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MAIN ARTICLE

The value of close monitoring in vestibular rehabilitation therapy

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Abstract

Background: Vestibular rehabilitation therapy is a well-established treatment modality for patients with vestibular problems.

Hypothesis: Performing vestibular rehabilitation therapy in a closely monitored setting may result in a better outcome than a home exercise programme.

Methods: A retrospective study was conducted of patients undergoing vestibular rehabilitation therapy between June 2005 and November 2012 in a tertiary university hospital. The Dynamic Gait Index, the main outcome measure, was utilised before and after the rehabilitation programme. The magnitude of improvement for all patients was analysed, mainly to compare the home exercise group with the closely monitored therapy group.

Results: Only 32 patients underwent the vestibular rehabilitation therapy programme. In all patients, there was significant improvement in the mean Dynamic Gait Index score (from 11.75 to 17.38; $p < 0.01$). Dynamic Gait Index improvement was significantly higher with closely monitored therapy (mean improvement of 7.83 *vs* 2.79; $p < 0.01$).

Conclusion: The small sample size is a major limitation; nevertheless, closely monitored vestibular rehabilitation therapy resulted in improved performance status. More studies are needed to establish the efficiency of vestibular rehabilitation therapy and compare closely monitored therapy with tailored home exercise rehabilitation.

Key words: Rehabilitation; Physical Therapy Techniques; Vestibular Diseases; Cost-Benefit Analysis

Introduction

With the increased average life span, visits for balance system disorders are becoming more common. With ageing, there are multiple factors that contribute to decreased balance, such as loss of neurons and vestibular hair cells, limitations of joint function, reduced visual acuity, and cognitive difficulties.[1,2] It is estimated that 80 per cent of elderly patients who experience unexplained falls have symptoms of vestibular impairment.[3] Falls in elderly people are responsible for 90 per cent of hip fractures, and the current cost of hip fractures in the USA is estimated to be about 10 billion dollars annually.[4]

Vestibular rehabilitation therapy has contributed significantly to the management of balance disorders, reducing the rate of falls in the elderly,[5] improving spatial orientation[6,7] and improving overall well-being.[8] A recent Cochrane review of 26 randomised controlled trials, with 1668 patients, has shown that vestibular rehabilitation is effective for the treatment of unilateral vestibular dysfunction (as cited in Browning).[9] Vestibular rehabilitation has been shown to be more effective for peripherally rather than centrally caused imbalance.[10] No studies, however, have demonstrated the value of performing vestibular rehabilitation therapy in a closely monitored unit with the continuous presence of a dedicated physical therapist as compared to performing these rehabilitation exercises alone after being given instructions. Our hypothesis is that performing these exercises in a monitored programme will yield better results than performing them unmonitored. A failure to establish this hypothesis will support unmonitored vestibular rehabilitation therapy, which will save more human resources, and consequently time and money, and will abolish the risk and effort associated with the transportation of disabled patients.

Materials and methods

The Vestibular Rehabilitation Program was initiated at the American University of Beirut Medical Center, Lebanon, in June 2005. Patients referred to this programme were assessed for Dynamic Gait Index score before and after treatment. The Dynamic Gait Index

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is a well-established international scale for assessing vestibular and balance impairment.[11] All patients were evaluated and referred for vestibular rehabilitation therapy by the primary investigator.

A total of 32 patients referred for vestibular rehabilitation therapy between June 2005 and November 2012 were eligible for inclusion in our study. Patients with co-existing musculoskeletal problems were excluded from the study. Patients with musculoskeletal issues who were excluded from the programme included: (1) patients who received total hip or total knee replacements, or who experienced femoral or tibial fractures, less than 2 years previously, or those with residual muscle weakness and/or limited range of motion compared to the contralateral side, or patients who have any limping that is clear on the first assessment; (2) patients who suffered ankle sprain less than 18 months previously, or those with residual muscle weakness and/or limited range of motion of the ankle joint compared to the contralateral side, or patients with any limping that is clear on the first assessment; (3) patients with acute low back pain; and (4) patients who have had an acute episode of osteoarthritis of the lower extremity joint of the lumbosacral spine that affects postural stability. All 32 patients completed the first 5 weeks of the programme, and underwent pre-treatment and post-treatment assessment.

