
Effectiveness of Sensing and Feedback Alerting Smart Cane System: An Assisted Device for Geriatric Population to Prevent Falling

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Abstract

Background: The main cause of injury-related death among the elderly is falling. The smart cane is a type of assistive tool. A smart cane's electronic sensors provide feedback and alert users to potential hazards, assisting users in keeping their balance while moving around.

Purpose: To evaluate the effectiveness of a smart cane system for the elderly population that integrates feedback alerts and sensors to reduce falls.

Materials and Methods: A Randomized Controlled Trial was done in elderly resort with 30 sample allocated into two group using lottery method .group-A receives conventional training using cane with quadripod base , while the group-B receives smart cane training using quadripod base .modified two-point gait pattern is employed for 2 months of training. The outcome measure used for physical measure is Elderly Mobility Scale (EMS) and for psychological is Activities-Specific Balance Confidence Scale (ABC,s).

Results: According to the statistical analysis of the elderly mobility scale outcome measure, there were substantial changes in mobility and a decreased risk of falling .Based on the ABCs scale, when comparing the pre-test and post-test values, the experimental group's confidence in daily living is superior to the control group.

Conclusion: According to the study's findings, a smart assistive cane can help the elderly population both physically and psychologically. During the gait training, the user of the smart assistive gadget did not encounter any unfavorable therapy-related consequences.

Key Word: Fall, Smart Cane, Elderly Population.

Introduction

Age plays a role in both disability and mobility issues. One of the most frequent and severe problems causing disabilities, particularly among the elderly, is falling. Elderly people have a higher risk of falling because

(1) With age, their abilities deteriorate (2) the likelihood of acquiring medical problems rises with age and (3) Associated drug dosages are frequently raised as well. Aging is typically accompanied by a wide-based gait, a decline in gait speed, step length, and lower extremity strength¹. The interplay between

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these long-term predisposing lifestyle factors and short-term environmental risk factors, such as adverse drug response, an acute illness, or tripping on an uneven surface, most frequently lead to falls. The fall management can be complicated. For groups of elderly individuals, a combination of therapies, such as medical evaluation, an exercise regimen, vitamin D prescription, and home evaluation, has been recommended. Normal sensory, neuromuscular, and musculoskeletal system operation is necessary for normal gait and postural stability. Maintaining the body's centre of gravity within its base of support depends on extremities proprioceptive and tactile input, vision input, and vestibular input and age and illness may damage these sensory pathways. Furthermore, age-related modifications in the way that sensory and motor processes are organised and integrated in the central nervous system can affect the speed and reliably postural reflexes respond, this raises the possibility of falls.

It is doable in order to broaden a sufferer's base of support, enhance equilibrium, and promote activity and mobility, which can be increased by using assistive devices including canes, crutches, and walkers. There are significant attentional, neuromotor, and musculoskeletal demands placed on users of assistive devices, and these demands have even been linked to injuries and falls. There are several reasons for canes' limitations as supportive devices and the possible fall risk they pose, includes (1) Improper cane usage (2) Abandoning the cane usage (3) disorders and impairment brought on by repeated stress (4) Using a cane when there are potential environmental threats around, such as obstacles, stairs, and surfaces with a high coefficient of friction. (5) Balance disruption caused on by the attentional conflict between cane manipulation and motion. Provided the smart cane are also used as assistive device. The electronic sensors in a smart cane help people maintain good balance while moving around by enhancing visual feedback and navigating obstacles through alerting signals²⁻⁵.

Subjects and Methods

Subjects: Elderly Population

Sampling technique: Simple random sampling

Sample size: 30 samples

Study Period: From June 2022 to July 2023

Selection criteria:

Inclusion criteria

1. Both Male and Female age above 65 years,
2. Individual complaints of fall and poor balance during mobility.
3. Comorbid conditions like systemic hypertension, diabetic, hypertension, thyroidism.

Exclusion criteria

1. Any recent postoperative case.
2. Patients with lower limb disability associated with other health problems.
3. Severe visual deficit
4. Psychosomatic and neurological problem

Procedure

The study was carried out in Sriperumbudur Elder's Resorts, preferably with an 850 square foot walkway. From the starting point to the ending point, two cones are marked. A total of 30 samples are used in the study, and two groups with 15 samples each are assigned by lottery method. Group A practiced with conventional quadripod base cane and Group B practiced with smart assisted cane with quadripod base (Fig:1). Sample selection is based upon the inclusion and exclusion criteria, each subject is examined with history of 1.history of fall and its durability 2. Any use of walking aids and its withdrawal 3.personal history. The baseline measurements of Activities-Specific Balance Confidence Scale for a psychologically based measure and the Elderly Mobility Scale for a physical based measure.

