CASE REPORT

RJME
Romanian Journal of Morphology & Embryology
http://www.rjme.ro/

Vestibulary rehabilitation – election treatment method for compensating vestibular impairment

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Abstract

Objective: This paper aims to reveal the actual benefit of vestibular rehabilitation (VR) in patients with unilateral vestibular loss. *Patient and Methods*: Case report of a young female patient with acute unilateral vestibular loss due to facial nerve schwannoma developed above the internal auditory canal (IAC) from where it seems to have entered the IAC. Betahistine associated to VR treatment was recommended due to persisting imbalance after tumor removal. The benefit of the combined therapy was evaluated objectively (sensory organization test) and subjectively (questionnaires regarding self-perception of the deficit in quality of life). *Results*: Both evaluations revealed great improvement in stability (SOT scores) as well as in health-related quality of life (HRQoL) – improvement of self-perception scores of disequilibrium in all questionnaires used. *Conclusions*: Combined recommended treatment (betahistine and VR) improves HRQoL after acute unilateral vestibular loss. It reduces self-perceived disability and intensity of symptoms during usual activities.

***Keywords*:** vestibular system, acute unilateral vestibular loss, vestibular rehabilitation.

Introduction

The vestibular system is an integrative component of human balance, together with visual and somatosensory systems. Impulses from the sensorial vestibular epithelium inside the inner ear convey to the central nervous system information regarding movement, effects of gravity and the position in space of the head and body, relatively to ground.

Acute unilateral vestibular loss (UVL) induces severe static and dynamic deficits, with long lasting effects on balance, thus reducing patients' quality of life. Immediately after handling the vestibular crisis the medical management of these patients includes two therapeutically directions – accelerating and perfecting the physiological phenomenon of vestibular compensation, through long term administration of betahistine and recovery of the balance deficits by creating new patterns of reaction to different daily balance situation, by means of physical treatment – vestibular rehabilitation (VR).

This treatment protocol of UVL patients is widely accepted [1, 2] for a faster and more complete recovery of the unilateral vestibular loss. VR is a form of physical treatment, based on specific programs of physical exercises that can diminish the negative effects of the vestibular impairment.

VR exercises target a reset of the brain through habituation (reduces avoidance of certain positions), adaptation (teaching the unaffected balance receptors to undertake the function of destroyed ones) and substitution (teaching other sensory systems to compensate for the vestibular impairment) strategies. The treatment is focused on improving clear vision when moving the head, reducing the intolerance to movement by use of repetitive eye, head and body movement and relearning of balance.

This paper presents the benefits of VR individualized program for a patient with facial nerve tumor, who also presents recently installed acoustic-vestibular deficit, due to the impairment of the eighth cranial nerve by the tumor. Her deficit persisted after surgery.

Patient

This is the case of the 24-year-old female patient, G.M., who presented to the "Professor Dr. Dorin Hociotă" Institute of Phono-Audiology and ENT Functional Surgery, Bucharest, for a two months persistent facial asymmetry, to which, at approximately ten days, left hearing loss and imbalance during walking, especially associated with head movement, were added. The paraclinical and oto-neurological evaluation revealed left peripheral facial paralysis of Vth degree on House–Brackman scale, left profound sensorineural hearing loss (Figure 1), left subacute vestibular deficit (Figure 2), and enlargement of left internal auditory canal, by destruction of the roof (Figure 3).

ISSN (print) 1220–0522 ISSN (on-line) 2066–8279

The final diagnosis of internal auditory canal syndrome (IAC) determined referring the patient for neurosurgical consult at the "Bagdasar–Arseni" Clinical Emergency Hospital, Bucharest. Computer tomography (CT) exam and magnetic resonance imaging (MRI) revealed the presence of a tumor above the left IAC, from where it seemed to have entered the IAC (Figures 4 and 5), respectively and the angiography showed the vascularization of the left temporo-basal, intracranial expansive process from the ascending pharyngeal artery, with mass effect on the posterior communicative artery (Figure 6).

