ORIGINAL ARTICLE

Vestibular Rehabilitation Outcome of Patients with Unilateral Vestibular Deficits

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OBJECTIVE: Patients with vestibular disorders frequently report vertigo, imbalance and gait problems. Pioneering authors Cawthorne and Cooksey suggested a treatment for vertigo that was a radical departure from the traditional medical management that many physicans still use today. The aims of this prospective study were to assess the efficacy of vestibular rehabilitation program for patients with unilateral peripheral vestibular deficits and to calculate the validation of the Turkish version of Dizziness Handicap Inventory (DHI-TR). Methods: Patients who had been diagnosed as unilateral peripheral vestibulopathy between January 2003-June 2007 in Dokuz Eylül University, Medical School, Department of Otolaryngology are assessed during pre and post-rehabilitation periods in terms of functional, physical and emotional conditions using the DHI-TR.

RESULTS: The mean age of patient group (n=47) was 52.2±13.5 years. The DHI-TR has been shown to retain good test-retest reliability (item-total correlation range >0.4) and internal consistency (Cronbach alpha value=0.833). Applied vestibular rehabilitation programme found to be effective for treating unilateral peripheral vestibular pathologies ($p<0.001$). Improvement affects the performance of activities of daily living.

CONSLUSION: As a result we found that the DHI-TR has enough reliability and validity to assess the effectiveness of vestibular rehabilitation programme.

During the acute stage after unilateral vestibular loss, horizontal vestibulo-ocular reflex is decreased for head movements both toward and away from the side of lesion, and vertical vestibulo-ocular reflex is symmetrically decreased [1]. Recovery is relatively rapid, and VOR gain is normal in 1 to 3 months [1,2]. This recovery, however is limited to low frequencies of head movements only. When rapid, unpredictable head movements are made toward the side of lesion, a marked and permanent vestibular deficit can be demonstrated [3]. The limited recovery of the vestibulospinal responses is more difficult to illustrate because its not possible to isolate the vestibulo-spinal response from other postural pathways. Several studies have noted recovery of the ability of patients with unilateral vestibular loss to maintain their balance when both visual and somatosensory cues are altered, a condition in which balance is maintained, presumably with vestibular cues. The mechanisms that may contribute to the recovery of vestibular function are cellular recovery, adaptation and central compensation [4]. Vestibular adaptation is context specific. If the gain of the VOR is adapted up at 0.2 Hz, the greatest change in gain will occur at the adapting frequency, with less significant changes occuring at other frequencies [5].

Specifity can also be shown for orientation of the head during adaptation, presumably because of the influence of the otoliths with different head positions [6] and for the eye in orbital position [7]. Altough adaptation is a potent characteristic of the vestibular system, not all head movements will result in a change in VOR gain. Horizontal and vertical head movements can be used to induce changes in VOR gain [4]. People with various impairments of the vestibular system complain of disorders with the functions of vestibular system. The hallmark of vestibular impairment is vertigo, the illusion of self-motion, sometimes described as a sense of spinning or falling. Many people complain of poor balance, blurred vision and bumping into walls or corners while walking [8].

Vestibular rehabilitation (VR) has become one of the most widely used treatments for balance disorders [9]. The use of vestibular exercises to treat patients with persistent symptoms of positional vertigo and disequilibrium has been around for many years [10]. Vestibular rehabilitation originated in the 1940's when Cooksey, a physiotherapist, and Cawthorne, an otolaryngologist, suggested exercises using head and eye movements in sitting and standing, plus dynamic balance exercises [11,12,13]. Thus, there is a growing body of evidence to support the use of vestibular rehabilitation with people with dizziness and functional loss as a result of vestibular disorders.

Vestibular rehabilitation programme can be individually tailored by asking the patient to score each exercise according to the symptoms. Patient with dizziness is advised to progress to the next exercises on the list when he/she is free of symptoms or after having performed the exercises for 2-3 weeks [14,15].

The Dizziness Handicap Inventory (DHI) was developed by Jacobson and Newman [16]. Since its development, the DHI has been used to assess quality of life of individuals with vestibular dysfunction as well as the efficacy of certain treatments for vestibular dysfunction [17,18,19]. The DHI consists of 25 questions concerning the presence of dizziness during performance of specific movements (items related to physical parameters) and during normal daily life activity (functional questions) and concerning the emotional impact caused by dizziness symptoms (items related to emotional parameters). Answers to each item were scored as 4 if dizziness was present all the time, scored as 2 if it was present sometimes, and as 0 if it was never present (16). The total score varies from 0 (no handicap) to 100 (maximum handicap) and 3 classes are defined indicating mild (0-30), moderate (31-60), and severe (61-100) degrees of perceived handicap (20). In previous studies, the DHI has demonstrated good validity and reliability with repeated testing and is frequently used in various studies (16,17,18,23). It also has been shown to be sensitive to a perception of decreased handicap in individuals in response to various treatments (19). To the best of authors knowledge, there is no published study pertaining the use of the Turkish version of this Inventory in patients with unilateral peripheral vestibular disorders.

