Gnoscience Group

Case Reports and Reviews: Open Access

Case Report| Vol 2 Iss 1

Moderate-Intensity Exercise in an Individual With Frontotemporal Dementia: A Case Report

Jeffrey Schmidt, Kayla Combs, Laurie Neely, and Nicole Dawson*

School of Kinesiology and Physical Therapy, University of Central Florida, Orlando, Florida, USA

***Corresponding author:** Dawson N, School of Kinesiology and Physical Therapy, University of Central Florida, 12805 Pegasus Drive, Orlando, FL 32816, USA; Tel: 407-823-1863; E-mail: Nicole.Dawson@ucf.edu

Received: April 21, 2021; **Accepted:** May 25, 2021; **Published:** June 05, 2021

Abstract

Background and Purpose: ***The National Institutes of Health has recognized the importance of identifying non-pharmacological interventions to promote cognitive and functional health in individuals with Alzheimer's disease and related dementias, including frontotemporal dementia (FTD). FTD, which is the second most common form of dementia in individuals under the age of 65, leads to deficits in behavior, executive function, language, and motor function. The purpose of this case report is to examine a progressive strengthening and balance exercise program to improve function in an individual with FTD.*** ***Case Description:*** ***The patient was a 47-year-old male with FTD, presenting with decreased balance and generalized weakness. His history included multiple falls and frequent hospital admissions due to physical/cognitive declines.*** ***Intervention:*** ***A biweekly, 12-week plan of care was developed to address weakness and balance impairments using moderate-intensity exercises based on an efficacious intervention for individuals with dementia. Outcomes: At discharge, the following improvements were noted: 30-Second Chair Stand Test = 12 repetitions to 29 repetitions (MDC=2 repetitions). Four Square Step Test = 9.33 seconds to 5.86 seconds (indicating a non-fall risk). Dual Task Interference = dual-task cost from 50.10% to 38.49%. Agility T-Test: 19.90 seconds to 15.01 seconds (MDC=1.10 second).*** ***Discussion:*** ***Improvements in strength and balance were seen in as little as 7-14 visits. Advances were also made in agility and dual-task cost, allowing the patient to wean from daily use of his cane. Therefore, moderate-intensity exercise has the potential to improve physical function in individuals diagnosed with FTD.***

Keywords: ***Frontotemporal dementia; Physical therapy; Strength training; Balance training; Non-pharmacological.***

1. Introduction

The National Institute on Aging has recognized the importance of identifying promising non-pharmacological interventions to promote health in individuals with Alzheimer's disease and related dementias [1]. The most recent summit urged scientists to include individuals with younger-onset dementia, such as frontotemporal dementia (FTD), in research as the body of literature is very limited. FTD is the second most common form of dementia in individuals

Citation: Schmidt J, Combs K, Neely L, et al. Moderate-intensity exercise in an individual with frontotemporal dementia: A case report. Case Rep Rev Open Access. 2021;2(1):123.

under the age of 65 and is defined by clinical presentation, such as deficits in behavior, executive function, language, and motor function, and focal degeneration of the frontal and temporal lobes [2], [3]. FTD includes three subtypes: behavioral variant FTD (bvFTD), semantic variant of primary progressive aphasia, and nonfluent variant of primary progressive aphasia. Half of the FTD cases reported are bvFTD, which displays bilateral frontal atrophy, a decline in social functioning, personality changes [3], [4], and an average survival time of 3 years [5]. Despite identifying these characteristics, there is no functional profile or consensus of how an individual with FTD presents clinically in balance, strength, or coordination.

Currently, there are no disease-modifying drugs approved for the treatment of FTD. As the disease progresses, the primary focus is managing the behavioral symptoms via selective serotonin reuptake inhibitors and low doses of atypical antipsychotics [6]-[9]. The effects of exercise or physical therapy on behavioral and physical function in these patients is absent from the literature. However, there is evidence that supports the use of exercise [10]-[15] and more specifically moderate-intensity exercise [16]-[19] to improve physical function as well as executive function in individuals with dementia. With exercise having such vital effects on function in individuals with and without dementia, there is a question of its effectiveness on related dementias, including FTD. It is important for clinicians to understand the most appropriate method of intervention for this specialized patient population; therefore, the purpose of this case report was to examine the impact of a progressive moderate-intensity strengthening and balance exercise program on an individual with FTD.

