

Is there a role for neck manipulation in elderly falls prevention? – An overview

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Many risk factors exist for falls in the elderly. Dizziness is an important risk factor for such falls. Spinal pain has also been identified as a risk factor for these falls. In this overview of the literature, we examine studies, including trials, of neck manipulation for neck pain, unsteadiness and falls risk relevant to the elderly. We also examine two related, but not mutually exclusive, mechanisms through which a putative beneficial effect may be mediated. These are the effects of neck manipulation on neck pain and on non-specific dizziness. We focus on the available evidence primarily in terms of clinical data rather than laboratory-based measures of balance. We conclude that chiropractors may have a role in falls

Beaucoup de facteurs de risque de chute existent chez les personnes âgées. L'étourdissement fait partie des facteurs de risque importants. Les douleurs lombaires sont également considérées comme un facteur de risque de chute. Dans le présent aperçu d'ouvrage, on examine des études, y compris des essais, sur la manipulation cervicale pour traiter les douleurs cervicales, le manque d'assurance en position debout et les risques de chute chez les personnes âgées. On examine aussi deux mécanismes liés, mais non mutuellement exclusifs, à partir desquels il serait possible de véhiculer des améliorations estimées. Il s'agit des effets de la manipulation cervicale pour traiter les douleurs cervicales et les étourdissements non précisés. On se concentre sur les preuves disponibles principalement en matière de données cliniques, et non pas les mesures d'équilibre réalisées en laboratoire. Conclusion : les chiropraticiens ont vraisemblablement un rôle à jouer dans les stratégies de prévention des chutes chez les personnes âgées souffrant de douleurs cervicales

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prevention strategies in the subpopulation of the elderly that suffer from mechanical neck pain or dysfunction and non-specific dizziness. However, this role remains to be rigorously studied and properly defined.

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KEY WORDS: dizziness, elderly, risk factor, neck pain, manipulation, chiropractic

Introduction

Falls in the elderly can be due to many causes. Dizziness is an important risk factor for these falls. In this overview of the literature, we examine the relationship between non-specific dizziness, an important form of dizziness in the elderly¹, and neck pain and dysfunction. We further examine whether rigorous evaluation of neck manipulation is justified for the treatment of non-specific dizziness that is concomitant with chronic neck pain or dysfunction, with the aim of reducing the risk of falls in the elderly. This review does not focus on research data in relation to changes in laboratory-based measurements of balance such as postural sway and their changes with neck pain or neck manipulation.^{2,3} Instead, we focus primarily on clinical research data. A non-systematic method using Pubmed searches was used to source the available literature on the subject. No language restrictions were applied. Care was taken to guard against inclusion or exclusion bias.

Falls in the elderly and dizziness

Many elderly patients with chronic neck pain and concomitant non-specific dizziness or unsteadiness consult chiropractors and other practitioners who perform spinal manipulative therapy (SMT). It has also been shown that at least the elderly patients who present to chiropractors in Auckland New Zealand and Melbourne Australia have risk factors for falls, including dizziness, that are comparable to the community dwelling elderly in general.⁴ However, the possible therapeutic effect of the primary modality of chiropractic treatment, namely SMT, for non-specific dizziness and prevention of falls in the elderly is yet to be adequately investigated. It is well established that falls in the elderly constitute an important

mécaniques ou d'un dysfonctionnement cervical, ainsi que d'étourdissements non précisés. Toutefois, ce rôle doit faire l'objet d'études rigoureuses et être défini adéquatement.

