International
Journal of Medical and Exercise Science
(Multidisciplinary, Peer Reviewed and Indexed Journal)

ORIGINAL ARTICLE

EFFECTIVENESS OF GAIT TRAINING WITH AUDITORY CUES ON SUBJECTS WITH PARKINSON'S DISEASE

Search engine:
www.ijmaes.org

Dr. Garima Srivastava[1] and Dr. Jibi Paul[2]

Author:
[1]Neuro Physiotherapist, Sahara Hospital, Lucknow, Uttar Pradesh India. E-Mail: garima_physio@rediffmail.com
Corresponding Author:
[2]Faculty of Physiotherapy Program, School of Health Sciences, KPJ Healthcare University college, Nilai, Malaysia, E-Mail: jibipaul74@gmail.com

Abstract

Background: *The name of Parkinson's disease is attributed to James Parkinson who first described the disease in 1987 in a treatise called "An essay on shaking palsy". As Parkinson's disease disturbs the locomotion of an individual it results in a substantial reduction in quality of life. Impairment in the temporal stability is worse in patients with Parkinson's disease. Conventional Physiotherapy and Conventional Physiotherapy.* ***Objectives:*** *The objectives of the study were to find the effect of conventional physiotherapy, conventional physiotherapy with auditory cues and the efficacy between conventional physiotherapy and conventional physiotherapy with auditory cues on the gait of subjects with Parkinson's disease.* ***Methods:*** *30 Subjects with moderate Parkinson's disease participated in the study and were randomly assigned into two groups. Group I received conventional physiotherapy only and group II received conventional physiotherapy with auditory cues. The gait parameters namely stride length; cadence and speed were noted before the intervention. The study duration was 4 weeks and at the end of the study period the parameters were re-assessed and the statistical analysis were done.* ***Results:*** *The gait parameters were significantly improved (p<.001) in the group I undergoing conventional physiotherapy and there was also a significant improvement (p< .001) in the gait parameters of group II.* ***Conclusion:*** *The study has concluded that auditory cues can be a useful tool in rehabilitation of patients with Parkinson's disease for improvement of gait.*

Keywords: *Parkinson's disease, Conventional Physiotherapy, Auditory cues, Gait parameters.*

Received on 1st December 2015, Revised 24th Dec 2015, Accepted 12th Jan 2016

INTRODUCTION

Parkinson's disease is a progressive degenerative neurological syndrome resulting in a myriad of movement disorders as slowness of movement (bradykinesia), freezing or akinetic periods, tremors, decreased mobility related to muscular rigidity and dyskinesis (involuntary movements) associated with anti Parkinsonian medications. Parkinson's disease accounts for approximately 75% of patient visits to most large disorder centers and rivals stroke as a leading cause of neurological disability[1].

In as short and succinct treatise entitled "On the shaking Palsy", James Parkinson presented in simple term the hallmark of this disabling condition. The symptoms and treatments have been described in our age-old system of medicine of Ayurveda as far back as 5000 BC and in the Chinese medical texts Nei Jing. The disease is known as Kampavata in modern Ayurveda. The earliest western literature can be attributed to Galven the famous Physician who in 175 AD gave one of the first descriptions of this condition under the name "Shaking palsy", It was described as Scelotyrbe Festinans by Francois Boissier (1706 – 1776). In 1895 Brissaud suggested that the disease was due to a lesion in substantia nigra. By 1919, the idea that the substantia nigra is the affected region of the brain was accepted[2].

Classic signs of Parkinson's disease include a "masked face", "pin-rolling" tremor of fingers and thumb, a shuffling gait and a stooped posture. Tremor is defined as a rhythmic, mechanical oscillation of a body part. Tremor at rest is a cardinal sign of Parkinson's disease and is often the first sign of the disease (Marsden 1994). Rigidity is the term used to describe the resistance to passive movements. It can affect axial, proximal, distal muscles and is evident in both flexors and extensors. Akinesia reflects an inability to initiate and carryout active movements[2]. Parkinson's disease patients also experience slowness of movement (bradykinesia) and a diminution in movement[3].

