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Case Report

Case Series Illustrating the Use of Nintendo Wiifit as an Adjunct Low Cost Tool for Balance Rehabilitation in Delhi/NCR

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ABSTRACT

The goal of the present case series was to evaluate the feasibility of utilizing the Nintendo Wiifit Therapy for balance rehabilitation in post stroke and Parkinson's disease. Despite its use in western countries, there is lack of evidence on balance outcomes, therapy efficacy and patients acceptance in India. All the patients' participated in twelve sessions, three times a week for four consecutive weeks playing the Nintendo Wii games for 30 minutes in a supervised environment to establish safety criteria. In addition to Wii therapy individualized Physiotherapy or Occupational therapy of 30 minutes at their own places were given by their concerned therapists. Despite the considerable variation in patients' presentation (time since diagnosis, age, clinical presentation) our therapy were able to track improvement for each patient in overall game performance and clinical outcomes. Results showed that the Nintendo Wiifit therapy can be utilized with the individualized Physiotherapy or Occupational therapy with relative ease for recovery of severe functional, motor, and postural deficits even at chronic stage. Patients' feedback was very positive and their comments may be used further to refine the scenario of utilizing Nintendo Wii therapy in India especially in terms of compliance. This case series may encourage other Physiotherapists and Occupational Therapists to explore this low cost Nintendo Wiifit therapy as an adjunct for balance strategies in Post Stroke and Parkinson's disease. Larger scale trials in comparison with standard treatment regimes will be the next viable step in certifying Nintendo Wiifit therapy as a part of rehabilitation for other disabled population too.

Key words: Nintendo Wiifit therapy, Occupational Therapy, Physiotherapy, Balance, Stroke, Parkinson's disease

INTRODUCTION

Stroke and Parkinson's are major health problem in India. The prevalence of stroke in India was estimated as 203 per 100,000 populations above 20 years, amounting to a total of about 1 million cases. [1] Correspondingly; among hospital-based series of 2,34,021 new patients, 27% had neurological disorders, of which 20% had movement disorders and PD was the third common neurological disorder and the commonest movement disorder (86.5%). [2] Good trunk strength is important for balance

during all the daily functional activities and due to trunk impairment, Stroke and Parkinson's disease patients are associated with poor balance and falls.

Even with optimal medications, problem of falls especially in Parkinson's disease are significantly affecting (40–70%) of the patients who have reduced the level of functional independence. [3] Balance being the essential part of sitting, sit-to-stand and walking activities found to be significantly correlated with locomotor function. [4] Balance training is aimed at retraining of postural control, development of effective specific strategies so that functional tasks can be performed in changing environmental contexts and will improve gait performance as well. Thus, balance retraining is a core area of a comprehensive rehabilitation. There are various Hospitals, Centres and Clinics of Delhi/NCR in which most of the Physiotherapists and Occupational Therapists are utilizing different therapeutical approaches like Motor learning, strengthening exercises of limb muscles, Neurodevelopmental treatment, Task oriented training and Progressive resistive exercise training for Balance rehabilitation in individuals with Post Stroke and Parkinson's disease. However, in this technological era where technology innovations in rehabilitation are rapidly being integrated and have the potential to enhance participation in community living, every time patients get above mentioned same traditional therapy, that relies on the repetition of specific movements, which many patients find monotonous, resulting in reduced motivation and compliance with training programs. Recently, Nintendo Wii fit as a low cost virtual reality tool has attracted considerable attention in western countries especially for neuro-rehabilitation with no serious adverse effects. [5,6] In comparison with the use of Traditional therapy alone, yet the use of technological advancement like virtual reality tool with traditional therapy is still a neglected area of stroke and Parkinson's disease rehabilitation in many hospitals, clinics and Centres of India. However, there is no such documented evidence of utilizing Nintendo Wiifit (virtual reality tool) as a part of rehabilitation protocol in Indian context so far as per the available literature. Thus, this case series was aimed at determining the effect and acceptance of Nintendo Wiifit as a low cost adjunct to Occupational and Physiotherapy intervention for individuals with Post-Stroke and Parkinson's disease in Delhi/NCR region.