2. Case Presentation

2.1 Patient description and case history

The patient was a 47-year-old white male living with his wife and son. He was diagnosed with bvFTD with Parkinsonism in 2013, confirmed via bitemporal hypometabolism by PET scan in 2017. He presented to physical therapy with primary complaints of back pain and balance impairments for six years. He had participated in physical therapy for his balance impairments with minimal improvements, but never for back pain. He used a single-point cane on his left side for community ambulation. The patient had a history of multiple falls, with the most recent being 1.5 years prior while descending stairs.

Relevant medical history included multiple nerve sheath tumors from radiation exposure while serving in the Navy. The three most distal tumors were resected prior to examination, with no reported change in function or pain. His wife reported frequent periods of stability by the patient, followed by a decline in physical and cognitive function, leading to violent psychotic episodes and psychiatric hospitalizations with medication adjustments. At the time of the examination, he was reportedly at a physical and mental peak. His medications at the time of the examination and indications for those medications are listed in Supplemental Table 1 (after the conclusion). He had been receiving botox injections for migraines, alternated with nerve blocks for pain every 12 weeks. Despite numerous comorbidities, bvFTD was the primary diagnosis for which he was being treated.

Informed consent was signed prior to beginning the initial examination. This study was completed meeting all HIPAA (Health Insurance, Portability, and Accountability Act) requirements of the institution for disclosure of protected health information.

2.2 Physical examination results

A subjective history was taken, all systems were reviewed, and vitals were stable prior to beginning the objective portion of the examination. The patient had functional, pain-free range of motion during squatting and overhead reaching. He demonstrated rounded shoulders with standing and sitting posture and bilateral Trendelenburg sign with single leg stance. All upper and lower extremity muscle strength [20] was normal (5/5), except middle trapezius (3+/5), lower trapezius (3+/5), supraspinatus (3+/5), and gluteus medius (4-/5) bilaterally. All dermatomes were intact to light touch. The patient's grip strength was recorded at 93.6 lbs/force (right/dominant) and 77.7 lbs/force (left).

Various functional measures (Table 1) were utilized to objectify the patient's gait speed, lower-extremity strength, as well as static and dynamic stability to determine the cause of the balance impairment. Since research is absent on outcome measures utilized for individuals with FTD, measures used were appropriate for individuals with cognitive deficits and individuals of younger age. Comfortable and fast gait speed were measured via the 8-Foot Walk Test (8FWT), as gait speed has shown to predict overall function, fall risk, and mortality in older adults [21], [22]. The 30-Second Chair Stand Test (30CST) was used to assess lower-extremity strength, as it has a moderate correlation to weight-adjusted leg-press performance (r=.77) and a high test-retest reliability (ICC=.89) [23]. Functional mobility was assessed via the Timed Up & Go (TUG), as it demonstrates good inter- (ICC=.91) and intra-tester (ICC=.92) reliability regardless of the level of cognitive function [24]. Static and dynamic balance were assessed via the Modified Berg Balance Scale (MBBS), the Four-Square Step Test (FSST) [25], and the Fullerton Advanced Balance (FAB) Scale. The MBBS was chosen over the Berg Balance Scale as it has been found to be a better predictor of falls in individuals with dementia [26], [27]. The FAB was used after the patient demonstrated a high score on the MBBS, as the FAB has been shown to have good validity and incorporates more difficult tasks including jumping and reactive balance [28], [29].

An outcome measure to examine the patient's cognitive status was not included in the examination due to the purpose of rehabilitation not being related to cognition. It is important to note that the patient was able to follow all commands and directions and respond to questions appropriately according to his caregiver/wife.

3. Clinical Impression

Currently, normative values for the FTD population are absent, so they were analyzed as follows:
Gait Speed: The patient demonstrated a comfortable gait speed faster than 1.0 meter/second, which correlates with a decreased risk of hospitalization and death in older adults [30].