A surgical intervention was performed (surgical team conducted by Dr. Ciubotaru): extradural approach from the antero-superior side of the temporal bone with complete removal of the tumor (Figure 7). The histo-pathological exam established the diagnosis of genicular ganglion schwannoma (Figure 8).

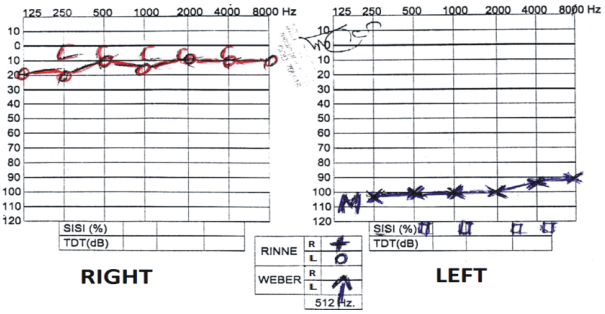

Figure 1 – ***Pure tone audiometry: left profound sensorineural hearing loss.***

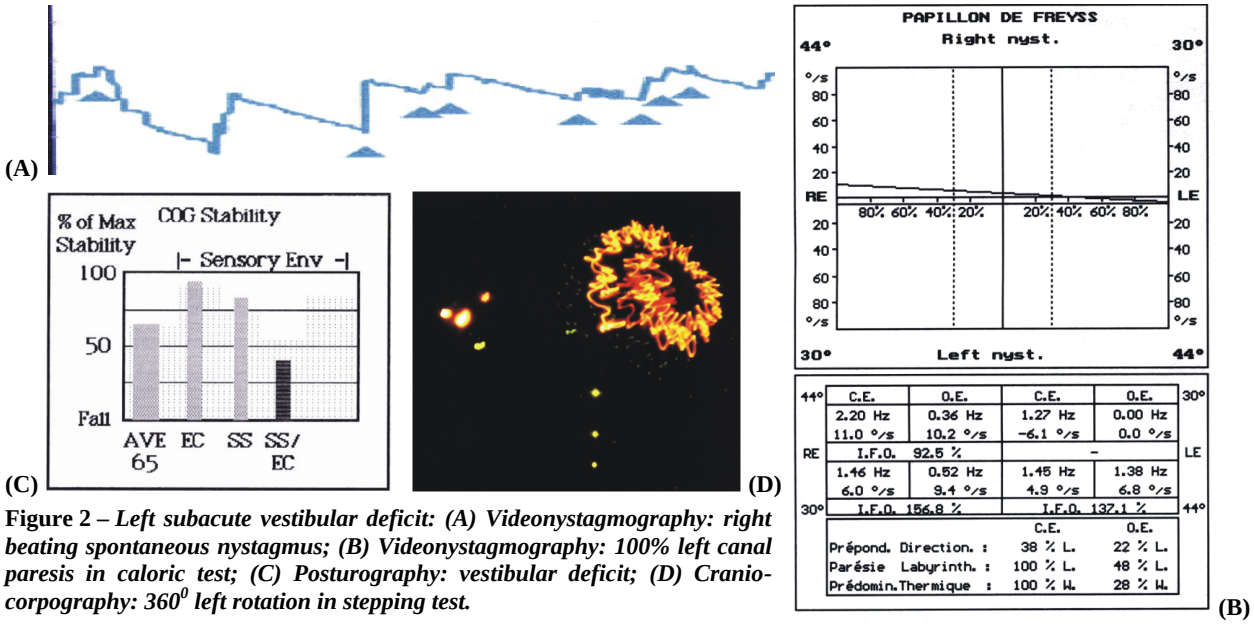

Figure 2 – ***Left subacute vestibular deficit: (A) Videonystagmography: right beating spontaneous nystagmus; (B) Videonystagmography: 100% left canal paresis in caloric test; (C) Posturography: vestibular deficit; (D) Cranio-corpography: 360^0 left rotation in stepping test.***

