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Original Article

Effectiveness of Customised Vestibular Rehabilitation Therapy in Unilateral and Bilateral Vestibular Lesion Patients

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ABSTRACT

Introduction: Vestibular dysfunction is either unilateral or bilateral. These depict similar signs and symptoms. Here patient primarily complains of head movement induced dizziness and imbalance. The present study compared the customized vestibular rehabilitation therapy (VRT) in unilateral and bilateral vestibular lesion patients. **Method:** The subjects were assigned into two groups by purposive sampling (n=10 each). Group A was Unilateral and group B was Bilateral Vestibular Lesion. Both were given customized vestibular rehabilitation therapy. The twelve days protocol included gaze stability (two mins), dizziness (thirty secs hold, three repetitions) and balance improvement progression exercises (five repetitions each) with thirty secs rest interval in between. Student *t* test was used for analysis. Patients were evaluated for dizziness and risk of fall using Dizziness Handicap Inventory (DHI) and Fall Efficacy Scale (FES). For the assessment of balance, Tandem Walk, Limit of Stability and Clinical Test of Sensory Interaction on Balance (CTSIB) sub-parameters were evaluated using Balance Master. **Result:** The vestibular rehabilitation therapy was effective for functional domain of dizziness and FES in both unilateral and bilateral lesion patients. In unilateral lesion patients even physical domain of dizziness, reaction time (RT), end point excursion (EPE) and directional velocity (DCL), sub-parameters of limit of stability and step width, speed, end sway sub-parameters of tandem gait also improved. In bilateral vestibular lesion, only the sway velocity in CTSIB showed improvement. **Conclusion:** Customized Vestibular Rehabilitation Therapy was effective in improving dizziness and risk of fall greater than balance in unilateral and bilateral vestibular lesion patients.

Key words: Balance Master, Dizziness Handicap Inventory, Fall Efficacy Scale, Vestibular Dysfunction.

INTRODUCTION

Vestibular System includes Central and Peripheral system. The Central Vestibular System comprises of relaying nuclei and pathways passing through and entering the brainstem at the pontomedullary junction.[1] Peripheral Vestibular System comprises of five end organs placed within the labyrinth of the inner ear and the vestibular portion of the vestibule-cochlear nerve.[1]

Causes of vestibular dysfunction are Viral infection (neuritis, labyrinthitis, otitis media), Benign Paroxysmal Positional Vertigo (BPPV), Ototoxicity, Trauma or tumor leading to lesions at the cerebellum or brainstem, Age related chronic degenerative disorders such as stroke and Meniere's disease[2] Dysfunction along either of the systems leads to vestibular dysfunction causing dizziness and imbalance.[1]

Dizziness is defined as abnormal sensations relating to perception of the body's relationship in space.[3] It is categorized by vertigo (illusion of movement), disequilibrium, feeling of lightheadedness and oscillopsia (experience of motion of object).[4] Prevalence of dizziness ranges from 1.8% in young adults to 30% in the elderly.[3]

Disequilibrium leads to imbalance in most of the vestibular dysfunction patients. Fall is a common concern in these patients.[5] It is observed that vestibular dysfunction results in postural dysfunction, instability in stance during ambulation and transitional activities.[5]

Vestibular dysfunction is either unilateral or bilateral.[6] These depict similar signs and symptoms. Here patient primarily complains of head movement induced dizziness and imbalance.[4,6] Blurring of vision, nystagmus, vertigo, oscillopsia, hearing impairment, nausea and vomiting are other symptoms associated with this condition.[6] The incidence of fall is higher in bilateral conditions as compared to unilateral conditions.[5]

Several scales and instruments are available to evaluate these symptoms. Dizziness handicap inventory will evaluate the effect of dizziness on physical, functional and emotional domains in patients.[7] Fall efficacy scale is designed questionnaire with score range from sixteen to sixty four points. Higher values indicate less fall-related self-efficacy.[7] Balance master is an equipment designed to assess static and dynamic balance using several tests. To evaluate static balance, Clinical Test of sensory Interaction on Balance