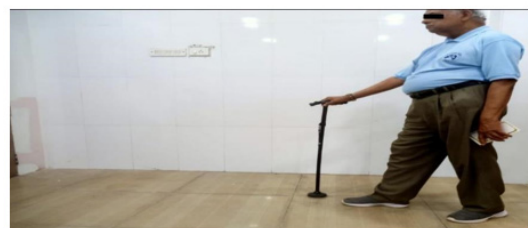


Fig 1: Gait training with a smart cane system

Outcome measures:

Elderly Mobility Scale: The 13-item Elderly Mobility Scale (EMS) was developed to evaluate

functional mobility in older people living in their communities¹².

Activities-Specific Balance Confidence Scale: is a 16-item scale that is frequently used to measure confidence in one’s ability to perform daily tasks¹³.

Intervention

Gait training with a conservative cane system

Samples are trained to walk around the walkway using a cane with a quadripod base. Two of the samples exhibited dysarthria, and they were advised to raise the unsupported hand if they were having trouble doing the gait activities. The therapist follows the samples during the training to prevent falling and sustaining an injury. To walk with a cane, a modified two-point gait is used. The measures are analysed in a variety of different ambulation situations, including straight walking, right and left turns, and straight walking over obstacles.

Gait training with a smart cane system

Samples are trained to use a smart assistive cane with a quadripod base in the walkway .The therapist assists the ambulation to prevent falling during training. A modified two-point gait is employed when using a cane. The metrics are analyzed while walking straight, turning right and left, and walking

straight over obstacles, in ambulation scenarios.

For two months, both groups undergo training on using assistive technology on a daily basis,2 sessions with 10 minutes of duration .

Statistical procedures

Datas were analyzed using SPSS 22 software to compare pre -test and post- test scores using Wilcoxon test with p<0.05.

Descriptive data on subjects

Elderly Mobility Scale	Pre-test	Post-test	
Study group	Mean ± SD	Mean ± SD	p-value
Control	26.67±9.35	31.50± 9.35	P=0.023
Experimental	20.67±5.05	26.17±5.95	P=0.006

In the course of the investigation, it was noted that, among the 15 patients, from experimental group there were 5 (33.3 %) belong to 65-68 years of age, 6 (40%) were from 69-70 years of age and 1(6.6%) had belonged to 71-75 years of age, 3 (20%) were from above 75 years of age. In the control group, of the 15 subjects, 2(13.3) were from 65-68 years of age, 4 (26.6) from 69-70 years of age, 6 (40%) from 71-75 years of age and only 3 (20%) had belonged to above 75 year of age (Table:1).

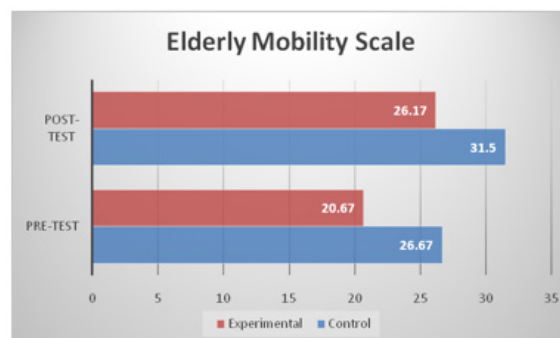
Table 1: Descriptive data of samples

Age in years	Experimental group			Control Group		
	Male	Female	Total	Male	Female	Total
65 -68	1	4	5	1	1	2
69-70	3	3	6	2	2	4
71-75	1	-	1	4	2	6
75 above	2	1	3	2	1	3
Total	7	8	15	9	6	15

Questionnaire data:

Datas were analyzed using SPSS 22 software to compare pre -test and post- test score.

Table 2: Mean and Standard deviation value of Elderly Mobility Scale

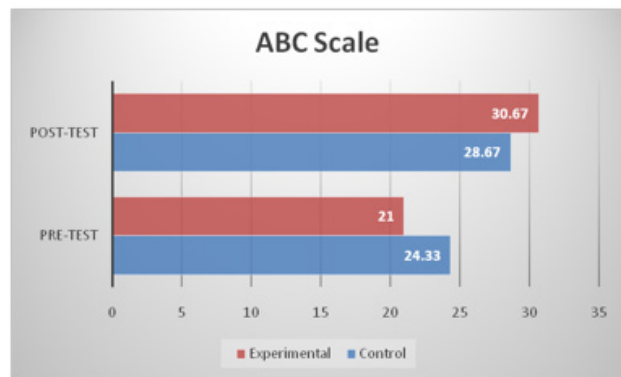


Graph 1: Graphical representation of Elderly Mobility Scale

Elderly Mobility Scale, the experimental group’s mean ± SD of pre-test is 20.67±5.05 and post-treatment is 26.17±5.95 .The difference between pre-test and post-test is statistically significant with p=0.006. (Table 2) and the control groups mean ± SD of pre-test is 26.67±9.35 ,post-treatment is 31.50± 9.35.The difference between pre-test and post-test is statistically significant with p=0.023(Graph 1).