Figure 3 – ***Stenvers X-ray: enlargement of left internal auditory canal, by destruction of the roof.***

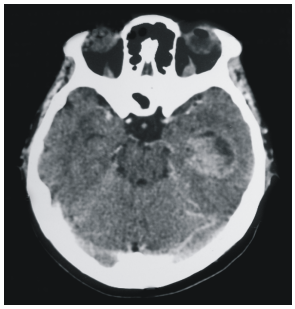

Figure 4 – ***Preoperatively CT image: tumor above the left IAC.***

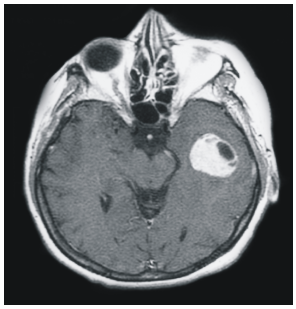

Figure 5 – ***Preoperatively MRI: left cerebellopontine angle tumor.***

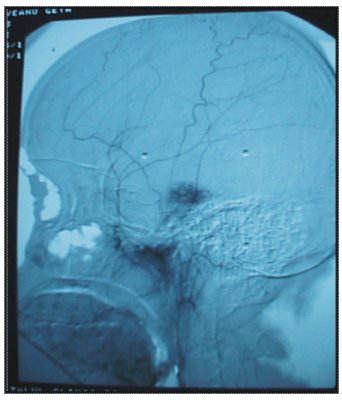

Figure 6 (left) – ***Preoperatively angiography: vascularization of the intracranial expansive process from the ascending pharyngeal artery, with mass effect on the posterior communicative artery.***

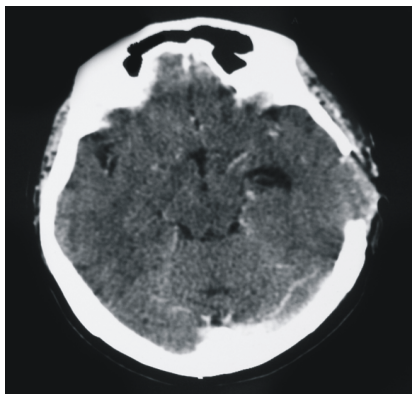

Figure 7 (right) – ***Postoperatively CT: complete removal of the tumor.***

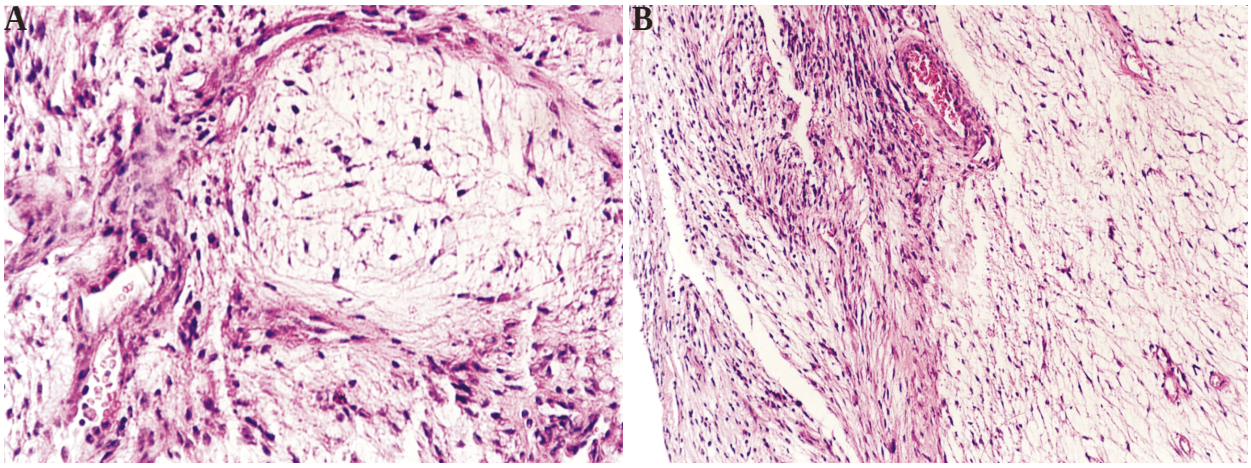

Figure 8 – ***(A and B) Histopathological exam: genicular ganglion schwannoma (HE stain, ob. ×4).***