The exercises consisted of habituation and adaptation exercises. The treatment approach for patients with complete loss of vestibular function involved the use of exercises that foster the substitution of visual and somatosensory information to improve gaze and postural stability, and the development of compensatory strategies that can be used in situations where balance is stressed maximally. Patients with some remaining vestibular function usually benefit from vestibular adaptation exercises to enhance the remaining vestibular function. For both groups, postural stability could be improved by fostering the use of visual and somatosensory cues.

A retrospective analysis was conducted; the data needed for the study were obtained by reviewing the files of patients who had received vestibular rehabilitation therapy in the course of their standard clinical management. Patients undergoing vestibular rehabilitation therapy at our facility are given the choice of undergoing fully monitored vestibular rehabilitation therapy, with a 1:1 physical therapist to patient ratio, or following a tailored home exercise programme. Patients decide based on their desire and ability to follow the exercise programme. Patients in the supervised group had to present to the physical therapy department three times a week for five weeks. Patients in the home exercise group performed the therapy on their own at home, and met with the physical therapist weekly for two sessions then biweekly until the end of the programme.

The patients in monitored therapy spent between 45 and 60 minutes each session in the physical therapy department with the therapist. The therapist continuously monitored the exercise performance to correct minor mistakes or deviations, using verbal cues and/or demonstrations. These sessions took place 3 times a week for 5 weeks, over a total of 15 sessions. Patients who chose to perform the exercises at home had one session of monitored physical therapy directly after the initial evaluation. In this session, the therapist spent 60 minutes with the patients, first teaching the patients how to perform the exercises, demonstrating them, and then supervising the patient's performance to ensure they were being done correctly. These patients were seen after one week, then after two weeks and then for reassessment after two additional weeks.

Patients in both groups had additional therapy after the abovementioned sessions. The assessments and Dynamic Gait Index were carried out before therapy and at the end of week five. At the time of reassessment, patients in the monitored therapy group had received 15 sessions with the therapist and patients in the home therapy group had received 4 sessions.

Pertinent data included information about the patients' age, sex, co-morbidities (mainly presence of musculoskeletal problems), aetiology of imbalance, vestibular rehabilitation therapy schedule and number of sessions, and Dynamic Gait Index scores before and after treatment. Data analysis was performed using Microsoft Office Excel® 2010 spreadsheet software. Data were assessed for overall improvement in Dynamic Gait Index scores after vestibular rehabilitation therapy, and to determine the magnitude and significance of this improvement (paired, one-tailed student's *t*-test). The difference in response for various subgroups was studied, based on age, sex, aetiology of imbalance, and location and supervision of vestibular rehabilitation therapy.

Results

Thirty-two patients satisfied the inclusion criteria. Age varied between 46 and 91 years (mean age, 68.9 years; standard deviation (SD) = 10.0). The patients consisted of 14 females and 18 males. Aetiology of imbalance was secondary to non-vestibular causes in 7 patients (4 cerebellar stroke, 1 meningitis, 1 cerebellitis and 1 frontal contusion) and to vestibular causes in 25 patients (21 bilateral vestibular impairment, 2 labyrinthitis, 1 Ménière's disease and 1 post-traumatic vestibular impairment).

Of the 32 patients, 18 chose to perform the vestibular rehabilitation therapy under close monitoring, while 14 patients chose the tailored home exercise programme. The closely monitored group had a mean age of 71.3 years (SD = 10.5), while the home therapy group had a mean age of 65.7 years (SD = 8.88). The closely monitored group consisted of 7 females and 11 males, while the home therapy group consisted of 7 females and 7 males. Among the 18 patients who chose closely monitored vestibular rehabilitation

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TABLE I
PATIENT CHARACTERISTICS FOR EACH GROUP

Characteristic	Close monitoring*	Home therapy†	Total‡
Age (mean (SD); years)	71.3 (10.5)	65.7 (8.88)	68.9 (10.0)
Females (*n*)	7	7	14
Males (*n*)	11	7	18
Non-vestibular aetiology (*n*)	4	3	7
Vestibular aetiology (*n*)	14	11	25

*$n = 18$; †$n = 14$; ‡$n = 32$. SD = standard deviation

therapy, 4 had non-vestibular and 14 had vestibular underlying aetiology for their imbalance, while in the home therapy group, 3 patients had non-vestibular and 11 patients had vestibular underlying aetiology (Table I).