Strength: The patient demonstrated muscular deficits bilaterally in his middle/lower trapezius, gluteus medius, and supraspinatus via MMT. His score of 12 repetitions on the 30CST was below the average of 13.7 repetitions in community dwelling adults (mean age = 70.5 years) [23], demonstrating functional lower extremity weakness. His grip

strength of 93.6 lbs/force (right/dominant) falls in line with similar-aged individuals, with the average being 103.6 lbs/force [31].

Functional Mobility: The patient completed the TUG in 7.43 seconds with a single point cane (SPC) and 7.40 seconds without. Both of these scores are well below the cut-off score of 14 seconds for falls; however, this normative data is comparative to ages of 60 and above [32].

Balance: The patient received full points for all categories, besides tandem stance, on the MBBS with a final score of 43/44. His score of 36/40 on the FAB was well above the cut-offs for fallers; however, the patient showed deficits in tandem walking, walking with head turns, and reactive balance. The patient's FSST score of 9.33 seconds placed him in the "non-multiple faller" group despite being below the cut-off score of 15 seconds for falls; however, he was not fast enough to be placed in the "non-faller" group due to the average time of this group being 8.70 seconds [25].

Overall, the results are indicative of numerous functional deficits requiring skilled intervention. The main impairments that appeared to be contributing to his falls were lower-extremity weakness and dynamic instability. The patient also demonstrated decreased postural strength and back pain, therefore postural strengthening was proposed to improve core strength. It was recognized that the cause of the back pain was likely not from a musculoskeletal origin, but rather nerve sheath tumors along his thoracolumbar region; therefore, the goal of core strengthening was not to decrease pain, but to improve strength and function.

4. Treatment Plan

A plan of care was created for two times per week for 12 weeks, utilizing moderate-intensity exercise as it is an effective method for improving function in individuals with dementia [16]-[18]. To increase adherence and participation, a strength-based approach was utilized as outlined by Dawson and Judge [18], [19].

Each session began with a warm up of a brisk walk or stationary bicycling. To encourage active engagement in the treatment, the patient chose one of two functional exercises from each of the following categories: upper extremity strengthening, lower extremity strengthening, balance, and agility (Fig. 1). Core strengthening/endurance exercises were added to the upper extremity strengthening category after the first session due to the patient's inability to perform a plank for 30 seconds. Each exercise was dosed at moderate-intensity via completing two sets of 8-12 repetition maximum (60-80% of one-repetition maximum). If an 8-12 repetition maximum was not appropriate for a given exercise, a rating of 6-8 (hard to very hard) was aimed for on the Modified Borg Scale for Rate of Perceived Exertion (RPE). Due to the decreased validity of RPE in individuals with dementia, a rating of 15-18 on the original Borg Scale for RPE was utilized after week three to compare the reported level of intensity with a more physiological objective value, heart rate. Research has shown a moderate correlation between heart rate and RPE scores in individuals with dementia [33]. The exercises were modified through altering intensity to ensure the patient remained in this range, as it has been shown to be effective for safe strengthening [34]. Fig. 2 displays a list of interventions utilized. As the patient

demonstrated improvements in strength and balance, the intensity of exercise was increased and more difficult interventions were added, such as dual-tasking.

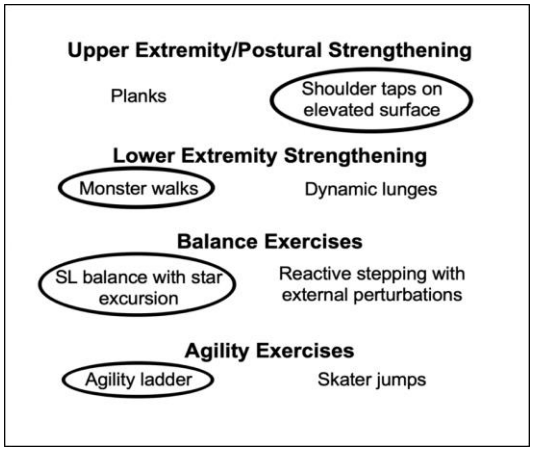

Fig. 1. Strength-based approach formatting.

Note: Session structured for the patient to select from the four categories. This strategy implemented the last component of the strength-based approach established in Dawson et al., [18], [29] (patient's choice) which encouraged active participation from the patient, and increased overall adherence to the regimen.