Parkinson's disease is insidious in onset and progressive. The incidence rates have not shown significant change in the few decades. Studies show that the incidence of Parkinson's disease is lowest among Nigerians, followed by Chinese, Japanese, Afro – Americans and Indians. Prevalence of Parkinson's disease varies across communities too. In India, the crude age – adjusted prevalence rate of Parkinson's disease per 100, 000 populations is 14 in Northern India, 27 in the South, 16 in the east, while its 363 for Parsis in Mumbai[3]. Average age of onset of Parkinson's disease is 35 to 60 years[4].

The exact etiology of Parkinson's disease is unknown but it is assumed to have genetic linkage, environmental toxins play an important role in the development of Parkinson's disease. About 15% of individuals with Parkinson's disease have a close relative with the disease (Marsden 1990). Certain drugs like heavy tranquilizers may cause Parkinson's disease. Diagnosis of Parkinson's disease remains clinical with no reliable test available. The exact pathophysiologic nature of Parkinsonian walking disability is not well understood. Idiopathic Parkinson's disease is characterized by degeneration of neurons in the substantia nigra, which is part of basal ganglia. These neurons make the neurochemical messenger dopamine, which is partly responsible for starting a circuit of messages that coordinate normal movement [5].

From previous research on normal and pathologic basal ganglia function, it has been proposed that the basal ganglia are implicated in two main roles in the control of sequential movements. The first role is as an internal cue or trigger to enable movement sequences to be carried out without attention. The second role is its contribution to cortical 'motor set'. The basal ganglia aid in the preparation and maintenance of motor plans in a state of readiness for action, enabling motor functions to be carried out functionally and appropriately[6].

Most pathologists require the degeneration of substantia nigra neurons and presence of

Lewy bodies for pathological diagnosis of Parkinson's disease. While the pathological diagnosis may indeed represent the 'gold standard' for Parkinson's disease diagnosis, the specificity and sensitivity of the pathological findings are unknown. Diagnosis of Parkinson's disease remains clinical with no reliable test available. Diagnosis can be difficult and relies on the recognition of the cardinal features of bradykinesia, rigidity and tremor[7, 8].

The management of the disease has been equally challenging in the early stages. The effect of gentle rocking was described almost 100 years ago in Parsis by Professor Charcot, who noted a dramatic improvement in patients with Parkinson's disease following rides in bumpy, horse drawn carriages. Following this observation he constructed a vibrating chair for these patients[9, 10].

The future treatment of Parkinson's disease will see improvement over current therapy with drug effective during all stages of illness. Physiotherapy has been used as a treatment modality of Parkinson's disease even before the introduction of L-dopa. After the introduction of L-dopa, physiotherapy has been able to capitalize on the positive effects of L-dopa and increase the functional status of these patients. Physiotherapists are involved in assessment and treatment of Parkinson's disease patients[11].

Perhaps the most noticeable and debilitating effect of Parkinson's disease appear in the gait of the client. The gait pattern of the patient with Parkinson's disease is characterized by small, shuffling pattern and a particular difficulty with the internal regulation of stride length. The patients with Parkinson's disease typically exhibit decreased velocity and a shuffling gait pattern with short steps and loss of heel strike. Gait hypokinesia affects almost everybody with Parkinson's disease and increases with severity with the progression of the disease. The fundamental deficit in gait hypokinesia is a disorder in step length regulation[12].

Physiotherapy is an important adjunct to the anti-parkinsonian medication. Generally, physiotherapy serves as reinforcement of the motor program and benefits the patients with Parkinson's disease. Physical therapy for these patients aims to preserve the remaining function on a high level, improve motor function, reduce tremor and rigidity, improves activities of daily living[13, 14].

Objectives

Objectives of the study were to analyze the effectiveness of conventional physiotherapy and conventional physiotherapy along with auditory cues on gait variables in patients with Parkinson's disease. The study was also to compare the efficacy of conventional physiotherapy along with auditory cues over conventional physiotherapy alone.

METHODOLOGY

Population:

A population is defined as the group of people to whom the research results are generalized. All the subjects who were suffering from primary Parkinson's disease were the universal population of this study.

Study Setting:

The study was conducted in the Department of Physiotherapy, Florence Rehabilitation Centre, KalyanNagar, Bangalore, India.