Participant Descriptions: The four patients' in this report represent four very different Stroke and Parkinson's disease presentations, in terms of age, therapy history and clinical presentation. Our selection criteria was developed in part to illustrate the use of Nintendo Wiifit therapy with a heterogeneous set of patients, each of whom received individualized Physiotherapy or Occupational Therapy treatment of 30 minutes at elsewhere by their concerned physiotherapists / Occupational therapists with the common set of treatment sessions of Nintendo Wiifit therapy (only) of 30 minutes given by us. All patients' completed informed consent. All were medically stable, Body weight not more than 150 kg and No history of seizures. [7]

Participant: P1 At the time of evaluation P1 was 72 years old male right-sided CVA damaged in Nov 2010. He Graded 3 on Modified Ranking Scale. His Brunnstrom Recovery for arm, leg and hand were in transition stage 4 to 5. His main problems listed were difficulty in concentrating on a task, left side neglect and difficulty in recalling previously learned information. All these problems were interfering in her compliance of taking regular therapy. He was taking physiotherapy since 2010 with

all the strengthening and task oriented training. He was facing problem in terms of performing daily routine activities with feelings of fall. He insisted on keeping himself busy and wanted to improve his community living. His previous medical history was unremarkable and included high cholesterol and Blood pressure. A combination of PNF, NDT, Functional retraining/simulation activities, frenkel exercises of upper and lower limb and gait training on different surfaces was given by her physiotherapist.

Fig.1 P2, Taking Virtual Nintendo Wiifit Therapy

All analysis was done using SPSS software version 16.

Participant: P2 A 46 year's old female, diagnosed with stroke, affected her right side of the body in May 2011. Being a housewife she complained of fear of fall while doing household tasks without any assistance. She graded 4 on Modified Ranking Scale. Her Brunnstrom Recovery for arm and hand were in transition stage 3 to 4 and for leg transition stage 4 to 5. On observation we found that she was not aware of the right side of her body. She had taken Physiotherapy for 3 months in 2011 and was continuously taking activity based, task oriented exercises since 2013 but according to her physiotherapist she was not paying much attention to the exercises at the therapy center as she was de-motivated to do the same exercises and was not improving much as her saying. Therapy sessions were designed using a combination of PNF, NDT and functional retraining/simulation activities, individualized to her requirements with the 12 sessions of Nintendo Wiifit therapy by us. (Fig.1)

Participant: P3 A 65 year's old male diagnosed with Parkinson's disease in 2010. He was on levodopa dosage. According to Hoehn and Yahr scale, P3 was on stage 3. Following problems were marked like bradykinesia, walking steps were shorter with little stooped posture. Due to that he was unable to move around confidently due to gait disturbance and balance problems that was affecting his quality of life and well-being. His main concern was to foster better mobility by improving balance. P3 wanted to engage in routine practice to improve his balance confidence and social participation. He was very regular and motivated to do his rehabilitation. Physical Therapy given at her place was a combination of PNF, NDT and functional retraining/simulation activities, frenkel exercises, gait training of multiple surfaces and departmental exercises like cycling, Horizontal sanding in standing etc.

Participant: P4 A 63 year's old male diagnosed with Parkinson's disease in 2008. His Hoehn and Yahr stage was 4. He was on continuous medication of Carbidopa and Levodopa dosage. During the enrollment of Virtual Reality Nintendo Wiifit Therapy some of the features were marked like, severe stooped posture even in standing, loss of automatic movements like swinging of arms in walking. He mainly complained about his posture that was hampering his functional mobility. He also noticed that the time taken to react to disturbing forces, in order to maintain balance had increased recently which made him slow to execute

his normal routine tasks. P4 wanted to live to the fullest with more confidence. He had already taken Physiotherapy and Occupational Therapy sessions which included Strengthening Exercises, Stretching, Activity Based Exercises, and Departmental Exercises at two places but still his recovery was slow. Treatment consisted of variety of therapeutic exercises consisted of joint mobilization, starting with the warm up, combination of PNF, NDT, Task oriented exercises with the ambulation combined with the head motion was given by his occupational therapist.

Material Used: Nintendo Wii-fit System comprises of a *console* that is attached to a television, a wireless *handheld controller* and *balance board* that have pressure sensors for measuring user's center of gravity and weight, [7] digital weighing machine

Clinical Evaluations: Evaluations selected were all validated measures commonly used in physical rehabilitation. They included the Berg Balance Scale (BBS), [8] the Timed Up and Go Test (TUG) [9-11] & Community balance and Mobility scale (CBM). [12,13] All the above measures were done at initiation of treatment and after the treatment post four weeks (Assessor blinded). Two other measures, the Numerical Rating Enjoyment Scale [14] that measured the exercise enjoyment status after the session (Fig.2) and the Modified Short Feedback Questionnaire [15] (SFQ) (Appendix 1) were administered post four weeks.

Special Safety Considerations: A four-point walker was placed around the balance board. Also blood pressure was recorded pre and post every session.

Therapeutic Intervention: Games played were 'Torso Twist', 'Penguin Slide' (A), 'Ski Slalom' (B), 'Ski Jump' (C), 'Table Tilt' (D), and 'Hula-Hoop' (E) (Table 1, Appendix 2). Parkinson's disease patients carried out the Wiifit therapy during the time when their medication was effective.