Intervention Categories	Examples
Upper Extremity/Postural Strengthening	Resisted shoulder horizontal abduction, Resisted shoulder external rotation, Resisted shoulder extension, Wall clocks with resistance, Prone YTIs, Paloff press, Elevated push-ups, Planks, Side Planks, Alternating shoulder taps in plank
Lower Extremity Strengthening	Forward step ups, Lateral step ups, Retrograde step ups, Resisted sidestepping, Forward lunge, Side lunge, Squats, Supine Bridges, Single leg deadlifts, Eccentric heel taps
Balance Exercises	Romberg stance (with eyes opened and closed; on varying surfaces; with perturbations), Tandem stance (on varying surfaces; with perturbations), Single leg stance (varying surfaces; addition of naming, serial calculations, and phonetic alphabet for motor-cognitive dual task; with perturbations; with opposite leg reaching for targets), Reactive stepping in various directions (with leaning into therapist's hands), Lateral step overs (varying heights; varying surfaces), Tandem walking (with catching/throwing objects and head turns for motor-motor dual task; with eyes closed), Tandem walking (with naming, serial calculations, and phonetic alphabet for motor-cognitive dual task)
Agility Exercises	Agility ladder (double leg forward; single leg forward; lateral double leg in/out; ickey shuffle) Four Square Stepping (over hurdles of varying heights; stepping onto varying surfaces), Hurdles (lateral and forward), Hopscotch, Shuttle runs, Alphabet cone drill (forward running and lateral shuffling)

Fig. 2. Intervention examples utilized.

5. Outcomes

Re-assessments were administered monthly and the plan of care was extended to 18 weeks secondary to the patient undergoing a nasal fracture surgery after the 2-month re-assessment and being unable to attend therapy for 20 days. Over the 18-week period, the patient participated in the total prescribed amount, 24 total sessions with reported compliance to the home exercise program. Multiple outcome measures were upgraded due a ceiling effect at baseline

or the patient scoring within age-related normative data, which provided a natural progression of goals as indicated. For example, the patient met normative values on the MBBS and FAB; therefore, new goals were made using the Agility T-Test and Dual Task Interference (DTI), which are more challenging measures of similar functional constructs. The DTI and the Agility T-Test (Fig. 3) were specifically added to target the effect of a cognitive task on physical function [35], [36] and higher-level agility performance [37]. Table 1 displays the change in scores from baseline to discharge.

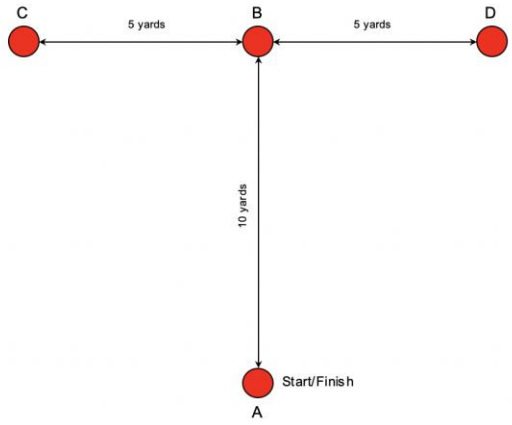

Fig. 3. Agility T-Test.

Note: The procedure of this test is as follows:

The patient starts at cone A. On "GO" the stopwatch begins and the patient runs forward to cone B to touch the cone with his right hand. He then turns left and side shuffles to cone C, touching it with his left hand. He then side shuffles to the right to cone D and touches the cone with his right hand. He then shuffles back to the left, touching cone B with his left hand. Finally, he backpedals to cone A. The stopwatch is stopped as he passes cone A. This is completed as fast, but safe, as possible.

Table 1: Outcome Measures Throughout Assessment Periods[a].