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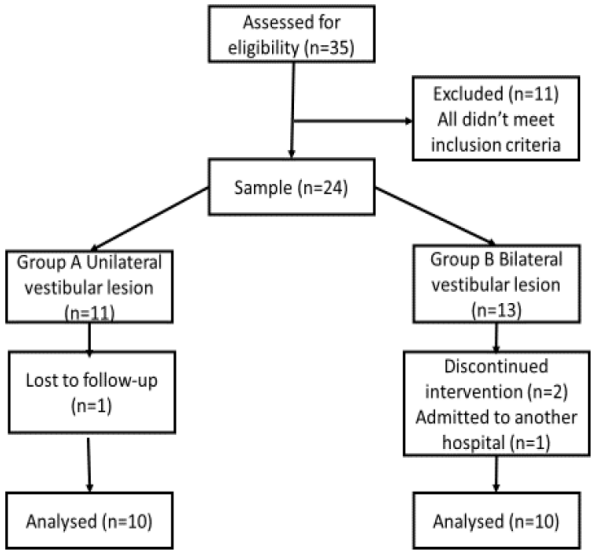
(CTSIB) and for dynamic balance, Tandem Gait and Limit of Stability parameters were taken.

Various interventions have been acknowledged to treat the vestibular dysfunction. Customized Vestibular rehabilitation therapy (VRT) is an exercise-based program designed to decrease dizziness and increase balance and gait functions. The treatment protocol is inclusive of static and dynamic exercises. These are supervised outpatient exercises along with home exercise programs. VRT facilitates the reduction of self-perceived dizziness provoked by head movement or movement in a busy visual environment, improves mobility and balance function and decreases gaze instability associated with head movement.[6]

Vestibular dysfunction be it unilateral or bilateral is one of the concerning yet ignored condition. One of the key symptom of this condition is balance impairment and dizziness. There have been a few studies done to check the effectiveness of VRT in patients with unilateral and bilateral vestibular lesions separately but none that had the same treatment protocol for the two. This study was an effort to check whether the customized vestibular rehabilitation therapy had an effect on dizziness, risk of fall and balance in patients with these two conditions.

MATERIALS AND METHODS

After the institutional ethical committee approval the patients as referred from ENT and Medicine department were recruited after purposeful sampling for this study. Following the informed written consent patients under the age of sixty-five diagnosed with peripheral or central unilateral and bilateral vestibular lesion using MRI were provided with twelve treatment sessions of customized vestibular rehabilitation therapy in the OPD of Dr. D. Y. Patil College of Physiotherapy. Patients with Benign Paroxysmal Positional Vertigo (BPPV), gait impairments due to stroke, TBI and tumor excision, vertigo due to cervical spondylosis were excluded from the study. Participants were then evaluated for dizziness and fall as primary outcome measures using DHI and FES scale. For balance assessment, LOS, CTSIB and Tandem Gait were assessed using balance master. Under LOS sub-parameters recorded were Reaction Time, End Point Excursion, Maximum Excursion, Movement Velocity and Directional Control. For Tandem Gait Step Width, Speed, End Sway were recorded on the 1st day followed by the twelfth day session of the intervention. Twenty four samples were evaluated with three dropouts in unilateral and one in bilateral group. Twenty samples (ten in each group) finally completed the study protocol.



CONSORT Diagram

Intervention: All the recruited patients were assigned in two groups based on unilateral and bilateral vestibular lesion. Group A (n=10) was unilateral vestibular lesion. Group B (n=10) was bilateral vestibular lesion. Both the groups were given customized vestibular rehabilitation therapy for twelve sessions in two weeks. Exercises included:

(i) Vestibular ocular reflex exercise for gaze instability
(ii) Habituation exercise for motion provoked dizziness (hold for thirty secs and three repetitions.)
(iii) Sit to stand from a chair (five repetitions)
(iv) Spot Marching (five repetitions)
(v) Rhomberg's stance with eyes open (five repetitions)
(vi) Side Walking (five repetitions)
(vii) Rhomberg's stance with eyes closed (five repetitions)
(viii) One leg standing (five repetitions)
(ix) Turn around-360 degree (five repetitions)
(x) Walking with horizontal and vertical head movements (five repetitions)

(After every exercise, break for twenty to thirty secs)

The data was analyzed using primer software.

