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Original article

Balance, dizziness and proprioception in patients with chronic whiplash associated disorders complaining of dizziness: A prospective randomized study comparing three exercise programs

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ABSTRACT

Background: Dizziness and unsteadiness are common symptoms following a whiplash injury.
Objective: To compare the effect of 3 exercise programs on balance, dizziness, proprioception and pain in patients with chronic whiplash complaining of dizziness.
Design: A sub-analysis of a randomized study.
Methods: One hundred and forty subjects were randomized to either a physiotherapist-guided neck-specific exercise (NSE), physiotherapist-guided neck-specific exercise, with a behavioural approach (NSEB) or prescription of general physical activity (PPA) group. Pre intervention, 3, 6 and 12 months post baseline they completed the University of California Los Angeles Dizziness Questionnaire (UCLA-DQ), Visual Analogue Scales (VAS) for, dizziness at rest and during activity and physical measures (static and dynamic clinical balance tests and head repositioning accuracy (HRA)).
Results: There were significant time by group differences with respect to dizziness during activity and UCLA-Q favouring the physiotherapy led neck specific exercise group with a behavioural approach. Within group analysis of changes over time also revealed significant changes in most variables apart from static balance. Conclusion: Between and within group comparisons suggest that physiotherapist led neck exercise groups including a behavioural approach had advantages in improving measures of dizziness compared with the general physical activity group, although many still complained of dizziness and balance impairment. Future studies should consider exercises specifically designed to address balance, dizziness and cervical proprioception in those with persistent whiplash.

1. Introduction

It is estimated that between 10 and 40% of persons sustaining neck trauma as a result of a motor vehicle crash will go on to have chronic persistent problems (Sterling et al., 2003; Kamper et al., 2008) and it is this group, that present considerable challenges to all professionals involved in their management. After pain, dizziness and unsteadiness are the next most frequent complaints in those with persistent problems following a whiplash trauma, with up to 70% reporting these complaints (Treleaven et al., 2003). These symptoms are thought to reflect a mismatch of afferent input from the proprioceptive, visual and or vestibular systems to the sensorimotor control system and have been associated with objective deficits in proprioception, head and eye movement control and balance in those with persistent whiplash (Sjöström et al., 2003; Treleaven et al., 2003, 2005a, 2005b). Abnormal cervical afferent input, due to factors such as pain altered neuromotor control, muscle fatigue, and psychosocial stresses, is suggested be one of the main causes of these disturbances (Treleaven, 2008a).

Further, dizziness, proprioceptive and balance deficits do not appear to be a consequence of long term problems but occur early

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after injury (Sterling et al., 2003; Dehner et al., 2008; Cobo et al., 2009) and may be related to persistent symptoms and a poorer prognosis following a whiplash injury often termed whiplash associated disorder (WAD) (Pleguezuelos et al., 2008; Schreiber and Fried, 2009; Cobo et al., 2010; Phillips et al., 2010). Nevertheless, high pain levels and the presence of dizziness have often been combined as predictors of a poorer outcome following whiplash trauma and may be related factors (Cobo et al., 2010; Phillips et al., 2010).

To date there is modest evidence for the effect of exercise in the management of WAD on neck pain and disability (Verhagen et al., 2007; Hurwitz et al., 2008). The suggested exercise interventions for chronic WAD include neck-specific exercise (Seferiadis et al., 2004), general activity, (Swedish National Institute of Health) and more recently neck-specific exercises in conjunction with a cognitive behavioural approach (Soderlund and Lindberg, 2001; Landén Ludvigsson et al., 2015) delivered by a single clinician. The inclusion of a behavioural approach in the treatment in the latter studies was reasoned to address factors such as low self-efficacy, psychological distress and fear of re-injury, which have been reported to negatively affect recovery in WAD (Stewart et al., 2007; Soderlund and Lindberg 2007). Despite this, in Landén Ludvigsson et al.'s study, subjects with chronic WAD reported a substantial reduction of both pain and neck specific disability in the physiotherapist led groups of neck specific training with or without the behavioural therapy approach when compared with self-administered general physical activity. Whilst these interventions seem to address some of the known causes of abnormal cervical afferent input, these treatments do not specifically address dizziness, proprioception and balance and it is unknown whether such interventions improve these signs and symptoms in those with chronic WAD who complain of these problems. Thus the aim of this study was to perform a secondary analysis of the data from Landén Ludvigsson et al.'s study to compare the effect of the three exercise programs specifically on balance, dizziness and proprioception in the patients with chronic (6 months–3 year of duration) WAD who complained of dizziness. It was hypothesized that interventions incorporating neck specific exercises would be superior to prescription of physical activity in improving dizziness, balance and proprioception.