Outcome Measures	Baseline Measurements (12/17/2018)	Progress Measurements (03/06/2019)	Discharge Measurements (03/30/2019)	Change[b]	MDC
8FWT with SPC at comfortable speed (m/s)	1.09	Discontinued based on ceiling effect			
8FWT with SPC at fast speed (m/s)	1.38	Discontinued based on ceiling effect			
30CST without UE (reps)	12	23	29	+17[c]	2
TUG with SPC (s)	7.43	Discontinued based on ceiling effect			
TUG without SPC (s)	7.40	Discontinued based on ceiling effect			
Modified Berg Balance Scale	43/44	Discontinued based on ceiling effect			
FSST without SPC (s)	9.33	5.86	6.10	-3.23	Not established

Fullerton Advanced Balance Scale	36/40	Discontinued based on ceiling effect			
Agility T-Test without SPC (s)	19.90	16.80	15.01	-4.89[c]	1.10
Dual Task Interference (%)	50.10	48.48	38.49	-11.61	Not established

[a]MCD = Minimal Detectable Change, 8FWT = 8-Foot Walk Test, SPC = single point cane, UE = upper extremities, TUG = Timed Up and Go Test, and FSST = Four square Step Test
[b]Change in score or time from baseline to discharge
[c]Change in score/time > MDC

Overall, the patient demonstrated improvements in strength, balance, agility, and dual-task interference. A 17-repetition increase was seen in the 30CST, which is well above the minimal detectable change (MDC) of 2 repetitions for lower extremity strength [38]. An increase in MMT scores was seen bilaterally for the lower trapezius (4+/5), middle trapezius (4+/5), supraspinatus (4-/5), and gluteus medius (5/5). FSST decreased from 9.33 to 6.10 seconds, which re-categorized him in the "non-faller" group [25]. A decrease of 11.61% in dual task interference was seen, with overall improvements in tandem gait speed both with and without dual task. A 4.89 second decrease was noted in the Agility T-Test (MDC = 1.10 second) [37]. These improvements in function also led to the discharge of the patient's single point cane during community ambulation. He reported that he felt much steadier on his feet, while his wife reported an increase in chores around the house. No adverse effects occurred or were reported during the duration of treatment.

6. Discussion

This study contributes to the literature by demonstrating functional gains made by an individual with FTD following moderate-intensity exercise. These findings are consistent with a large body of evidence supporting moderate-intensity exercise in individuals with Alzheimer's disease and related dementias; however, it is the first to outline its impact on a younger-onset dementia [10-18]. Moderate-intensity exercise is a critical non-pharmacological intervention that is vastly underutilized in this patient population and this study demonstrates a successful implementation with our patient and the potential utility in managing symptoms in other individuals with FTD.

There is a need to create evidence-based programs that empower these individuals to continue increasing and maintaining their physical function. Utilizing the structure outlined by Dawson et. al, there is evidence that supports the use of a moderate-intensity exercise program with a strength-based approach to improve overall function in individuals with dementia [18], [19]. Through this 18-week intervention, the patient saw improvements in strength and balance in as little as 7-14 visits, which can be applicable to the outpatient physical therapy setting [39]. These results highlight the importance of physical therapy in the multidisciplinary care of individuals with any type of dementia.

Due to the lack of normative values and MDC's for individuals with FTD, there were limitations with comparison of initial outcomes and improvements to a population of similar age and diagnosis. Based on this lack of literature, there is a need to gather this data for the affected younger population with FTD. Another limitation of this case report is the presence of neurologic comorbidities alongside the diagnosis of bvFTD, including Parkinsonism, multiple spinal nerve

sheath tumors, and neuropathy. Although the patient didn't present with any signs and symptoms of Parkinson's Disease and demonstrated normal sensation/proprioception, it is unknown how his additional diagnoses played a role in his rehabilitation outcome. Due to the presence of these additional comorbidities, there is uncertainty that his functional symptoms were attributed solely to bvFTD, and thus limits the ability to generalize these results to all individuals with FTD. More research is needed at the current time to determine the functional profile in individuals with FTD.

7. Conclusion

This case report utilized skilled physical therapy that included progressive moderate-intensity strength and balance exercises with a strength-based approach to improve overall function in an individual with bvFTD. These results highlight the importance of integration of these techniques into clinical practice and further research on the impact of exercise in individuals with FTD.

Supplemental Table 1: Patient's Medication List.