Table 3: Mean and Standard Deviation value of ABC’s Scale

ABC’s	Pre-test	Post-test	
Study group	Mean ± SD	Mean ± SD	p-value
Control	24.33±4.63	28.67± 4.68	P=0.009
Experimental	21.0±9.25	30.67±6.19	P=0.025



Graph 2: Graphical representation of ABC’s Scale

From the Activities-Specific Balance Confidence Scale , the experimental group’s mean ± SD of pre-test is 21.0±9.25 and post-test is 30.67±6.19 .The difference between pre-test and post-test is statistically significant with P=0.025.(Table 3) and the control groups mean ± SD of pre-test is 24.33±4.63 ,post-test is 28.67± 4.68.The difference between pre-test and post-test is statistically significant with P=0.009 (Graph 2).

Results

Ambulation with a smart cane system

According to the statistical analysis of the elderly mobility scale outcome measure, both the control group and the experimental group had significant changes in mobility and a reduced risk of falling.The

ABCs scale reveals that the experimental group’s confidence in daily living is higher than that of the control group comparing with the pre-test and post-test values.

Ambulation with a conservative cane system

From the statistical analysis of elderly mobility scale outcome measure the study reveals that there is significant change in mobility there by reduced risk of falls in both the control and experimental group .The ABCs scale reveals that the control group’s confidence in daily living is lower than that of the experimental group comparing with the pre-test and post-test values.

Discussion

Using a cane can assist elderly people move around more easily and lower their risk of falling. As an alternative, employing a smart assisted cane with features like warning sensors and visual feedback technology is a superior choice for enhancing mobility and lowering the risk of falling. The medical community should address the five major issues that this study’s cane users were found to have: a lack of medical advice when choosing or using a device; incorrect cane height; cane placement in the wrong hand; an inability to maintain a correct alternating gait pattern and poor posture while ambulating¹¹. Older adults with mild to moderate dementia as well as cognitively healthy older adults.It requires a lot of cognitive effort to learn to walk with a single-point cane, but AD sufferers are more likely to experience the effects. When walking in a straight line while multitasking or on more complicated courses requiring maneuvering around obstacles, people with AD demonstrated statistically significant boosts in gait variability. Attempting to provide capabilities for distant surveillance, localized signal interpretation, and real-time feedback on cane use to reduce the danger of falling, the SmartCane system integrates developments in the fields of wireless networking, embedded enumeration, and signal processing ⁵.By classifying whether a person is walking with the correct cane motion and applied forces throughout a stride, the new technology offers local data processing capacity⁸. Obstacles that they encounter when walking put them at risk of injury from falls. The smart cane device will warn blind

individuals of the problems and solve using audio output⁹. Walking and standing postures require quite different approaches to balance maintenance. The intention of standing is to maintain the gravity centroid on the surface that provides assistance. However, walking disturbs the body's equilibrium, and adjustments are needed in response to changes in the gravity line. Gait abnormalities typically begin around the age of 60, although more major changes are seen in people between the ages of 75 and 80⁷. Contrary to the 3-point gait with WSFC 6, the lower extremity muscle activation during the phase of stance was abnormally high in the 2-point gait with WSFC.

Beauchamp et al. investigated how walking sticks affect symmetry when walking. It was shown that utilizing walking sticks improved symmetry when walking. In their investigation of the potential effects of a walking assistance on balance and gait, Bateni et al.⁸⁻⁹ found that such devices increased mobility and balance.

Amitejash Rout et al. conducted the study on Smart Quadripod Walking Stick for Visually Challenged and Elderly People. If an impediment is within 50 cm of the smart quadripod walking stick, it will recognise it and give the user haptic input. The smart baton's LED light will illuminate and shine a warning to strollers of its presence, depending on the ambient lighting. When a crisis occurs, the user can push the panic button to send specific phone numbers an SMS giving the stick's GPS locations¹⁰⁻¹³.

Conclusions

The study concluded that smart assistive cane is effective in both the physical and psychological domain of the elderly population. The participant in the smart assistive device did not experience any therapy-related adverse effects during the administration of the gait training.

Conflict of Interest: No conflict of interest.

Source of funding: self-funded project.

Ethical Clearance: The Institutional Ethical Committee issued their approval to the research. Before the randomization and training allocation, all participants gave written informed consent.

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