MATERIALS AND METHODS

Fourty-four patients who have vertigo, dizziness and imbalance were included in the study. Patients went to vestibular testing, including detailed anamnesis, computerized electronystagmography, balance evaluation tests and audiologic tests after the assessment by an otolaryngologist in Dokuz Eylül University, Medical School, Department of Otolaryngology. Audiologic tests included pure-tone audiometry, acoustic immitancemeter, speech discrimination test and otoacoustic emissions. Balance evaluation tests include Romberg, Sharpened Romberg, Quix, Unterberger, Dix-Hallpike, open/closed eyes tandem walking tests. The balance evaluation tests were used in order to support the history/anamnesis. Electronystagmography test battery included saccadic, tracking, optokinetic, gaze and bithermal caloric tests. All 47 patients had taken a clinical diagnosis of peripheral vestibular pathology.

Patients with the following problems were excluded from the study:

1. Bilateral peripheral vestibular pathology
2. Central vestibular pathology
3. Meniere's disease
4. Benign paroxysmal positional vertigo
5. Neurological problems
6. Post-traumatic vertigo
7. Psychological vertigo

Medical management: In acute stage, some patients had vestibular suppressive medication (Cinnarizine) a few days for symptomatic relief before inclusion in the study. However, during the vestibular rehabilitation period, no vestibular suppressants or sedatives were used fro treatment

Exercise Programme: Following no medication period of 4 to 6 weeks if vestibular problems did not resolve, the decission was to treat the patient in terms of vestibular rehabilitation. Information was given to the patients concerning the balance system, the mechanisms of vestibular rehabilitation and the present study. All patients received oral and written instructions consisted of home exercises to be performed twice a day at least 30 minutes in a setting. The programme consisted of Cawthorne-Cooksey exercises as well as balance and proprioceptive retraining program. Balance and proprioceptive retraining program included exercises for static and dynamic balance execises like standing and walking on different firm, uneven or complaint surfaces with combinations of eyes open or closed, movements of head, trunk and extremities. The exercises were designed to be challenging to the patients, so the degree of difficulty increased during the training period and different aspects of balance training were emphasized for different patients in order to individualize the exercises. All patients were also encouraged to take walks outdoors. They were followed up on a weekly basis when exercises were made progressively more challenging. The length of treatment varied from four to twelve weeks and they were discharged when the symptoms decreased and the independence of daily life activities were gained. Patients were evaluated two times with DHI-TR at their initial appointment for vestibular rehabilitation and at discharge.

Statistical Analysis: Descriptive statistics and mean and standard deviations were calculated. The correlation between items and item-total was calculated by using Pearson's Bivariate Correlation Analysis. Validity of the scale was assessed by looking at item-total correlation and average inter-item correlation for the contributing items and Cronbach's alpha coefficient while the item-scale correlation indicates the relationship between the item and the total scale score. The inter-item correlation indicates the average relationship between the item and the other items. Cronbach's alpha coefficient tells how well the scale measures a single underlying construct. Paired-samples t test were used for comparing the prerehabilitation and postrehabilitation scores in the DHI-TR (see Addendum for the original version of DHI). All of analyses were done using SPSS 11.0 for windows.

RESULTS

As the terms of vestibular rehabilitation schedule explained, fourty-four patients (33 women and 11 men) with a mean age ± standard deviation (SD) of 52.2 ± 13.5 years (min:26-max:78) were included in the study (Table-I).

Table-I: Average age and standart deviation of the patients.

Number of Patients	Mean Age (years)
Men (n=11)	54.6 ± 10.4
Women (n=33)	51.4 ± 14.4
Total (n=44)	52.2 ± 13.5

The Cronbachs' values were calculated for all three subscores and total score (Table-II)

Table-II: The Cronbachs' values of DHI-TR.

	Cronbachs' values
Physical Score	0.737
Functional Score	0.804
Emotional Score	0.774
Total Score	0.833

The inter-item and item-total correlation analyses were not assessed in detail, but inter item correlation values weren't included this paper detailed. The inter-item correlation values, alpha if item deleted, and corrected item-total correlation values of three subscores were included (Tables III-IV).