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MOTS CLÉS : étourdissement, personnes âgées, facteur de risque, douleur cervicale, manipulation, chiropratique

global health problem. Every year in the US⁵ and Australia⁶, approximately one in three elderly people fall, with 10-20% experiencing serious injury including fractures⁷. Similarly, a large population study has found the incidence of falls over a twelve month-period in Canadian elderly to be as high as 19.8%.⁸ Falls in the elderly are associated with increased morbidity, disability, loss of independence and even death. Hence, they constitute a serious health problem with substantial human costs.^{9,10} They account for 75% of all casualty visits in the elderly, and result in significant hospital stays.⁹ The frequency of falls in the elderly increases sharply with age¹¹, making this health problem particularly significant in aging populations of the industrialised world. These falls also result in substantial economic costs to the individuals concerned and the health care system, with the estimated cost per fall between \$2,000 to \$42,000¹² and the total economic burden for falls \$23.3 billion in the USA, with comparable substantial costs in the UK¹³ and Canada⁸. In addition, falls in the elderly are an increasingly important global health problem. As the size of the elderly population grew in Australia, the annual direct health costs of fall-related injuries are estimated to almost triple in five decades from \$498.2 million in 2001.¹⁴

Dizziness, which predisposes the elderly to falls^{4,15-17}, is also very common in the elderly population. For instance, a study from Scotland found the point prevalence for dizziness to be 30% in 893 elderly people¹⁸, and the comparable proportion in Brazil has been reported as high as 45% in a cohort of 391 community dwelling elderly adults¹⁹. Moreover, the proportion of those above the age of 70 presenting with non-specific dizziness was recently reported as 63% in South Korea.²⁰ Moreover, dizziness becomes more prevalent with age.²¹ There is a strong as-

sociation between dizziness and falls in the elderly.^{15,22,23} A recent systematic review has also confirmed dizziness as a risk factor for falls in the elderly.²³ In short, falls, falls-related injuries, and dizziness are common and closely associated in the elderly.

The neck, postural balance and dizziness

Vestibular disorders are widely believed to constitute the most common cause of dizziness. However, there is evidence in the primary care setting that cardiovascular disease and related medications may be the most common cause in the elderly.²⁴ Consistent with this notion, vestibular disorders have been found to be much less prevalent in the general population than the symptoms of vertigo dizziness and unsteadiness.¹⁶ It is generally accepted that the second most common cause of dizziness in the elderly (after benign positional paroxysmal vertigo) is what is termed “multisensory dizziness”.^{25,26} This condition is attributed to aging and deterioration of multiple sensory systems, namely the vestibular, optic and proprioceptive. The prevalence of dizziness in the elderly that can be attributed to pain and dysfunction of the cervical spine (cervicogenic dizziness) is not known. At least some patients diagnosed with multisensory dizziness may suffer from cervicogenic dizziness. For this reason, this review focuses on ‘non-specific’ rather than ‘cervicogenic’ dizziness.

It is established that somatic afferent information from the neck, particularly the upper cervical spine, converges with vestibular and visual inputs on central nervous system (CNS) nuclei involved in processing and integration of postural balance inputs. For instance, Hikosaka and Maeda demonstrated that somatic sensory information for upper cervical spine is relayed to motoneurons in the abducens nucleus modulating the vestibulo-ocular reflex that causes abduction of the eye to the contralateral side of head rotation to allow for fixed gaze.²⁷ Conversely, Cornil and colleagues showed that cervical spine muscles respond to stimulation of the superior colliculus²⁸, which is a primary CNS centre for processing of visual information. Furthermore, Shinoda and colleagues showed that stimulation of the semicircular canals in the inner ear is relayed to cervical motoneurons.²⁹ Finally, Peterson and co-workers demonstrated that the vestibulocollic and the cervicocollic reflexes interact and produce a summative effect on muscle activation in the neck.³⁰ Taken together these data convincingly demonstrate integration of ves-

tibular, visual and proprioceptive (particularly from the neck) inputs to maintain postural balance. Given this integration, it is probable that abnormal cervical proprioceptive input to the CNS (as a result of injury, pain, or musculoskeletal dysfunction of the neck) may create a mismatch with the other inputs thereby causing dizziness.³¹⁻³³ This can be particularly so in the context of the elderly who suffer deterioration of multiple sensory systems.