RESULTS

In Table 1, the comparison between 1st and 12th day for group A showed significant difference ($p \leq 0.05$) in physical and functional domain of DHI along with FES

In Table 2, the comparison between 1st and 12th day for group A showed significant difference ($p<0.05$) in reaction time(RT), end point excursion(EPE) and directional velocity(DCL), sub-parameters of limit of stability and step width, speed, end sway sub-parameters of tandem gait.

In Table 3, the comparison between 1st and 12th day for group B showed significant difference ($p<0.05$) in functional domain DHI and FES.

In Table 4, the comparison between 1st and 12th day for group B showed significant difference ($p<0.05$) in sway velocity sub parameter of CTSIB.

DISCUSSION

Vestibular lesion patients present with wider range of symptoms with affection of some symptoms greater than other. To address all such symptoms the therapy has to be customized and should focus on a sensible treatment. These patients have impairments including dizziness and vertigo, oscillopsia, balance and gait impairments resulting in functional limitations.[8]

In the present study, it is observed that after twelve sessions of treatment, DHI reported physical and functional domain improvement in unilateral vestibular lesion patients. Emotional domain did not show any noticeable improvement. (Table 1)This result could be attributed to the fact that the

Table 1: Group A DHI and FES comparison on 1st and 12th session of intervention

Variables	Mean Difference	Standard Error of difference	t-value	p-value
DHI Physical domain	5.60	1.185	4.72	P<0.05
DHI Emotional domain	2.6	1.551	1.67	P>0.05
DHI Functional domain	9	1.125	7.996	P<0.05
FES	7.9	1.09	7.24	P<0.05

Table 2:Group A Balance Master Parameters comparison on 1st and 12th session of intervention

Parameters	Mean Difference	Standard Error of Difference	t-value	p-value
LOS				
Reaction Time	0.2310	0.079	2.9393	P<0.05
End Point Excursion	-17.00	5.300	3.2076	P<0.05
Maximum Excursion	-4.10	3.427	1.1809	P>0.05
Directional Velocity	-7.30	1.713	4.2615	P<0.05
Movement Velocity	-0.550	0.348	1.5801	P>0.05
CTSIB				
Sway Velocity	0.130	0.090	1.0526	P>0.05
Tandem Gait				
Step Width	0.1510	0.636	2.3728	P<0.05
Speed	-2.980	1.650	1.8060	P<0.05
End Sway	1.330	0.86	2.7377	P<0.05

Table 3: Group B DHI and FES comparison on 1st and 12th session of intervention

Variables	Mean Difference	Standard Error of difference	t-value	p-value
DHI Physical domain	2.20	1.381	1.5933	P>0.05
DHI Emotional domain	2.80	1.692	1.6550	P>0.05
DHI Functional domain	4.40	1.327	3.3166	P<0.05
FES	3.10	0.526	5.89	P<0.05

Table 4: Group B Balance Master Parameters comparison on 1st and 12th session of intervention

Parameters	Mean Difference	Standard Error of Difference	t-value	p-value
LOS				
Reaction Time	0.1700	0.139	1.2263	P>0.05
End Point Excursion	-5.80	10.316	0.5622	P>0.05
Maximum Excursion	-4.80	6.987	0.6870	P>0.05
Directional Velocity	-0.60	2.634	0.2278	P>0.05
Movement Velocity	-0.730	0.459	1.5913	P>0.05
CTSIB				
Sway Velocity	-0.090	0.171	0.5226	P<0.05
Tandem Gait				
Step Width	0.810	1.166	0.6947	P>0.05
Speed	1.350	2.762	0.4887	P>0.05
End Sway	0.610	0.391	1.5607	P>0.05

emotional and psychological factors were not taken into consideration while setting the customized vestibular rehabilitation therapy protocol and hence no such counselling or guidance was given to the patients. Also keeping the duration of twelve sessions in mind, attaining this goal would have been quite difficult.