Drug (Indications)	Dosage
Oxycodone (Pain)	5 mg PRN every 8 hours
Oxycodone (Pain)	10 mg every 8 hours
Valtrex (Antiviral)	500 mg every day
Effexor (Depression)	187.5 mg every day
Docusate (Constipation)	100 mg twice daily
HCTZ/Lisinopril (Hypertension)	12.5 mg/20 mg every day
Loratadine (Antihistamine)	10 mg PRN
Sennosides (Constipation)	8.6 mg three, twice daily
Depakote (Seizures)	500 mg three daily
Vitamin D3	400 units twice daily
Quetiapine Fumarate (Bipolar 1 Treatment)	100 mg half morning, half mid-day, twice at night
Mirtazapine (Depression)	30 mg every day

REFERENCES

1. Gitlin L and Maslow K. Research summit on dementia care: Overview and recommendations. *Advisory Council on Alzheimer's Research, Care and Services.* NIH Campus, Washington, D.C. USA, 2017.
2. Olney NT, Spina S, and Miller BL. Frontotemporal dementia. Neurol. Clin. 2017;35(2):339-374.
3. Bott NT, Radke A, Stephens ML, et al. Frontotemporal dementia: Diagnosis, deficits and management. Neurodegener Dis Manag. 2014;4(6):439-454.
4. Johnson JK, Diehl J, Mendez MF, et al. Frontotemporal lobar degeneration: demographic characteristics of 353 patients. Arch Neurol. 2005;62(6):925-930.
5. Roberson ED, Hesse JH, Rose KD, et al. Frontotemporal dementia progresses to death faster than Alzheimer disease. Neurology. 2005;65(5):719–725.
6. Rohrer JD, Guerreiro R, Vandrocova J, et al. The heritability and genetics of frontotemporal lobar degeneration. Neurology. 2005;65(5):719-725.
7. Boxer AL, Gold M, Huey E, et al. Frontotemporal degeneration, the next therapeutic frontier: molecules and animal models for frontotemporal degeneration drug development. Alzheimers Dement. 2013;9(2):176-188.

8. Lee BS, Jun IG, Kim SH, et al. Intrathecal gabapentin increases interleukin-10 expression and inhibits pro-inflammatory cytokine in a rat model of neuropathic pain. J Korean Med Sci. 2013;28(2):308-314.
9. Miller ZA, Rankin KP, Graff-Radford NR, et al. TDP-43 frontotemporal lobar degeneration and autoimmune disease. J Neurol Neurosurg Physciatry. 2013;84(9):956-962.
10. Cancela JM, Ayan C, Varela S, et al. Effects of a long-term aerobic exercise intervention on institutionalized patients with dementia. J Sci Med Sport. 2016;19:293-298.
11. Kemoun G, Thibaud M, Roumagne N, et al. Effects of a physical training programme on cognitive function and walking efficiency in elderly persons with dementia. Dement Geriatr Cogn Disord. 2010;29:109-114.
12. Hauer K, Schwenk M, Zieschang T, et al. Physical training improves motor performance in people with dementia: a randomized controlled trial. J Am Geriatr Soc. 2012;60(1):8-15
13. Baker LD, Frank LL, Foster-Schubert K, et al. Effects of aerobic exercise on mild cognitive impairment: A controlled trial. Arch Neurol. 2010;67(1):71-79.
14. Kramer AF, Colcombe SJ, McAuley E, et al. Fitness, aging and neurocognitive function. Neurobiol Aging. 2005;26(1):1-11.
15. Ahlskog JE, Geda YE, Graff-Radford NR, et al. Physical exercise as a preventative or disease-modifying treatment of dementia and brain aging. Mayo Clin Proc. 2011;86(9):876-884.
16. Dawson N, Judge K, and Gerhart H. Improved functional performance in individuals with dementia after a moderate-intensity home-based exercise program: A randomized controlled trial. J Geriatr Phys Ther. 2019;42(1):18-27.
17. Dawson N and Judge K. Accepting the challenge – Moderate-intensity exercise with individuals with dementia: A Case Series. Rehabil Process Outcome. 2019;8:1-9.
18. Dawson N, Judge K, and Gerhart H. Findings from a strength-based moderate-intensity exercise interventions for individuals with Dementia (Innovative Practice). Dementia. 2017;19(4):1265-1273.
19. Judge KS, Yarry SJ, Orsulic-Jeras S. Acceptability and feasibility results of a strength-based skills training program for dementia caregiving dyads. Gerontologist. 2010;50(3):408-417.
20. Kendall FP, McCreary EK, and Provance PG. Muscles, Testing and Function: With Posture and Pain. 4th ed. Baltimore MD: Williams & Wilkins; 1993.
21. Abellan van Kan G, Rolland Y, Andrieu S, et al. Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people an international academy on nutrition and aging (iana) task force. J Nutr Health Aging. 2009;13(10):881-889.
22. Mantel A, Trapuzzano A, Chizmar S, et al. An investigation of the predictors of comfortable and fast gait speed in community-dwelling older adults. J Geriatr Phys Ther. 2019;42(4):E62-E68.
23. Jones C, Rikli R, and Beam W. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Res Q Exerc Sport. 1999;70:113-119.
24. Nordin E, Rosendahl E, and Lundin-Olsson L. Timed “up & go” test: Reliability in older people dependent in activities of daily living--focus on cognitive state. Phys Ther. 2006;86(5):646-55.
25. Dite W and Temple VA. A clinical test of stepping and change of direction to identify multiple falling older adults. Arch Phys Med Rehabil. 2002;83(11):1566-1571.