Sample and sampling technique:

Those subjects who were screened as Parkinson's disease and satisfied the selection criteria were included in the study. There were 30 male and 10 female subjects of these 2 patients had cognitive deterioration, 4 of them were not willing to participate in the study and 4 patients had musculo-skeletal impairments. 30 patients met the inclusion criteria and were willing to participate in the study.

From the subjects who were reported to the physiotherapy department, 30 subjects were selected and were randomly divided into two groups, with 15 in each. Total sample included both the gender. Simple random sampling was selected so that each and every unit in the population has an equal probability of being selected in the sample.

Inclusion criteria:
Primary Parkinson's of both genders, aged between 45–70 years, severity grading 2 and 3 on Hoehn & Yahr Scale. Score 1 in gait assessment according to Unified Parkinson's Disease Rating Scale-III. Scoring 1, 2, 3 on posture grading according to Unified Parkinson's Disease Rating Scale-III.

Exclusion criteria:
Subjects with Secondary Parkinson's, Non ambulant or bed ridden, Sensory & auditory deficits, Cognitive deterioration, Parkinson-plus syndromes were excluded from the study.

Methods of data collection:

Primary data had been collected through experiment. The researcher has conducted experiments, observed some quantitative measurements, with the help of which the truth contained in the hypothesis can be examined.

Thirty subjects were referred to the investigator at the outpatient department of Florence College of Physiotherapy. The referring physician was aware of the inclusion and exclusion criteria. Written informed consent was taken from the subjects after explaining the study.

Patients diagnosed with Parkinson's disease satisfying inclusion criteria were selected for the study. The sample composed of 30 subjects. The subjects were randomly divided into 2 groups.

Group	Male	Female	Exercise Program
G-1	10	5	Conventional Physiotherapy
G-2	11	4	Conventional Physiotherapy plus auditory cues

The frequency of the treatment was 5 sessions per week for four consecutive weeks with 30 minutes session each. Group II was the experimental group, it comprised of 11 male and 14 female subjects with a mean age of 62.53 and a Standard Deviation of 5.65. The minimum age was 45 and the maximum age was 70 years. These subjects were given conventional physiotherapy along with auditory cues for gait training. The frequency of the treatment was 5 sessions per week for four consecutive weeks with 30 minutes session each.

Measurement Tools:

Hoehn & Yahr grading, Unified Parkinson's Disease Rating Scale-III (Gait and Posture assessment), Gait Variables- Cadence; Stride length, Speed.

Materials Used:

Materials used for the study were Mat or treatment bed, Colour chalk and powder, Inch tape, Stop watch / timer, Walkman with ear phones, Audio cassettes and batteries, Treatment tray.

Procedure:

30 patients were selected for the study and were randomly divided into Group I (control) and Group II (experimental). Control group was given conventional physiotherapy and experimental group was given conventional physiotherapy with auditory cues.

GROUP I:

The 15 subjects were randomly selected for conventional therapy interventions. The patients were made to sit comfortably after a thorough assessment. The patients were clearly explained about the treatment. The patients were instructed to walk on the plane surface of straight corridor in physiotherapy department. Their feet were dipped in colored water such that the footprints could be appreciated. The patients were instructed to walk for fifteen seconds.

The cadence, stride length and speed were noted on the first day of assessment prior to the treatment. The stride length was calculated by measuring the distance between

one heel strikes of the right leg to the successive heel strike of the right leg. The cadence was calculated by counting the number of steps in one minute. The distance covered in one minute calculated speed. The same parameters were measured on the last day of the treatment i.e., on the fifth day of the fourth week, after the treatment.

The treatment frequency was 5 sessions/week for 4 consecutive weeks, the treatment duration being 30 minutes in each session.

Conventional physiotherapy treatment draws on techniques from a range of approaches – theories of learning neuro-physiological and biomechanical approaches to manage individuals with Parkinson's disease. The dominant treatment concept has been termed METERS (Movement Enablement through Exercise Regimes and Strategies) General therapeutic exercise programme included:

Relaxation exercises: Slow rhythmic, rotational movements were given. The patients were made to lie supine. Deep breathing exercises were incorporated throughout the session. They were instructed to do slow side-to-side head rotations and lower trunk rotations in hook lying. Relaxation exercises preceded all other interventions.

Flexibility exercises: Both active and passive range of motion exercises were given to improve flexibility. Stretches were repeated 3 times. Ballistic stretches were avoided.