These results are in accordance with the findings reported by Arash Bayat and Nader Saki who found that the emotional factor was least affected by the treatment whereas the physical and functional aspect though most affected showed better results.[8] A study in 2001 concluded with considerable improvement in only physical component of DHI.[9]

Significant results were also reported for FES (Table 1) and all parameters of balance master except movement velocity (MVL) and maximum excursion (MXE) (Table 2). Evidence shows that the central nervous system including vestibular system has the property of plasticity of the Vestibular Neuclei due to which they change or get adapted when facilitated by vestibular rehabilitation therapy.[1,8,10] As for Movement Velocity, Maximum Excursion and Tandem Gait, these are parameters that are somehow dependent on speed. It is difficult to find improvement in the speed given the time duration of the therapy. A longer treatment protocol might show positive results in these factors. This leads to compensation of the deficits resulting in its improvement.[11] Similar results were found in a study conducted by Gino Marioni *et al.* 2012 showing significant results improvement in the sway velocity.[11]

In bilateral vestibular lesion, only functional domain of DHI showed improvement. (Table 3) In these cases, the severity of the symptoms especially oscillopsia is highly prevalent. This might be a reason for no noticeable changes in the physical domain of DHI.

While taking the emotional domain of DHI into consideration, studies have shown that it is equally important to focus on the psychological and emotional aspect of the treatment in the patients with vestibular lesion as mentioned earlier. These patients experience anxiety due to dizziness and the fear of fall.[12,13] Studies have shown that inclusion of psychological counselling about the condition and its prognosis along with emotional support in the treatment protocol can go a far way in reducing a patient's anxiety and improving their emotional state.[13]

A study done by Kathryn E. Brown *et al.* 2001 suggested that in bilateral vestibular lesion the emotional and physical domains of the scale show significant improvement but the functional domain doesn't.[14] This study also states that improvement with risk of fall is less due to the presence of severe oscillopsia.[14,15]

FES had also reported significant results (Table 3). Severity of the condition in this study might have not been as extreme as anticipated. For balance master only, Sway Velocity in CTSIB showed significant improvement (Table 4). Rhomberg's Stance is one of the exercise in the protocol which is similar to this test. Having performed this exercise over and over again everyday could have led to its adaptation and giving them the confidence to perform it easily as a test. The symptoms of vestibular lesion are co-dependent. The lesion leads to osillopsia and dizziness which leads to impaired balance. This causes static and dynamic gait disturbances increasing risk of fall. Hence, all the symptoms should be given equal importance and should be treated for to avoid the further worsening of the condition.

The study suggests customized vestibular rehabilitation therapy shows improvement by the end of the twelve sessions in both the conditions. Though clinically more improvement was seen in unilateral as compared to bilateral lesion.

Future studies can be done using larger sample size to better generalize the results. The study has its limitations. The duration of the treatment was short. Longer duration of the treatment could have shown better results. Lack of consideration of the emotional factor of DHI was another drawback. Inclusion of a home protocol is necessary for an even better improvement. Visual cues should have been included as vestibular lesion patients tend to have hearing impairment which leads to communication barrier in certain cases.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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ABBREVIATIONS

BPPV: Benign Paroxysmal Positional Vertigo; **CTSIB:** Clinical Test of Sensory Interaction on Balance; **VRT:** Vestibular Rehabilitation therapy; **DHI:** Dizziness Handicap Inventory; **FES:** Fall Efficacy Scale; **LOS:** Limit of Stability; **MVL:** Movement velocity; **MXE:** Maximum Excursion; **RT**: Reaction Time; **EPE:** End point Excursion; **DCL:** Directional velocity

SUMMARY

The present study was conducted to find effect of customized vestibular rehabilitation therapy on dizziness, risk of fall and balance in unilateral and bilateral vestibular dysfunction patients. Though risk of fall was reduced in both the groups, dizziness and balance components have shown greater improvement in unilateral vestibular lesion patients. This can be attributed to more severity of symptoms seen in bilateral vestibular lesion patients.

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