The mean values of DHI-TR scale scores and subcores were presented in Table V and Figure 1. Statistically significancy level for the group were presented for the physical, functional and emotional subscales in Table VI.

Table-III: Item-total correlation coefficients of original and Turkish version of DHI, and α values if item deleted in Turkish version of DHI.

DHI Questions	Turkish version (α if item deleted)	Turkish version (item α total value)	Original version (item total r value)
Q1(P)	0.712	0.67**	0.54
Q2(E)	0.7	0.448**	0.34
Q3(F)	0.732	0.644**	0.76
Q4(P)	0.72	0.578**	0.39
Q5(F)	0.744	0.431**	0.50
Q6(F)	0.726	0.675**	0.69
Q7(F)	0.727	0.582**	0.44
Q8(P)	0.718	0.491**	0.54
Q9(E)	0.696	0.59**	0.43
Q10(E)	0.721	0.202	0.46
Q11(P)	0.744	0.209	0.51
Q12(F)	0.728	0.552**	0.49
Q13(P)	0.743	0.414**	0.43
Q14(F)	0.733	0.596**	0.58
Q15(E)	0.702	0.455**	0.30
Q16(F)	0.724	0.658**	0.62
Q17(P)	0.714	0.557**	0.58
Q18(E)	0.697	0.569**	0.49
Q19(F)	0.713	0.638**	0.48
Q20(E)	0.691	0.549**	0.27
Q21(E)	0.683	0.601**	0.41
Q22(E)	0.686	0.517**	0.46
Q23(E)	0.687	0.487**	0.41
Q24(F)	0.744	0.425**	0.56
Q25(P)	0.725	0.568**	0.57

**= Correlation is significant at the p<0.01 level.

(P): Physical items, (E): Emotional items, (F): Functional items.

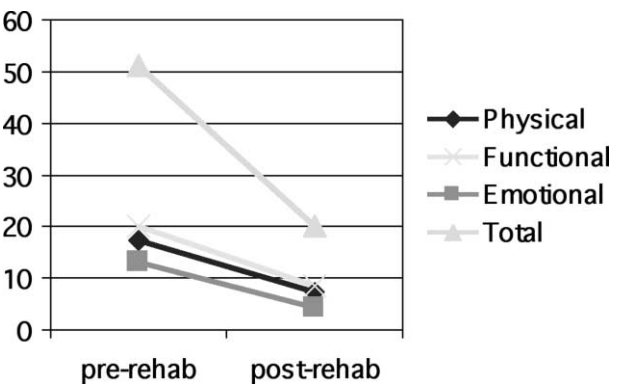

Figure-1: Mean values of the DHI scores before and after the vestibular rehabilitation.

Table-IV: Corrected Item-Total Correlation values of three subscores and total score of DHI-TR.

	Corrected Item-Total Correlation
Physical Subscore	0,776*
Emotional Subscore	0,762*
Functional Subscore	0,811*
Total Score	0,974*

* =Correlation is significant at the p<0.01 level.

Table-V: Mean values of the DHI-TR scores before and after the vestibular rehabilitation.

	Pre-rehabilitation Mean Value±1SD	Post-rehabilitation Mean Value±1SD
Physical Score	17.5 ± 5.9	7.4 ± 5.6
Functional Score	20.9 ± 8.4	8.4 ± 6.7
Emotional Score	13.1 ± 8.08	4.4 ± 4.6
Total Score	51.3 ± 19.3	20.06 ± 15.9

Table-VI: Paired samples t-test for DHI scores before and after the vestibular rehabilitation (p values).

	Sig (2-tailed) p values
Physical Score	0.000
Functional Score	0.000
Emotional Score	0.000
Total Score	0.000

DISCUSSION

The purpose of balance function studies encompanses three major goals [21]. The most traditional is site of lesion localization. The second one is to assess the patient's functional ability. And the last one is to evaluate the current degree of physiologic and functional vestibular compensation in the process of the rehabilitation [22].

The demographical structure and the sampling size of the subjects' were similar to literature [24, 25, 13, 26, 27, 28]. The number of females was obviously higher than males in all of these studies. And the mean ages were higher than 44 years.

The Cronbachs' alpha value of DHI-TR total score was 0.833. This value is similar to literature [16, 17, 25].

The correlation coefficient analysis were done in detailed. The values of item-total correlation coefficients showed high significancy except Q10 (E) (r=0.202) and Q11 (P) (r=0.209). Q10 was "Embarassed in front of others", Q11 was "The effects of quick head movements on dizziness". These results supported by the α values if item deleted (αQ10=0.721, αQ11=0.744). The correlation coefficient levels of subscores and total score were high ($p<0.001$). These findings were similar to other papers [16, 17, 25, 29].