In agreement with this premise, a recent study has found greater levels of sensorimotor dysfunction (particularly in terms of joint position error in the neck) in association with upper cervical pain than lower cervical pain³⁴ correlating with the higher density of proprioceptors in the upper cervical region. We also know that anaesthetising the deep structures of the neck, or unilateral sectioning of the cervical dorsal roots induce severe ataxia and disturbance of balance.^{31,35} Equally importantly, stimulation of the abundant neck muscle spindle afferents³⁶, by the use of vibration, increases body sway^{37,38}, and influences the velocity and direction of gait and running^{39,40}. Additionally, there is evidence that the elderly may be more reliant on proprioceptive input for maintenance of postural balance than younger people.⁴¹ For instance, afferent input from the legs is important for postural control in healthy elderly people.⁴² Furthermore, the elderly with polyneuropathy suffer from a higher risk of falls.⁴³ In addition, the inability to stand in tandem stance is associated with double the risk of falls in the elderly.⁴⁴ These data together demonstrate the importance of proprioception to postural balance, particularly in the elderly. They also support the notion that neck pain and/or disturbed proprioception may contribute, or act as a predisposing factor, to dizziness and falls.

Neck pain and dizziness

Neck pain is common in the general population. Cote and colleagues demonstrated in a large population study in 1997 that the point prevalence of neck pain in Saskatchewan adults was 22.2%.⁴⁵ This study also reported six month prevalence of: low intensity and low disability neck pain; high intensity low disability neck pain; and high intensity and moderately or severely disabling neck pain were found to be 39.7%, 10.1%, and 4.6% respectively.⁴⁵ In addition, neck pain is common in the elderly. Its prevalence has been estimated at 36.1% and 40.5% for men and women respectively in community dwelling elderly people in Australia.⁴⁶

Musculoskeletal problems of the neck can cause disturbance of balance, which is termed “cervicogenic dizziness” “cervical dizziness” or “cervical vertigo”.⁴⁷⁻⁵⁰ Patients who have suffered whiplash neck injuries as a result of motor vehicle accidents often complain of dizziness and exhibit motor co-ordination deficits.^{51,52} Persistent neck pain following whiplash injury has also been recently associated, in a small cohort, with impairments of a variety of dynamic and functional balance tasks such as a timed 10m walk.⁵³ These signs and symptoms are not surprising, due to the stretch and shear forces involved in whiplash injury, which can damage vestibular and neck receptors. Furthermore, in cases of whiplash that warrant the diagnosis of mild traumatic brain injury (or concussion), it may be the damage to the brain itself that causes the common post-injury symptom of dizziness.⁵⁴ Nevertheless, it is important to note that dizziness balance deficits and joint position errors are also common in patients with non-traumatic neck pain.^{33,51,55-62} It is likely then that pain originating from the neck may in itself be responsible for, or at least associated with, dizziness in these cases.

Not surprisingly, in a recent secondary analysis of a prospective cohort study of 516 randomly selected community dwelling elderly participants (aged 73-92 years old), risk factors associated with dizziness were correlated with risk of falls over a 12 month period. In this study, 42% of the participants reported dizziness in general.⁶³ Interestingly, self-reported neck or back pain was far more common in those reporting dizziness with a high degree of statistical significance. As expected, participants with dizziness, anxiety, depression and history of transient ischemic attacks were more likely to experience multiple falls (more than 2 falls). However, the strongest predictors of multiple falls were found to be neck and back pain as well as anxiety in this population.⁶³ Therefore, there may be a strong causal relationship between neck pain, dizziness, and multiple falls in at least a subpopulation of the elderly.

There are reports, in neck pain patients, of a correlation between cervical joint stiffness and hypertonicity of the upper cervical musculature on one hand, and the presence of dizziness on the other.^{64,65} A recent study has found that in middle-aged chronic neck pain patients, the presence of vertigo is highly correlated with neck stiffness.⁶⁶ In addition, fatigue of the neck muscles disturbs standing balance.^{32,60} Additionally, neck tenderness is associated with

cervical vertigo in the elderly.⁴⁸ Taken together these data suggest that neck pain, and associated joint stiffness and muscular hypertonicity and tenderness, may cause postural imbalance possibly by altering the proprioceptive input to the CNS, or its processing by the CNS, leading to dizziness. This in turn, could predispose the individual, particularly the elderly, to falls.