Mobility exercises: Turning over and getting out of bed is a frequent problem reported by people with Parkinson's disease. Repetitive practice of a bed mobility strategy as well as breaking the action sequence down into steps is indicated in these patients.

The patients were made to stand in front of wall, about 8″ away, raising arms and reaching as high as possible, towards the top of the wall, leaning towards the wall and stretching, standing with the back to the wall alternate raising the legs as high as possible by bending the knees as if marching in place, holding on to something secure, squatting down as far as possible, bending knees and then coming up, making faces in front of the mirror, made to recite the alphabets and count the numbers with exaggerated facial movements.

Gait training: Gait training is typically accomplished through combination of weight bearing, stretching techniques and walking practice. Parkinson's disease patients have slowed speed with shuffling gait pattern, reduced arm swing and trunk movements and an overall attitude of flexion while walking. Physiotherapy treatment aims at marching in place, emphasizing high stepping to strengthen hip flexors. Commands were given to lengthen stride, broaden base of support, improve stepping, improve heel toe gait pattern, increase contra lateral trunk movement and arm swing (Fig 1).

Fig 1. Gait training on footprints

GROUP II:

Neurologist Enrico Fazzini MD, a neurologist at New York University Medical Center, says that music helps reconnect Parkinson's disease patients to what Parkinson's disease takes away: the ability to move automatically.

Rhythmic auditory pacing may provide cues that help normalize walking pace and overcome freezing. External cues utilize cortical mechanisms to activate and sustain movement and in so doing bypass the defective basal ganglia–supplementary motor area circuits.

Rhythmic auditory beats at 96b/minute added along with the conventional physiotherapy treatment were used to analyze the gait parameters – cadence, stride length and speed. The patients were made to sit comfortably after a thorough assessment. The patients were clearly explained about the treatment. The patients were instructed to walk on the plane surface of straight corridor in physiotherapy department. Their feet were dipped in colored water such that the footprints could be appreciated.

The patients were instructed to walk for fifteen seconds in synchrony with the auditory cues. The cadence, stride length and speed were noted on the first day of assessment prior to the treatment. The stride length was calculated by measuring the distance between one heel strikes of the right leg to the successive heel strike of the right leg. The cadence was calculated by counting the number of steps in one minute. Speed was calculated by the distance covered in one minute.

The same parameters were measured on the last day of the treatment i.e., on the fifth day of the fourth week, after the treatment and gait training being done with the auditory cues. The treatment frequency was 5 sessions/week for 4 consecutive weeks, the treatment duration being 30 minutes in each session(Fig 2).

Fig 2. Gait training given with auditory cues

Statistical Analysis: Paired't' test has been used to find the significance of stride length, cadence and speed between pre and post treatment period. Independent' test has been used to find the significance of post treatment values in both the groups.

RESULTS

Section I – Intra group analysis

Intra group analysis was done by using paired't' test.

	PRE		POST		
Stride Length	Mean	SD	Mean	SD	*P* Value
Group I	1.044	± 0.1043	1.16	± 0.121	0.00001
Group II	1.135	± 0.115	1.296	±0.0815	0.00001

Table I A: Intra Group Analysis of Stride Length in both the Groups

The data presented in Table I A shows the pre treatment mean value of stride length as 1.044 with Standard Deviation ± 0.1043 in group I. The post treatment mean value of stride length is 1.16 with Standard Deviation ± 0.121. Here, in group I, the difference of mean stride length is statistically significant (P<0.05) with t value 8.33.This clearly denotes that there was a significant improvement in stride length.

This table also depicts the data in group II with the pre treatment mean values of stride length as 1.135 and Standard Deviation ± 0.115.The post treatment mean value of stride length is 1.296 with Standard Deviation ± 0.0815. Here, in group II, the difference of mean stride length is statistically significant (P<0.05) with t value 7.32. This indicates that there was a significant improvement in stride length.

The group I in Table I B shows the pre treatment mean value of cadence as 104.67 with Standard Deviation ±8.61 and the post treatment mean value of cadence as 108.40 with Standard Deviation ±8.69. Here, in group I, the difference of mean cadence is statistically significant (P<0.05) with t value

7.90. This shows that there was a significant improvement in cadence.

The group II in shows the pre treatment mean value of cadence as 106.53 with Standard Deviation ±9.49 and the post treatment mean value of cadence as 116.80 with Standard Deviation ±9.13. Here, in group II, the difference of mean cadence is statistically significant (P<0.05) with t value 7.94. This shows that there was a significant improvement in cadence.