Materials and Methods

One week after surgery, the patient presented at "Professor Dr. Dorin Hociotă" Institute of Phono-Audiology and ENT Functional Surgery, Bucharest, for recovering the imbalance persistent during walking and enhanced by head movement.

For six weeks, while treating with Betaserc 48mg/day, we initiated the individualized VR program, based on daily exercise sessions at home (derived from first original exercises since 1946 Cawthorne's [3], Cooksey's [4] and Herdman's [5] exercises) and weekly sessions on special equipment, dedicated for this physical recovery – the SMART Balance Master® System platform (NEUROCOM).

We evaluate the efficacy of the used treatment both objectively – the SOT test (sensory organization test) and subjectively by means of DGI (dynamic gait index), DHI (dizziness handicap inventory) questionnaire and the ABC scale (activities-specific balance confidence scale).

The SOT allows the evaluation of the tested subject's capacity of maintaining his balance in situations similar to daily activities – the result is percentual, thus sustaining the quantification of the patient's evolution under treatment.

DGI is a reliable test developed to assess falling risk while walking in older adults. It consists in tasks evaluating gait in eight challenging situations: normal speed walking for 20 feet distance, change in gait speed, gait with head turns (horizontal/vertical), gait and pivot turning, stepping over/around obstacle, walking up stairs. Maximum score is 24 points and scores of 19 or less have been related to increase incidence of falls in the elderly.

DHI is a validated questionnaire for auto-appreciation of the quality of life in patients with vestibular problems. It consists of 25 standard questions, grouped in three categories of functional (F), physical (P) and emotional (E) modifications in the quality of life due to vestibular impairment. To these questions, the subject can answer with yes/no/sometimes and they are graded with 4, 0 and 2 points, respectively. The total score ranges between 0 and 100: 0–30 indicates mild, 31–60 moderate, and 61–100 severe handicap caused by dizziness [6].

The ABC scale is used for self-assessment of the trust in one's own balance during activities that involve movement (walking around the house, up or down stairs, up or down a ramp, in crowded places, on icy sidewalks, reaching for something, bending over and picking something, getting into or out of a car, stepping onto or off an escalator).

Lower ABC scores are associated with lower levels of mobility [7] and falls [8].

ABC scale seems to correlate significantly with DHI in patients with vestibular disorders [9].

Results

Objectively, the evaluation of the stability level on the NEUROCOM platform at the initial examination and at the end of the vestibular rehabilitation program (six weeks) revealed an improvement of the global stability score from 65% to 87% (Figure 9A) and especially that of the stability score in the conditions for testing the vestibular system (45% to 83%) (Figure 9B). Also, during VR program, the patient improved her capacity of using visual information for maintaining balance (85% to 97%), considering her peripheral vestibular lesion is permanent (Figure 9C).

The improvement in balance and quality of life for our patient is also subjectively visible since patient reported an improvement of the DHI score by 74 points (from 86 to 12). She also showed regaining confidence in her strength – she is now independent again, being able to go in the street alone: her ABC score raised from 3.75% to 94% (Figure 10).

The improvement of the DGI score from 1 to 22 points proved as well great benefit achieved in walking – a score under 21 score indicates active balance impairment (Figure 11).

Comparative analysis of balance scores (SOT analysis) and of exercises' degree of difficulty allowed quantification of the vestibular rehabilitation program's benefit in patient's quality of life.

