scale\textsuperscript{11}, scoring was 18 that patient is at high concern for falling. The cognitive screening was done using Mini Mental State Examination\textsuperscript{12}, scoring was 26 which is considered normal. The depression was assessed using Geriatric Depression Scale (long form)\textsuperscript{13}, scoring was 5 which is considered normal means patient had no depression.

The outcome measures for balance were Four-Stage Balance Test\textsuperscript{14,15} and Berg Balance Scale\textsuperscript{16,17} for muscle strength was the 30 second Chair Stand Test\textsuperscript{18,19} and for walking ability was Timed Up and Go Test\textsuperscript{20,21}.

TREATMENT
The patient received physiotherapy including the muscle strengthening exercises 3 times a week for two weeks to improve strength and mobility. Then the patient was progressed to otago exercise program.

The Otago exercise program focused on major lower limb muscles knee flexors, knee extensors, and hip abductors, which are important for function and mobility and the ankle dorsiflexors and plantar flexor muscles, which are important for maintaining balance. The starting level of each exercise by the amount of ankle weight the patient can lift to perform eight to ten good quality repetitions before fatigue. The exercise was started with half kilogram weight which would minimize both muscle soreness and compliance problems. The patient did the exercises slowly (two to three seconds to lift the weight, four to five seconds to lower the weight) through the functional range of active joint movement. The patient took a one to two minute rest between sets. Muscle strengthening exercises such as trunk movements, knee flexion and extension, hip abduction, ankle dorsiflexion and plantarflexion, heel raising and toe raising. Progression was done by increasing ankle weights or the number of sets performed, according to the Levels and Repetitions for the Exercises. Patient completed two sets of 10 repetitions before progressing to the next level.

Walking was done 3 times a day for 10 minutes so total duration 30 minutes/day for twice in a week. The muscle strengthening exercise and balance retraining was given for 3 times/week\textsuperscript{3} (table 1). The physiotherapist visited at home on 1\textsuperscript{st} day and 3 times a week for first 4 weeks at home and then for next 4 weeks regular phone contact was maintained to motivate the patient for doing exercises and last visit was on last day of 8\textsuperscript{th} week.\textsuperscript{9,22}
Table 1 Main features of Otago

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Strengthening</th>
<th>Balance Retraining</th>
<th>Walking</th>
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<tbody>
<tr>
<td></td>
<td>30 Second Chair Stand Test</td>
<td>Four-Stage Balance Test</td>
<td>Timed Up &amp; Go</td>
</tr>
<tr>
<td>Activity</td>
<td>Five leg muscle strengthening exercises</td>
<td>Twelve balance retraining exercises</td>
<td>Advice about walking</td>
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<td></td>
<td>Four levels of difficulty</td>
<td>Four levels of difficulty</td>
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<td></td>
<td></td>
<td>Not all exercises were prescribed</td>
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<td>Intensity</td>
<td>Moderate Challenge</td>
<td>Moderate Challenge</td>
<td>Usual pace</td>
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<td></td>
<td>8-10 repetitions before fatigue</td>
<td>Each exercise at a level that the patient</td>
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<td></td>
<td></td>
<td>can safely perform unsupervised</td>
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<td>Progressions</td>
<td>Increase from one to two sets</td>
<td>Supported exercise to unsupported exercise</td>
<td>Walk indoors</td>
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<td></td>
<td>Increase amount of ankle weight after 2 sets of 10</td>
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<td>Advance to walking outdoors when</td>
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<td></td>
<td></td>
<td></td>
<td>strength and balance have improved</td>
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<tr>
<td>Length of Exercise</td>
<td>Approximately thirty minutes total for exercises;</td>
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<tr>
<td>Sessions</td>
<td>Exercises can be divided up over the day</td>
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<tr>
<td>Frequency</td>
<td>3 times/ week with rest day between</td>
<td>3 times/ week</td>
<td>2 times/ week</td>
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<td>Duration</td>
<td>8 weeks</td>
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</table>

RESULTS

The scoring for Berg Balance Scale was (40 on first day, 43 on last day of 4th week, 48 on last day of 8th week), Four-Stage Balance Test (semi tandem stand for 8 sec on first day, tandem stand for 6 sec on last day of 4th week, one leg stand for 3 sec on last day of 8th week), 30 second Chair Stand Test (11 times on first day, 14 times on last day of 4th week, 18 times on last day of 8th week), Timed Up and Go test (17 seconds on first day, 13 seconds on last day of 4th week, 9 seconds on last day of 8th week).

DISCUSSION

The results of the study showed that 8 weeks session of Otago exercises is useful in the treatment of fall risk. Despite the emphasis in the fall prevention literature on the importance of balance training for preventing falls, it is likely that strength training is also important since strength declines steadily after the age of 65 years and impaired lower limb muscle strength has been identified as an important fall risk factor. Exercises that focus on building strength in the lower limb muscle groups and muscles of the ankles and feet have been included in successful fall prevention programs. For elderly, these activities may increase risk of falling with poorer postural control so individually prescribed exercises which safely challenge.

Balance is defined as the ability to maintain the projection of the body’s centre of mass within manageable limits of the base of support, as in standing or sitting, or in transit to a new base of support, as in walking. Therefore balance involves anticipatory and ongoing postural adjustments and is thus a co-ordination task. Effective challenge to balance is provided with exercises such as standing in which participants aim to stand with their feet closer together or on one leg, minimize use of their hands to assist balance and practice controlled movements of the body’s centre of mass. The use of a systems approach to understanding balance enables the contribution of the physiologic systems to be evaluated and the effects of ageing considered. The systems are sensory, central processing, neural pathways for motor control, and musculoskeletal. Balance exercises help maintain postural control, which is an essential element in maintaining the balance. Spink et al said that exercises that focused on muscles of the ankles and feet were considered to be important components of a successful podiatry fall prevention trial.

Strength is a key element of fall prevention; however, strength training alone without a balance component is not an effective strategy to prevent falls. Training specificity is also an important concept. The key components of strength training that translate to improved balance and reduced falls risk including focus on lower-extremity and postural muscles; minimal upper-extremity
support; delivered at moderate intensity to achieve the desired results. Observable changes in strength can be expected due to initial neural and neuromuscular adaptations. A study was conducted in which strengthening exercises using body weight and general exercises were of sufficient intensity to improve strength in the lower limb and to decrease accidental falls. 26

Walking is one of the safest and easiest forms of aerobic exercise and may be an appropriate addition to a fall-prevention program in higher functioning individuals. Otago showed increase in strength and balance which are improved by backward walk, walking and turning around, heel to toe walking and stair walking in the exercise program. These factors are an important predictors or causes of walking. In addition, through stair walking, the patient practiced with a fixed foot support, acceleration, balance control, contraction of the lower limb and ankle dorsiflexion to move the centre of gravity to control the afferent, efferent and contraction of the lower limb muscles. As a result, coordination and weight shifting were learned through movement of the lower limbs and this improvement resulted in an increase in mobility. Thus by improving the parameters there can be reduction in the rate of falls of elderly.

CONCLUSION: The results of this study suggest that otago exercise program is an effective management strategy for a patient with fall risk in an older adult when treated for 8 weeks.

IMPLICATION FOR PRACTICE AND FUTURE RESEARCH: Adherence of exercise program was good. As exercises were in home environment, the frequency of exercise can be altered, timings to do the exercises were flexible and it was cost effective. Future study can be done on long term follow up larger population.

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