26. McGough EL, Logsdon RG, Kelly VE, et al. Functional mobility limitations and falls in assisted living residents with dementia: physical performance assessment and quantitative gait analysis. J Geriatr Phys Ther. 2013;36(2):78-86.
27. Kenny AM, Bellantonio S, Foritnsky RH, et al. Factors associated with skilled nursing facility transfers in dementia-specific assisted living. Alzheimer Dis Assoc Disord. 2008;22(3):255-260.
28. Muir S and Speechley M. Establishing predictive validity of the fullerton advanced balance scale. Arch Phys Med Rehabil. 2010;91(7):1147
29. Klein PJ, Fiedler RC, and Rose DJ. Rasch analysis of the fullerton advanced balance (FAB) scale. Physiother Can. 2011;63(1):115-125.
30. Cesari M, Kritchevsky, Penninx B, et al. Prognostic value of usual gait speed in well-functioning older people--results from the health, aging, and body composition study. J Am Geriatr Soc. 2005;53(10):1675-1680.
31. Westropp M. Hand grip strength: Age and gender stratified normative data in a population-based study. BMC Research Notes. 2011;4:127.
32. Shumway-Cook A, Brauer B, and Woollacott M. Predicting the probability for falls in community-dwelling older adults using the timed up & go test. Phys Ther. 2000;80(9):896-903.
33. Yu F and Bil K. Correlating heart rate and perceived exertion during aerobic exercise in Alzheimer's disease. Nurs Health Sci. 2011;12(3):375-380.
34. Mueller M and Maluf K. Tissue adaptation to physical stress: a proposed "physical stress theory" to guide physical therapist practice, education, and research. Phys Ther. 2012;82(4):383-403.
35. Weightman MM and McCulloch K. Dual-task assessment and intervention. *Mild Traumatic Brain Injury Rehabilitation Toolkit.* Sam Houston, TX: Office of the Surgeon General (Borden Institute), 2014.
36. Plummer P and Eskes G. Measuring treatment effects on dual-task performance: a framework for research and clinical practice. Front Hum Neurosci. 2015;9(225):1-7.
37. Raya MA, Gailey RS, Gaunaurd IA et al. Comparison of three agility tests with male servicemembers: Edgren side step test, T-Test, and illinois agility test. J Rehabil Res Dev. 2013;50(7):951-960.
38. Hesseberg K, Bentzen H, and Bergland A. Reliability of the senior fitness test in community-dwelling older people with cognitive impairment. Physiother Res Int. 2015;20(1):37-44.
39. Woznowski-Vu. Factors affecting length of stay in adult outpatient physical rehabilitation: A scoping review of the literature. Physiother Can. 2015;67(4):329-340.

Citation: Schmidt J, Combs K, Neely L, et al. Moderate-intensity exercise in an individual with frontotemporal dementia: A case report. Case Rep Rev Open Access. 2021;2(1):123.