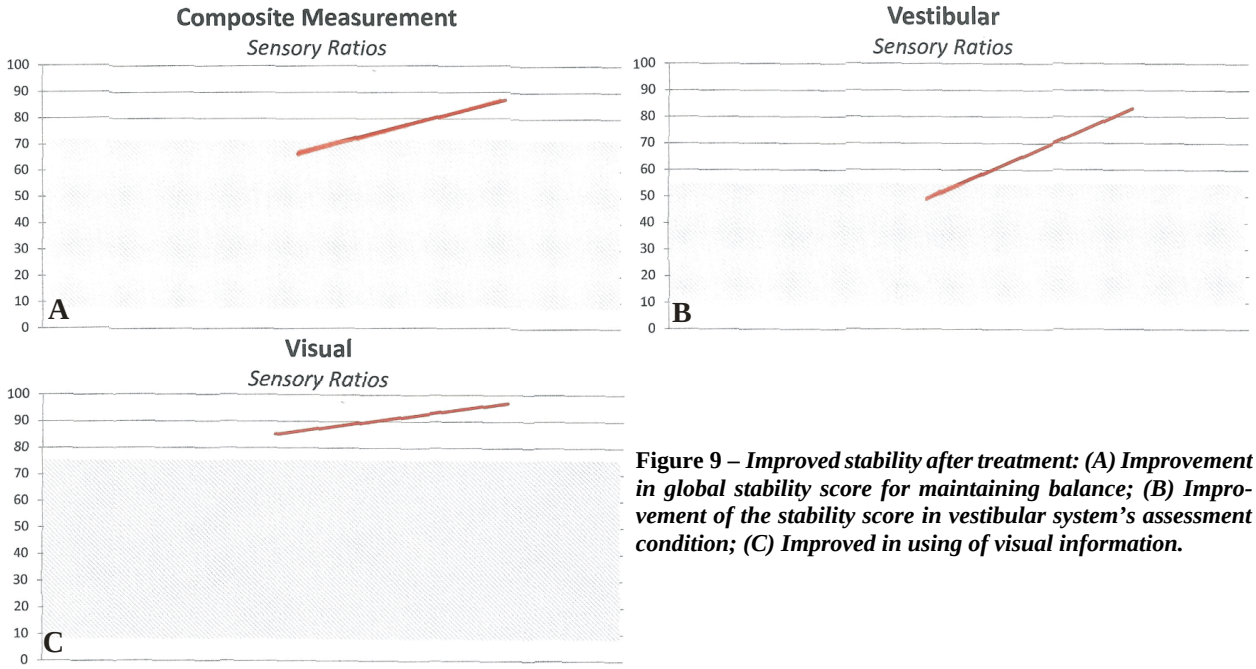

Figure 9 – ***Improved stability after treatment: (A) Improvement in global stability score for maintaining balance; (B) Improvement of the stability score in vestibular system's assessment condition; (C) Improved in using of visual information.***