We found a statistically significant decrease between DHI-TR total scores pre and post rehabilitation periods. This was also valid for all three subscores with contrasts with Cowand et al who found that the emotional score did not significantly change. These studies measured efficacy of vestibular rehabilitation (VR) in 37 patients using the self assessment DHI. They found that 35 % of patients undergoing VR, showed significant improvement, and 78 % of them indicated some improvement [26]. Also they have recognized a significant statistical reduction between total DHI scores before and after VR.

Humphriss et al analysed the differences before and after VR, using DHI scores. They found that all three components and total score differences were statistically significant (Wilcoxon signed rank test, $p<0.0001$) [13]. Our findings were similar to this research.

Meli et al [27], and Topuz et al [28] found improvements in the emotional and functional state. The physical state after rehabilitation did not show any improvement in this study . These findings may be related to inclusion criteria of the particular study. Thus, all kinds of vestibular pathologies (central, fluctuating and bilateral peripheral vestibular pathologies) were included to this study. This situation may lead to different results of DHI subscores and total score after VR. Because, we know that, the effectiveness of VR is comparatively poorer in those pathologies defined above. In order to promote the central compensation process, the central nervous system and the contralateral peripheral vestibular structures must be non-fluctuating and intact.

The inclusion criteria of this study have allowed only the patients with persistant unilateral periphral vestibular pathologies. This condition might have limited the number of the subjects. In addition, there might be other limitations concerning the study. It could be claimed that these patients would have improvement in remission period after the acute phase. This condition was valid in other papers. In the present study, the rehabilitation programme was started for the patients who could not complete the central compensation process properly, 4 to 6 weeks after the onset of the symptoms.

The lack of control group in this study, might be a disadvantage. Including a non-treatment group could well be a limiting factor of the study, in terms of ethical aspects. There are similar studies, which used the patient group as an own control group [26,30,31].

CONSLUSION

The Turkish version of DHI is applicable for Turkish population who undergone vestibular disorders. The translation of DHI to Turkish have no negative effect in terms of reliability and validity level. The higher Cronbachs' alpha values and higher level of item-total correlation coefficients imply that the DHI can be used in clinical studies.

The Cawthorne-Cooksey exercises, when provided intensely and appropriately, led to measurable improvement in balance and the subjective feeling of dizziness in patients affected by peripheral vestibular disease. In order to further evaluate the compensation mechanism and effectiveness of vestibular rehabilitation programmes in patients with peripheral vestibular disorders, comprehensive studies should be conducted.

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Inquiry Form

	PHYSICAL DOMAIN (P)	4 all	3 most	2 some	0 never
1	Does looking up increase your problem?				
2	Does walking down the aisles of a supermarket without a cart increase your problem?				
3	Does performing more ambitious activities like sports, dancing, or household chores increase your problem?				
4	Do quick head movements increase your problem?				
5	Does turning over in bed increase your problem?				
6	Does walking on the lawn increase your problem?				
7	Does bending over increase your problem?				
	FUNCTIONAL DOMAIN (F)	0	0	0	0
8	Because of your problem do you restrict your travel for business or recreation?				
9	Because of your problem do you have difficulty getting into or out of bed?				
10	Does your problem significantly restrict your participation in social activities?				
11	Because of your problem do you have difficulty reading?				
12	Because of your problem, do you have someone accompany you when you leave home?				
13	Because of your problem, is it difficult for you to take care of yourself (bath, dress prepare a meal)?				
14	Because of your problem, is it difficult for you to walk around your house in the dark?				
15	Because of your problem, do you avoid driving your car during the daytime?				
16	Because of your problem, is it difficult for you to go for a walk by yourself?				
17	Because of your problem, is it difficult for you to walkup and down stairs?				
18	Because of your problem, do you avoid driving your car in the dark?				
19	Does your problem interfere with your job or your household responsibilities?				
	EMOTIONAL DOMAIN (E)	0	0	0	0
20	Because of your problem, is it difficult for you to concentrate?				
21	Because of your problem, do you feel frustrated?				
22	Because of your problem, are you afraid to stay home alone?				
23	Because of your problem, are you afraid people think you are intoxicated?				
24	Has your problem places stress on your relationships with members of your family or friends?				
25	Because of your problem, are you depressed?				

	All	Most	Some	Never	Total
P	0	0	0	0	0
F	0	0	0	0	0
E	0	0	0	0	0