2. Methods

2.1. Design overview

This study was a secondary analysis of an assessor blinded prospective randomized controlled multi-centre study (RCT) with a 24 month follow-up (Peolsson et al., 2013). Clinical trial NCTO15228579 http://clinicaltrialsfeeds.org/clinical-trials/show/NCT01528579. For this study, in order to assess the effects on dizziness, only subjects who reported dizziness defined as a University of California Los Angeles, Dizziness Questionnaire (UCLA-DQ) score of 5 and above were included in the analysis (Fig. 1). The 12 month follow-up was the measuring end point for the physical tests of proprioception and balance measured by a physiotherapist, and therefore was used for the scope of the present study. The study was approved by the Regional ethical review board in Linköping, Sweden.

2.2. Setting and participants

Patients aged 18 to 63 (n = 216, 65% female, mean age 40.5 (SD 11.4)) with chronic WAD grade II (neck problems verified in a manual clinical examination to emanate from the cervical spine) and III (history of arm pain/paresthesia with additional neurological signs in the physical examination), (Spitzer et al., 1995) that was nominated as the cause of the current symptoms, participated after informed consent in a RCT (Peolsson et al., 2013; Landén Ludvigsson et al., 2015). Patients were recruited between February 2011 and May 2012 by searches in electronic medical records from primary health care centres, orthopaedic clinics and hospital outpatient services in Sweden. Patients with a WAD diagnosis at least 6 months but no more than 3 years after a whiplash injury received written and oral information about and request of interest for the study. Interested patients were screened by telephone by an experienced physiotherapist. Those who fulfilled the eligibility criteria (Table 1) attended a physical examination to ensure eligibility. Of the 216 subjects who participated in the original study, 140 patients (mean age 41.0 (SD 11.8)), 69% female) had dizziness (UCLA-DQ $\geq$ 5) and thus were used for the secondary analysis. One hundred and eight (77%) of the patients received treatments for their WAD before participating in the present study, with no significant differences ($p = 0.56$) in the treatment expectations between the groups of randomization. Treatment expectation was measured using the statement: “What kind of expectations do you have for participation in this study?” Alternatives to choose from were: “to be fully recovered”, “to have great improvement”, “to have some improvement” and “no expectations of recovery or improvement”.

2.3. Outcome measures

All measurements (clinical and questionnaires) were conducted at baseline, 3, 6 and 12 months after baseline. Clinical, neck-related, measurements were performed in a standardized way by a well-trained investigator, who was blinded to the randomization procedure and not involved in the provision of the physiotherapy treatment.

This study was part of a RCT of 210 subjects, where NDI was considered the primary outcome measure (Peolsson et al., 2013; Landén Ludvigsson et al., 2015). For the purposes of this paper, data from only the 140 patients with dizziness (UCLA-D >5) was analysed, using the outcome measures below. . All measurements have been reported to have acceptable measurement properties (Johansson and Jarnlo, 1991, Honrubia et al., 1996; Kammerlind et al., 2005a; Wibault et al., 2013).

- Self-reported dizziness intensity at rest and during movement or activity measured with VAS (0–100 mm, 0 = no symptoms and 100 = worst symptoms) (Carlsson, 1983; Kammerlind et al., 2005a).
- Self-reported dizziness with the University of California Los Angeles, Dizziness Questionnaire (UCLA-DQ) (Honrubia et al., 1996). UCLA-DQ consists of five questions of dizziness with regard to frequency, intensity, impact on daily activities, impact on quality of life and fear of dizziness giving a total score range of 5 (least severe) to 25 (most severe). No dizziness is scored as 0.
- Static clinical balance test; sharpened Romberg (tandem stance without shoes and eyes closed) with the non-dominant foot in front of the dominant foot (Kammerlind et al., 2005a). Arms were hanging alongside the body. The test-leader stood in front of the patient and measured the time in seconds with a stopwatch until the patient moved their feet from the test position, opened their eyes, touched the wall with their hand/arm or reached the maximum of 30s. The test was performed three times and the mean value was calculated.
- Dynamic clinical balance test; walking in a figure of eight (Johansson and Jarnlo, 1991). The figure of eight (two circles with inner diameter 1.5 m and outer diameter 1.8 m) was painted on an oilcloth. Patients were instructed to walk two circuits without shoes at a speed given by a metronome (1 step/