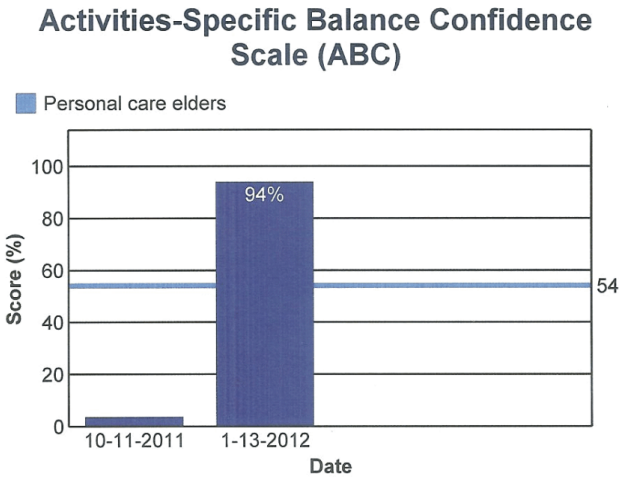

Figure 10 – ***Improvement of ABC scale score.***

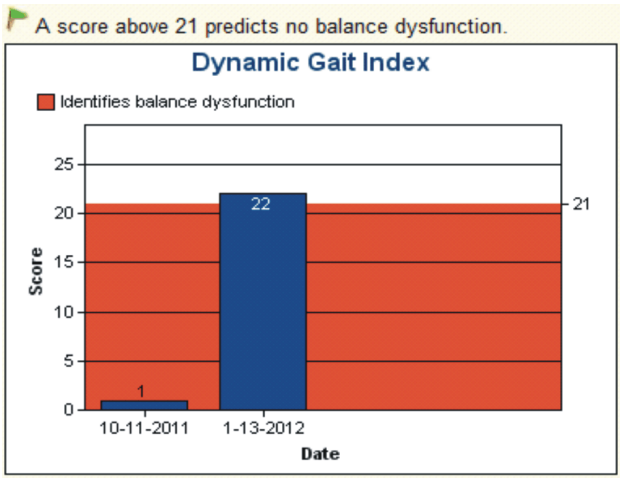

Figure 11 – ***Improvement of the DGI score.***

Discussion

Based UVL's recovery occurs due to central vestibular compensation. This physiological recovery is frequently incomplete and takes up to three month. In present case study, we demonstrate, similar to other studies in literature [10–14], that customized VR improves physical impairment caused by UVL (postural stability, mobility and independent ambulation), in terms of quality and duration of recovery.

Clinical examination before VR revealed pathologic results in all clinical tests and questionnaires: spontaneous nystagmus to the healthy ear, pathologic rotation in Unterberger stepping test, abnormal SOT score in posturography, unilateral caloric deficit, high falling risk in DGI test, severe impairment of quality of life (DHI score) and very low confidence in own balance (ABC scale).

After six weeks of combined betahistine and VR treatment, clinical examination was normal: absence of spontaneous nystagmus, significant improvement in SOT stability scores and normalization DGI test as well as ABC and DHI questionnaire scores.

SOT results demonstrate overall normal stability score (87%) after VR program due to high improvement in using vestibular pathways and new strategies of balance (more usage of visual cues).

First DGI score was just 1, similar to a very high risk of falling, with gait difficulties while moving head, walking slowly, inability to achieve a significant change in speed, slowing down while stepping around or over obstacles and using rail while walking up stairs alternating feet. Patient achieved the maximum score (22), with no walking impairment, after VR protocol.

DGI appears to assess accurately balance and gait in UVL patients and it is considered among the most rigorously developed functional balance tests. Its main withdraws are limitation of the assessment to lower extremity functioning and scoring based only on time required for the task and not at all on quality.

Regarding self-appreciation of the UVL-induced impairment upon quality of life, ABC scale and DHI questionnaire are the most frequently used evaluation methods in literature. With this case study, we also demonstrate the usefulness of these methods in evaluation of UVL recovery process.

Patient reported an improvement of the DHI score by 74 points (from 86 to 12). According to original authors [15], a decrease of at least 18 points in DHI total score is considered to reflect significant reduction of disability for an individual. Significant improvement was obtained also in all aspects of the DHI aspects – physical, functional and emotional.

ABC scale showed as well regaining confidence in patient's strength – the patient is now independent again, being able to go in the street alone: her ABC score raised from 3.75% to 94%. Starting from a high risk of falling – a score below 67% is a prediction factor for the risk of falling (Figure 12A), a severe self-limitation to household activities due to the scare of falling on the street – a score below 54% is an indicator of these limitations (Figure 12B), and high impairment of active balance – a score below 85% is considered a prediction factor for this aspect of life (Figure 12C), the patient managed to regain normal activity levels, improving from low to high level of functioning (Figure 12D).