Spinal manipulative therapy for mechanical neck pain

SMT, including joint manipulation and mobilisation, has been used clinically for neck pain by chiropractors and other health care practitioners for many years. Several studies have shown that SMT and spinal exercise regimes are significantly more effective than usual medical care in reducing neck pain.^{67,68} A recent systematic review has found high quality evidence for greater short term pain relief with manual therapy and exercise over exercise alone.⁶⁹ The same review also found evidence, although of low quality, for clinically important long term improvement in pain and functional status with manual therapy and exercise compared to no treatment.⁶⁹ Similarly, Maiers and colleagues have recently reported short-term effectiveness of SMT in the elderly. Theirs was the first randomised controlled trial (RCT) of cervical SMT in community dwelling elderly comparing its effectiveness for chronic mechanical neck pain with home and supervised exercises using 241 participants.⁷⁰ They found that the SMT and home exercise group had a statistically significant reduction in pain at the conclusion of the treatment period compared to either the home exercise alone or home exercise and supervised exercise groups, even though this effect was not sustained at 40- or even 14-weeks follow-up.

In a 2010 Cochrane systematic review of 27 RCTs, Gross and colleagues found low quality evidence for the benefits of manipulation and mobilisation compared to control for short-term neck pain reduction.⁷¹ In another 2010 systematic review of manual therapy for neck pain, D’Sylva and colleagues reported low quality evidence suggesting a clinically significant improvement in pain relief, improved function and global perceived effect when manipulation and mobilisation were combined with massage. Once again, poor methodological quality of the studies and inadequate control for bias prevented a more conclusive assessment of the potential of SMT to

treat neck pain. It is important to realise that compared to drug trials, rigorous RCTs of SMT are more challenging to design and the choice of control intervention is particularly problematic due to the hands-on nature of manual therapy. It is not possible to blind the clinician with respect to the treatment delivered, and it is difficult to blind the participant. Control interventions for SMT that have been used to date often are other physical treatment modalities, such as mobilisation, or exercise therapy. Given that mobilisation, exercise and similar “control” interventions are likely to exert a therapeutic effect on the neck, the search for a more inert control for these studies needs to continue. Using a truly inert control may demonstrate greater therapeutic effect for SMT in treating neck pain. Efforts are currently underway to develop such a control.^{72,73} Nevertheless, SMT has shown at least short-term effectiveness in treating neck pain. It has also been found to be a relatively safe intervention^{74,75} particularly in the elderly⁷⁶.

Spinal manipulative therapy for non-specific dizziness

Usual treatment of non-specific dizziness in the elderly comprises mainly of vestibular rehabilitation.^{41,77,78} According to a recent Cochrane systematic review, there is moderate evidence to support the use of vestibular rehabilitation for vertigo and dizziness of vestibular origin, such as benign paroxysmal positional vertigo (BPPV) and Ménière’s disease.⁷⁹ However, non-specific dizziness is a diagnosis by exclusion, and it has no established satisfactory treatment at present.²⁰ In the elderly, patients with non-specific dizziness are often diagnosed with multisensory dizziness or presbyastasis (age related decreased vestibular function) and are often inadequately treated. Nonetheless, their treatment often involves vestibular manoeuvres and vestibular rehabilitation exercises.⁸⁰ Vestibular rehabilitation has been found to provide some relief for non-specific dizziness, alone and in combination with other therapies. For instance, vestibular rehabilitation neck exercises alone have been shown to be moderately effective for non-specific dizziness in a retrospective study of 153 elderly cases.²⁰ Furthermore, Andersson’s group conducted two small RCTs, with dizziness due to a range of aetiologies, of vestibular rehabilitation combined with cognitive behavioural therapy (CBT) compared to a waiting list control.^{81,82} These studies showed signifi-

cant improvement with dizziness using provocative head movements, but no improvement in depression, anxiety or stress. Although, results from these studies are limited by small sample sizes and variability in treatment protocols, they do show promise for the use of neck rehabilitation exercises in treatment of non-specific dizziness, particularly in the elderly population. However, while these studies have aimed their treatment at rehabilitation of the vestibular system, the role of proprioceptive input from the coupling movements of the neck joints during these movements cannot be discounted. Therefore, focused modulation or rehabilitation of proprioceptive input from the neck in non-specific dizziness, is an area deserving of concerted research attention.