	PRE		POST		
Stride Length	Mean	SD	Mean	SD	*P* Value
Group I	104.67	± 8.61	108.40	± 8.69	0.00001
Group II	106.53	± 9.49	116.80	± 9.13	0.00001

Table I B: Intra Group Analysis of Cadence in both the Groups

The group I in Table I C shows the pre treatment mean value of speed as 53.60 with Standard Deviation ±4.22.

The post treatment means value of speed as 55.33 with Standard Deviation ±4.25. The t value is 9.12, which is highly significant (P<0.05).

The group II shows the pre treatment means value of speed as 54.27 with Standard Deviation ±4.53 and the post treatment mean value of speed as 60.80 with Standard Deviation ±5.33. The t value is 2.30, which is significant (P<0.05). This clearly denotes that there was a significant improvement in speed.

	PRE		POST		
Stride Length	Mean	SD	Mean	SD	*P* Value
Group I	53.60	± 4.22	55.33	± 4.25	0.019
Group II	54.27	± 4.53	60.80	± 5.33	0.00001

Table I C: Intra Group Analysis of Stride Length in both the Groups

Section II-Intergroup analysis

Inter group analysis is carried out by independent 't' test.

	Group I		Group II		P value	t value
Speed	Mean	SD	Mean	SD		
Pre	1.044	± 0.1043	1.16	± 0.121	0.038	1.84
Post	1.135	± 0.115	1.296	± 0.0815		

Table II A: Inter Group Analysis of Stride Length in both the Groups

The Table II A shows the post treatment comparative values of stride length in both the groups. The pre treatment mean value of stride length in group I is 1.044 with Standard Deviation ±0.1043 and the post treatment mean value of stride length is 1.16. In group II the pre treatment mean values of stride length is 1.135 and Standard Deviation ± 0.115.The post treatment mean value of stride length is 1.296 with Standard Deviation ± 0.0815. The obtained t value is 1.84 that is highly significant with P<0.05. This shows that the treatment in group II was more effective than that of group I in improving the stride length. This shows that the treatment in group II was more effective than that of group I in improving the stride length.

	Group I		Group II		P value	t value
Cadence	Mean	SD	Mean	SD		
Pre	104.67	± 8.61	108.40	± 8.69	0.00001	4.75
Post	106.53	± 9.49	116.80	± 9.13		

Table II B: Inter Group Analysis of Cadence in both the Groups

The Table II B shows the post treatment comparative values of cadence in both the groups. The pre treatments mean value of cadence in group I is 104.67 with Standard Deviation ±8.61 and the post treatment mean value of cadence as 108.40.

The group II in shows the pre treatment mean value of cadence as 106.53 with Standard Deviation ±9.49 and the post treatment mean value of cadence as 116.80 with Standard Deviation ±9.13. The obtained t value is 4.75 that is highly significant with P<0.05. This shows that the treatment in group II was more effective than that of group I in improving the cadence.

DISCUSSION

Parkinson's disease is a progressive movement disorder of the extra pyramidal system, which controls and adjusts communication between neurons in the brain and muscles in the human body. As Parkinson's disease disturbs the locomotion if an individual it results in a substantial reduction in the quality of life. In our study we have tried to find out the individual effects of conventional physiotherapy, conventional physiotherapy with auditory cues and the effectiveness of conventional physiotherapy along with auditory cues over conventional physiotherapy alone on gait pattern in patients with Parkinson's disease.

Three gait parameters namely, stride length; cadence and speed have been studied in both the groups. The present study suggests that conventional physiotherapy and conventional physiotherapy with auditory cues improves the gait parameters significantly (with p<0.05), when tested before and after the treatment.

Comparison of intergroup i.e., group I and group II shows that group II had a more significant improvement in stride length (p=0.00001), cadence (p=0.00001) and speed (p=0.0380).

On intra group analysis in Group I and Group II conventional physiotherapy alone and conventional physiotherapy with auditory cues was effective in improving the gait pattern in patients with Parkinson's disease that is supported by previous researchers.