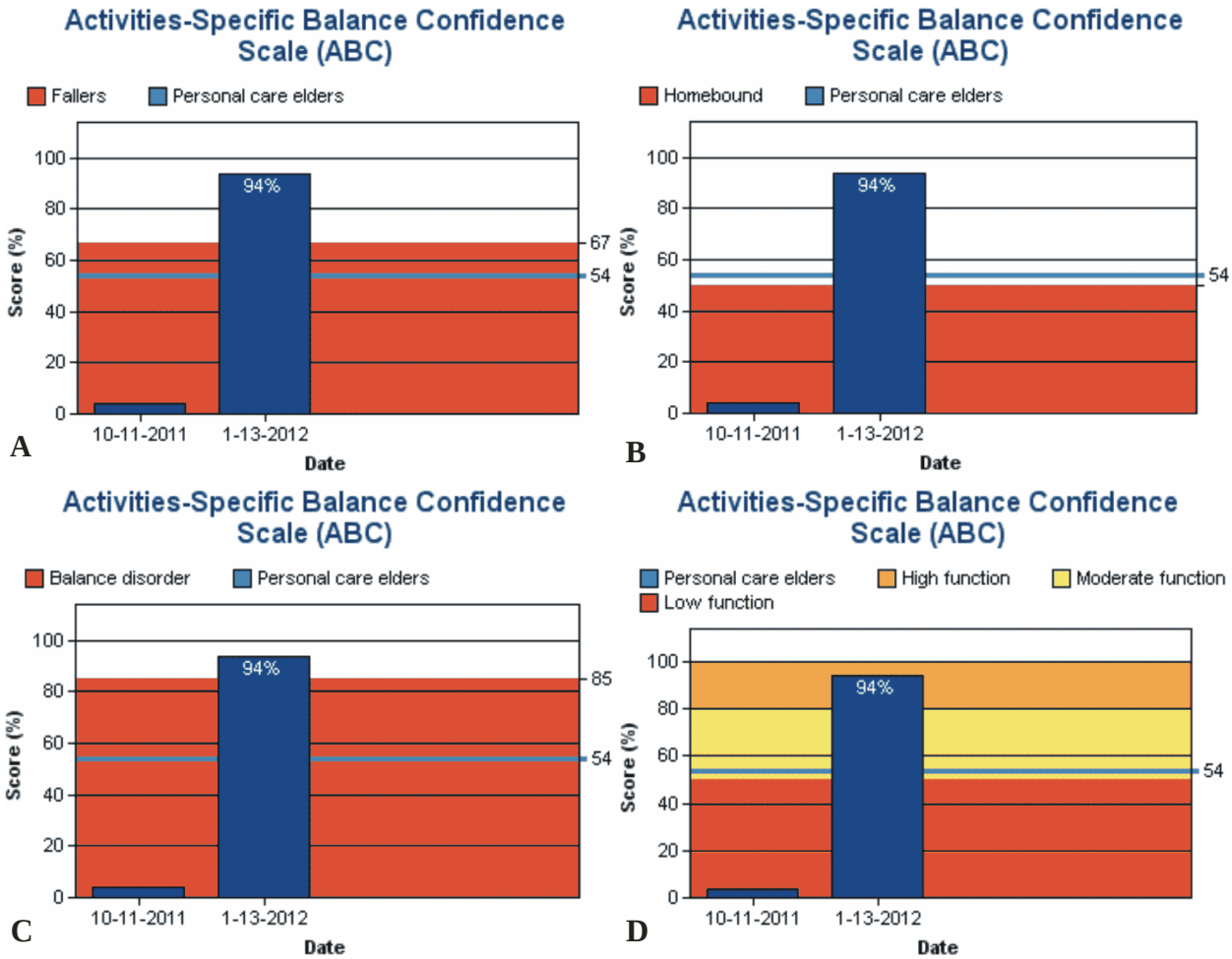

Figure 12 – ***Patient's benefit regarding ABC scale: (A) ABC improvement related to risk of falling (score below 67% – prediction factor for the risk of falling); (B) ABC improvement related to patient's self-limitation to household activities; (C) ABC improvement related to active balance impairment (score below 85% – prediction factor for an active balance impairment); (D) ABC improvement in levels of functioning (from "low" to "high function") (orange area reflects "homebound predictor").***

The main limitation of our study was the lack of a control group, which could establish how much of the improvement accomplished in one month was due to rehabilitation program, and how much was the consequence of spontaneous recovery.