Table 1: Showing interventions/Days {3 sessions on alternate daysx4weeks (30min)}

Day 1	Warm up stretching exercise by Torso Twist Demonstration of Wiifit balance games with researcher assistance. Ski Slalom x 3 times , Penguin Slide x 3 times, Deep breathing Exercise
Day 2	Ski Slalom x 3 times, Penguin Slide x 3 times, Deep breathing Exercise (therapist assistance)
Day 3	Ski Slalom x 3 times, Penguin Slide x 3 times, Deep breathing Exercise (walker assistance)
Day 4	Ski Slalom x 3 times, Penguin Slide x 3 times, Deep breathing Exercise (independently)
Day 5	Penguin Slide x 3 times, Ski Jump x 3 times, Deep breathing Exercise
Day 6	Ski Slalom x 3 times, Ski Jump x 3 times, Deep breathing Exercise
Day 7	Penguin Slide x 3 times, Ski Jump x 3 times, Deep breathing Exercise
Day 8	Ski Jump x 3 times, Table tilt x 3 times, Deep breathing Exercise
Day 9	Ski Jump x 3 times, Hula Hoop x 3 times, Deep breathing Exercise
Day 10	Penguin Slide x 3 times, Hula Hoop x 3 times, Table tilt x 3 times, Deep breathing Exercise
Day 11	Ski Jump x 3 times, Table tilt x 3 times, Hula Hoop x 3 times, Deep breathing Exercise
Day 12	Table tilt x 3 times, Hula Hoop x 3 times, Deep breathing Exercise

RESULTS

All patients showed improvement in their performance scores in given games 'A', 'B', 'C', 'D' and 'E'. We also used different cues for all the games like: laterally shift your weight by saying "lean a little to the left/right and try to catch the fish", "go through the gates rightly", "stand up tall and lean forward to prompt an anterior weight shift", "rotate your hip in circular motion" Because of all these cues and over all practice, Game performance were improved day by day as shown in Graph 1. Similar performance was noted in all the games played. Blood pressure recorded pre-post each session was within the normal range. Scores of the clinical evaluations are included in Table 2.

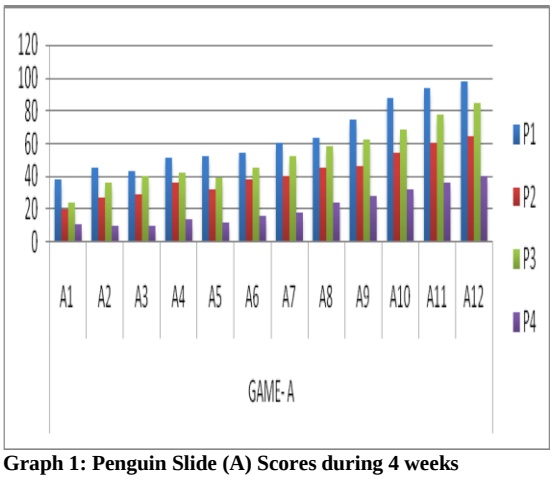
Table 2 Change in outcome measures post 4 weeks

	BBS		TUG		CBM	
	Pre	Post	Pre	Post	Pre	Post
P1	41	45	20	16	36	40
P2	37	40	23	20	29	31
P3	40	44	22	19	34	36
P4	36	39	26	24	26	27

Their score changes can be interpreted with the values of minimal detectable change (MDC). P1 & P2 improved maximum 4 points and minimum 3 points on BBS and TUG. Research on the BBS in different populations has reported MDC ranges from 2.5 points in person with chronic stroke [16] to 5 points for individuals with initial scores between 35-44 points [17] and MDC range for TUG has reported 2.9 seconds for stroke. [18] This suggests that the changes seen in P1 and P2 patients were clinically meaningful. Although there were changes in the scores of BBS, TUG and CBM were seen in P3 and P4 patients but we were unable to detect relevant MDC in the scores of P3 & P4 patients. Also all patients reported their feedback and acceptance of Nintendo Wiifit Therapy in Table 3.

Table 3 SFQ

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
P1	4	4	2	3	4	4	4	3
P2	3	4	3	3	4	4	4	3
P3	4	4	2	3	4	4	4	3
P4	3	4	3	3	4	4	4	3



Graph 1: Penguin Slide (A) Scores during 4 weeks

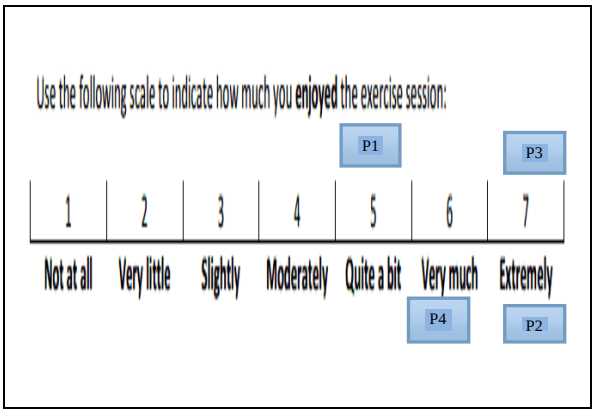


Fig.2 Enjoyment Rating Scale Feedback Post 4 weeks

Patients Perspective:

P1-: "It took me a little bit to figure it out but after that it was fun"

P2 -: "It was hard work but I enjoyed it"

P3-: "It was a distraction. If you told me to shift my weight like that without playing a game, I would be really scared and I probably wouldn't do it but when it was in a game, I didn't really think about how scary it was. I had a goal and I just went for it"

P4 said "I had to really work hard but it was good"

Game Preference: Table Tilt and Penguin Slide.

DISCUSSION AND CONCLUSION

This case series illustrates how Nintendo Wiifit therapy can be added to routine clinical rehabilitation practice, in now days to rehabilitate stroke and Parkinson's disease patients. We applied this therapy in heterogeneous set of patients, and allowing the individualized care, motivation and compliance. P1 and P2 showed major changes in postural stability, dynamic balance, gait and coordination in upper and lower extremities. Correspondingly, P3 and P4 also showed improvement in balance rehabilitation and mentioned that they improved in terms of their posture, functional mobility and automatic movements like swinging of arms with walking and even too motivated to continue Nintendo Wiifit with regular Physiotherapy. Due to the amazing quality of Nintendo Wiifit of producing external focus such as audible clicks or music that was helping all the patients especially P3 & P4 in facilitating rhythm throughout all the games to maintain their attention and in preventing freezing episodes during the Nintendo Wiifit Therapy. External Cues may access cortical

circuitry, thereby bypassing the dysfunctional basal ganglia. [19] Also with the other quality of visual feedback, during the therapy we observed that all the patients were unable to ignore visual input and were able to change their postural orientation in response to the changing visual field that enhanced their gaming score and performance day by day, thereby confirming the efficacy of the Nintendo Wiifit therapy. No indication of worsening incidence reported during or following the intervention. From Improved performance score it has been suggested that by using self observation and correction while executing an action could facilitate motor re-learning in neuro-rehabilitation by the use of mirror neurones, which could prepare the individual for action imitation. [20,21] During the Nintendo Wiifit therapy, all the patients' were seeing an avatar that mimics their movements while playing. This could be another factor and quality of Nintendo Wiifit therapy supporting good results obtained in performance improvements throughout 4-weeks.During the intervention all patients' were motivated by the feedback results which help them to try more, gain points and beat their scores. Some authors suggested that this reward circuitry may be activated by this process, and may benefit many neurological impaired patients. [22,23] We believes that one of the most important successes of Nintendo Wiifit intervention lies in the pleasure component of training, with simple amusing games that can be performed easily, hence maximizing compliance of the patients.

In conclusion, our experience suggests that despite the heterogeneity of stroke and Parkinson's disease, patients' showed the great level of compliance and positivity. We encourage other Physiotherapists and Occupational Therapists that they may also adopt this low cost Nintendo Wiifit therapy for balance strategies and should explore its applicability in different settings and in different populations.

Limitation: We had modified the Short feedback questionnaire with the authors consent for our study but it was not validated.

Future scope: Large group should be selected with rigorous methodologies in comparison to standard treatment regimes.

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Appendix:

Appendix 1: SFQ was administered with four response options (1=strongly disagree to 4=strongly agree) Questions were like : Was the Nintendo Wii games based exercises fun to play?, Did the Nintendo Wii games increase your motivation to perform exercises?, Was the Nintendo Wii games based exercises challenging?, Did Nintendo Wii games have an impact on your balance confidence?, Do you prefer Nintendo Wii games based balance exercises as an adjunct to traditional balance exercises?, Do you feel cheerful and in good spirits after the Nintendo Wii exercise session?, Do

you feel that Nintendo Wii games help you to imitate movements that you fear to perform?, Do you feel regular Nintendo Wii games based exercises can help you to maintain health?

Appendix 2: Game Summary

Games	Name	Purpose	Details
A	Penguin Slide	Lateral Weight Shift	User is represented by a penguin in the centre of an iceberg that tilts to the left and right to catch as many fish as possible.
B	Ski Slalom		User is required to lean left and right to guide the screen character through a series of gates
C	Ski Jump	Forward Weight Shift	User straightens the knees and swing arms behind. Heels should not be off the board.
D	Table Tilt	Multi- Directional Balance	User tilts the platform in the corresponding direction so that marbles sitting on the surface roll into holes.
E	Hula Hoop		User rotates the hips in a circular motion to spin a hula hoop.
	Torso Twist	Warm Up Stretching	User holds arms out to the side and twist slowly from left to right while maintaining dot steady within the target circle.

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