Palmer SS et al. stated that exercise therapy brings about improvements in gait. Schenkman et. al, suggested that a special exercise program can improve mobility in patients with early and mid stage Parkinson's disease. Knutsson, stated that the intricate series of component movement characteristic of normal gait are primarily disrupted, the change being merely of a quantitative nature, with more or less pronounced decreases in range and speed of movement. It has been seen that despite bradykinesia, the gait can be improved in clients with Parkinson's disease through coaching efforts and repetitive gait exercises.

Music therapy has been found to be effective in all the spheres of life. Music soothes the soul right from enhancing concentration and memory to dealing with diabetes and labor pains, as well as boosting ones immunity, music therapy leads to its healing touch in dementia, autistic, cancer, chronic pain, comatose, elderly patients, and head injuries.

CONCLUSION

Loss of mobility is one of the most disabling factors of Parkinson's disease. There is requirement for improvement in locomotion and the motor deficits in Parkinson's disease.

The results showed that the use of auditory cues along with conventional physiotherapy could bring out significant changes in the stride length, cadence and speed of subjects with Parkinson's disease. The data analysis found a significant difference between conventional physiotherapy and conventional physiotherapy with auditory cues.

The study concluded that the use of auditory cues can improve the gait and mobility in patients with Parkinson's disease with mild to moderate disability.

REFERENCES

1. Mathew B. Stern and William C. Koller, Parkinsonian syndromes, 1st ed.; 1993:3-23.
2. Singhal B, et. al., Epidemiology and treatment of Parkinson's disease in India. Parkinsonism Relat Disord; 2003 Aug; 9 (Suppl 2): S 105-9.
3. Darcy Ann Umphred, Neurological Rehabilitation, 2nd ed. Mosby publishers; 1999: 551-578.
4. Robertson C, Flowers KA. Motor set in Parkinson's disease. J Neurol Neurosurg Psychiatry 1990; 53: 583-92.
5. Susan B O' Sullivan, Schmitz Thomas J: Physical Rehabilitation, 4th ed. JP publishers; 1999: 747-781.
6. Morris ME. Movement disorders in people with Parkinson's disease: a model for physical therapy. Phys Ther.2000; 80:578-597.
7. Cees J.T. de Goede et. al., The Effects of Physical Therapy in Parkinson's disease. A Research Synthesis. Arch Phys Med Rehabil 2001 April; 82:509-15.
8. M. Suteerawattananon, G.S. Morris, B.R. Etnyre J. Jankovic and E.J. Protas, Effects of visual and auditory cues on gat in individuals with Parkinson's disease. Journal of the Neurological sciences 2004 April 15; 219(1-2): 63-69.
9. Fernandez del Olmo M, Cudeiro J. A simple procedure using auditory stimuli to improve movement in Parkinson's disease: a pilot study. Neurol Clin Neurophysiol 2003 Jan 25: 2003 (2): 1–7.
10. Claudio Pacchetti, et. al., Active Music Therapy in Parkinson's disease: An Integrative Method for Motor and Emotional Rehabilitation.Psychosom Med.2000 May-Jun;62(3):386-93.
11. Gunther Bernatzky et. al., Stimulating music increases motor coordination in patients afflicted with Morbus Parkinson. Neuro Science Letters. 2004 May 6; 361 (1-3): 4-8.
12. Howe TE, Lovgreen B, Cody FW, Ashton VJ, Oldham JA, Auditory cues can modify the gait in persons with early–stage Parkinson's disease: a method for enhancing Parkinsonian walking performance? Clin Rehabil. 2003 Jul; 17(4): 363 – 7.
13. Robert L. Freedland et. al, The effects of pulsed auditory stimulation on various gait measurements in persons with Parkinson's disease. Neurorehabilitation. 2002 Nov; 17(1): 81-87.
14. Ma HI, Trombly CA, Tickle Degnen L, Wagenaar RC, Effect of one single auditory cue on movement kinematics in patients with Parkinson's disease. Am J Phys Med Rehabil. 2004 Jul; 83(7): 530-6.

Citation:

Dr. Garima Srivastava and Dr.Jibi Paul, Effectiveness of gait training with auditory cues on subjects with parkinson's disease, IJMAES, 2016; 2 (1), 69-77.