The significance level was set at $p < 0.01$. There was a significant overall improvement in the Dynamic Gait Index score after vestibular rehabilitation therapy ($p < 0.0001$). The Dynamic Gait Index score increased by 5.63, out of 24 points. The average Dynamic Gait Index score pre-vestibular rehabilitation therapy was 11.75, and this improved to 17.38.

There was no significant difference in improvement based on patient age group (grouped as 65 years or less (12 patients) *vs* over 65 years (20 patients)). The average improvement in Dynamic Gait Index was 5.7 points for patients aged 65 years or less, as compared to 5.7 points for patients aged over 65 years ($p = 0.922$).

Similarly, there was no significant difference in response to therapy based on patient sex. There was a Dynamic Gait Index improvement of 5.14 points for the 14 females versus an improvement of 6.00 points for the 18 males ($p = 0.667$).

The difference in response to therapy was not significant for patients with an underlying vestibular aetiology as compared to those with a non-vestibular cause for their imbalance. Twenty-five patients with a vestibular aetiology had a mean Dynamic Gait Index improvement of 5.00 points while patients with a non-vestibular aetiology had a mean improvement of 7.86 points ($p = 0.227$).

There was a significant increase in Dynamic Gait Index improvement in patients undergoing closely monitored vestibular rehabilitation therapy compared with those who completed the home tailored exercise programme. In the closely monitored group, the mean Dynamic Gait Index score pre-vestibular rehabilitation therapy was 10.78 (SD = 6.92) and it significantly ($p < 0.0001$) improved to 18.61 after therapy (SD = 3.48). In the home therapy group, there was a significant increase in Dynamic Gait Index score, but of less magnitude than in the closely monitored group. In the home therapy group, the mean Dynamic Gait Index pre-vestibular rehabilitation therapy was 13.00 (SD = 7.93) points, and this significantly improved ($p = 0.0058$) to 15.79 after therapy (SD = 7.40). The Dynamic Gait Index increase in the closely monitored group averaged 7.83 points, while in the second group it averaged 2.79 points. This represented a significant increase in Dynamic Gait Index score, with a *p*-value of 0.0036 (Figure 1).

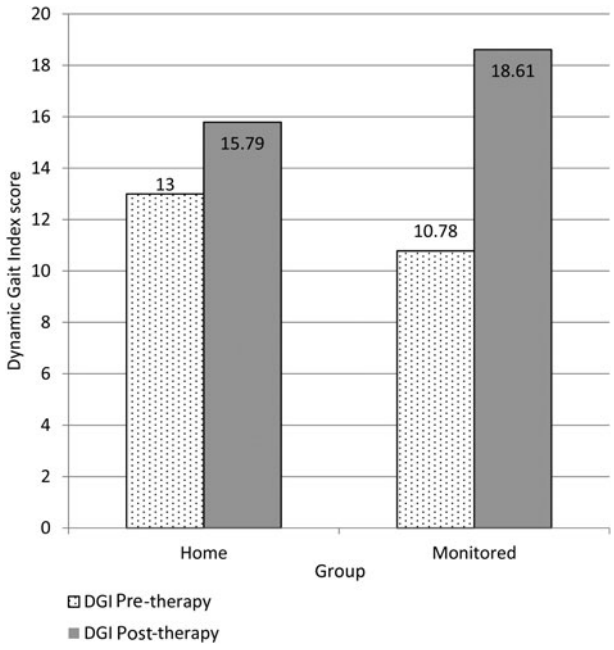

FIG. 1
Differences in response (Dynamic Gait Index scores) for the closely monitored group versus the home therapy group.