Conclusions

As it is the case for other studies, the present paper demonstrates the efficacy of vestibular rehabilitation in reducing vestibular symptomatology and self-perception of the unilateral vestibular deficit, improving emotional and functional status and resuming independent activities (*e.g.*, driving, walking alone on the street, shopping).

Acknowledgments

This paper is partially supported by the Sectorial Operational Programme Human Resources Development, financed from the European Social Fund and by the Romanian Government under the contract number POSDRU/89/1.5/S/64109 and POSDRU/89/1.5/S/64331.

References

[1] Baloh RW, *Clinical practice. Vestibular neuritis*, N Engl J Med, 2003, 348(11):1027–1032.

[2] Strupp M, Brandt T, Chapter 25 – Vestibular neuritis. In: Eggers SDZ, Zee DS (eds), *Vertigo and imbalance: clinical neurophysiology of the vestibular system*, Handbook of Clinical Neurophysiology, vol. 9, Elsevier SV, Amsterdam, 2010, 313–330.

[3] Cawthorne T, *The physiological basis for head exercises*, J Chart Soc Physiother, 1944, 30:106–107.
[4] Cooksey FS, *Rehabilitation in vestibular injuries*, Proc R Soc Med, 1946, 39(5):273–278.
[5] Herdman SJ, *Vestibular rehabilitation (contemporary perspectives in rehabilitation)*, 3rd edition, F.A. Davis Company, Philadelphia, 2007, 265–272.
[6] Jacobson GP, Newman CW, *The development of the Dizziness Handicap Inventory*, Arch Otolaryngol Head Neck Surg, 1990, 116(4):424–427.
[7] Whitney SL, Wrisley DM, Brown KE, Furman JM, *Is perception of handicap related to functional performance in persons with vestibular dysfunction?* Otol Neurotol, 2004, 25(2):139–143.
[8] Lajoie Y, Gallagher SP, *Predicting falls within the elderly community: comparison of postural sway, reaction time, the Berg balance scale and the Activities-specific Balance Confidence (ABC) scale for comparing fallers and non-fallers*, Arch Gerontol Geriatr, 2004, 38(1):11–26.
[9] Tinetti ME, Richman D, Powell L, *Falls efficacy as a measure of fear of falling*, J Gerontol, 1990, 45(6):P239–P243.
[10] Hillier SL, Hollohan V, *Vestibular rehabilitation for unilateral peripheral vestibular dysfunction*, Cochrane Database Syst Rev, 2007, 4:CD005397.
[11] Kammerlind AS, Ledin TE, Odkvist LM, Skargren EI, *Effects of home training and additional physical therapy on recovery after acute unilateral vestibular loss – a randomized study*, Clin Rehabil, 2005, 19(1):54–62.
[12] Giray M, Kirazli Y, Karapolat H, Celebisoy N, Bilgen C, Kirazli T, *Short-term effects of vestibular rehabilitation in patients with chronic unilateral vestibular dysfunction: a randomized controlled study*, Arch Phys Med Rehabil, 2009, 90(8):1325–1331.
[13] Patatas OH, Ganança CF, Ganança FF, *Quality of life of individuals submitted to vestibular rehabilitation*, Braz J Otorhinolaryngol, 2009, 75(3):387–394.
[14] Kammerlind AS, Ledin TE, Odkvist LM, Skargren EI, *Recovery after acute unilateral vestibular loss and predictors for remaining symptoms*, Am J Otolaryngol, 2011, 32(5):366–375.
[15] Whitney SL, Hudak MT, Marchetti GF, *The activities-specific balance confidence scale and the dizziness handicap inventory: a comparison*, J Vestib Res, 1999, 9(4):253–259.

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Received: May 14th, 2012

Accepted: August 27th, 2012