There is, in fact, a growing body of preliminary evidence for physical and manual treatment of the neck for non-specific dizziness. A course of individualised physiotherapy including massage and cervical and thoracic joint mobilisation has been reported to improve dizziness in a cohort of 20 neck pain patients.⁶⁴ Matsui and co-workers have recently reported that a course of primarily conservative physical therapy, was able to substantially reduce dizziness in neck pain patients.⁶⁵ A recent feasibility study has also reported significant improvement in dizziness handicap inventory (DHI) scores with Osteopathic SMT in 16 adults with chronic vertigo.⁸³ Similarly, improvement in DHI scores has been reported in a small group of elders in a recent pragmatic single group pre-test/post-test chiropractic intervention study.⁸⁴ In addition, a pilot randomised study of chiropractic care, including SMT, by the same group has reported improvement in both pain and DHI scores in the elderly.⁸⁵ These observations are consistent with anecdotal evidence from practitioners of SMT that some patients presenting with neck pain also report an improvement with their sense of balance. There are a number of clinical studies including five RCTs on the efficacy of manual therapy for cervicogenic dizziness.^{57,64,88,89,96,97} However, two systematic reviews have concluded that there is limited to moderate evidence for the use of manual therapies, particularly cervical manipulation and mobilisation, in the management of this condition.^{86,87} These two systematic reviews analysed five RCTs and 14 non-randomised controlled trials or cohort studies.^{57,64,88-106} The overall quality of these data was found to be moderate to low due to lack of control groups, and inadequate blinding and randomisation. In spite of these

limitations, symptomatic improvement in dizziness was consistently reported. Treatments included mobilisation and or manipulation alone⁸⁸⁻⁹⁴ and in combination with other therapies such as acupuncture⁹⁵, massage^{57,64,96-103}, traction^{99,104}, ergonomic advice^{57,64,105}, anti-inflammatory medications^{95,98,105}, and home exercises^{57,64,98,106}. These data show promising preliminary evidence that warrants rigorous research in this area.

Conclusion

At present there is no satisfactory treatment for non-specific or age related dizziness. However, there is preliminary evidence that physical treatment of the neck may improve balance in neck pain patients. Therefore, it is important to examine the possible therapeutic effect of chiropractic interventions (particularly SMT) directed at the neck in treatment of this condition and prevention of falls in this subpopulation of the elderly. The need for this research is particularly acute given the substantial health and economic costs of falls in the elderly and the aging of the population in the industrialised world. We know that postural stability and motor control relies on integration of proprioceptive vestibular and visual inputs by the CNS, inputs that are widely believed to deteriorate with age. Neck pain is widely believed to be capable of compromising mechanisms of postural balance by distorting the proprioceptive input from the neck to the CNS. It is possible that integration of incongruous inputs by CNS balance centres becomes more challenging as proprioceptive visual and vestibular sensory mechanisms age. Whilst neck manipulation, a commonly practiced treatment by chiropractors, has shown effectiveness for neck pain, it has not been adequately evaluated for non-specific dizziness. However, there is encouraging preliminary data that seems to support the use of neck manipulation in treating this condition. Given that both spinal pain and dizziness are risk factors for balance deficits and falls in the elderly, rigorously designed randomised controlled trials are needed in this area. These trials should focus on both efficacy and effectiveness of the various chiropractic neck manipulation and mobilisation techniques and strategies on: neck pain; non-specific dizziness; dizziness-related disability; and falls frequency in the community dwelling elderly population.

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