Discussion

Many studies have reported on the efficacy of vestibular rehabilitation therapy for improving Dynamic Gait Index and performance; however, few studies have quantified this effect.[6,12] According to our results, the average Dynamic Gait Index improvement for all imbalance problems was 5.63, out of a total of 24 points (with scores increasing from 11.75 to 17.38). The correlation of Dynamic Gait Index score with performance of daily life activities and subjective reports, is well established, but decreases in clinically significant morbidity have not been shown to correlate with improvement in the Dynamic Gait Index. This is an area for further study.[13–15]

Although 32 patients is a small sample size, similar studies have been carried out on even smaller numbers. This is mainly because of the small number of patients eligible and referred for such treatment, and the even smaller number of patients who are willing to comply with and complete the vestibular rehabilitation therapy programme. Nevertheless, our study revealed a significant increase in Dynamic Gait Index score, with a significant difference between the closely monitored therapy group and the home therapy group. Our confidence in these findings would be greater with a larger sample.

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There was no significant difference in Dynamic Gait Index improvement based on sex, age or aetiology. Some studies have shown better responses to treatment in patients with vestibular aetiology of imbalance.[10,16] There was a trend for a better response in vestibular patients in our study, but this difference was not significant. This is likely to be because of the small sample size. It could also be because of the inclusion of a patient in the non-vestibular group who had an increase in Dynamic Gait Index score from 0 pre-treatment to 22 post-treatment, which could be partially due to a resolved cerebellar stroke rather than a response to the vestibular rehabilitation therapy. The most probable explanation for this patient's improvement is the intensive vestibular rehabilitation therapy (the patient underwent 45 sessions). If this patient was not included in the data analysis, the Dynamic Gait Index improvement in response to vestibular rehabilitation therapy would be significantly higher in the vestibular group. The inclusion of more patients in the study would have enabled better analysis of these two variables (vestibular and non-vestibular aetiologies). There is also a potential overestimate of the Dynamic Gait Index improvement in the closely monitored group because this group was composed of a larger proportion of patients with vestibular aetiology. Again, a larger sample size is needed for further assessment, in order to perform subgroup analysis that preserves the power of the study.

Overall, the findings suggest that the home exercise plan is less costly, and involves less patient effort, less transport (and a lower risk of falls and fractures associated with transport) and fewer human resources. Moreover, it is easier for the patient to follow, which might correlate with better compliance. Closely monitored therapy, on the other hand, guarantees closer follow up, with more 'ideal' performance of the exercises and continuous adjustment of the exercises to patients' needs. These are all assumptions; nevertheless, the study findings support our hypothesis that closely monitored vestibular rehabilitation therapy results in a better Dynamic Gait Index score.

- **Dynamic Gait Index is a well-established international scale for assessing vestibular and balance impairment**
- **Index scores improved after vestibular rehabilitation therapy, regardless of imbalance aetiology**
- **The magnitude of improvement was higher when vestibular rehabilitation therapy was monitored by a physical therapist**

The vestibular aetiology group showed improvements in Dynamic Gait Index score both with home therapy and closely monitored therapy, while the non-vestibular group showed improvement only with closely monitored therapy (the home therapy did not have a favourable outcome). This result could be because of a smaller degree of improvement which was not significant, or due to chance. The very small number of patients in each subgroup does not allow for better delineation of this observation.

As mentioned above, a major limitation of this study is the sample size. Additionally, sicker patients might have chosen the home exercise programme, and thus biased the home therapy subgroup such that there may have been more patients with poorer prognosis in this group. However, this is not supported by the available data, which show that the home therapy group actually had a higher pre-therapy Dynamic Gait Index score. The lower baseline score for the closely monitored therapy group might have contributed to over-estimation of the treatment effect. A larger sample size is needed to study the effect and usefulness of closely monitoring vestibular rehabilitation therapy, and to determine its cost-effectiveness, especially if the benefits over home exercises were duplicated in similar future studies. In addition, a long-term follow up would enable us to explore the continuity of the improvement gained during the treatment period, as the personality and reliability of the patients themselves may be factors for remission of the symptoms.[17]

Conclusion

Closely monitored vestibular rehabilitation therapy has a significantly better outcome than home exercises for vestibular rehabilitation. The study alone is not sufficiently powerful, but it paves the way for similar, larger-scale studies to further establish this conclusion. It is also a small reminder for clinicians that medications and surgery are not the only effective measures, and that physical therapy, aside from orthopaedics, is still a potent treatment modality.

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