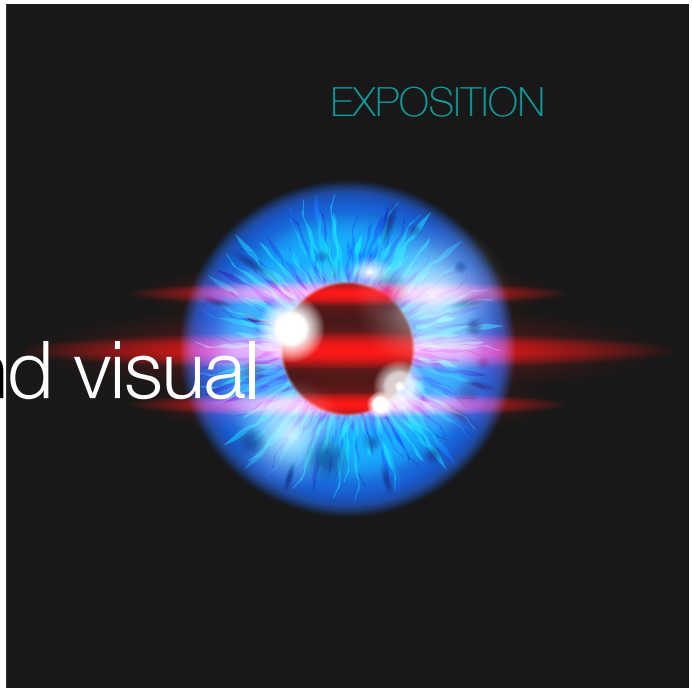
Asia-Pacific Chiropractic Journal



Cervical Spondylosis and visual dysfunction: A brief overview

King Yi Leung and Eric Chun-Pu Chu

Abstract: Cervical spondylosis is one of the common spinal conditions chiropractors encounter on a daily basis. While pain and stiffness are commonly seen, tinnitus, nausea, headaches, gastrointestinal discomfort, hypomnesia, palpitations, and visual impairment are some of the less common symptoms also seen in cervical spondylosis. There are currently three proposed hypothesis that may explaining the mechanism of spinal related visual dysfunction: opthalmoneural, neural, and immunochemical. Spinal manipulation and surgery appears to be equally successful in addressing spinal related visual impairment, but the correlations and underlying mechanism is still not well understood and controversial. This article aims to provide a narrative overview on visual impairment seen in associated cervical spondylosis.

Indexing terms: blurred vision; cervical spondylosis; chiropractic; spinal manipulation; visual dysfunction

Introduction

Cervical spondylosis is one of the common spinal conditions chiropractors encounter on a daily basis. While pain and stiffness are commonly seen, tinnitus, nausea, headaches, gastrointestinal discomfort, hypomnesia, palpitations, and visual impairment are some of the less common symptoms also seen in cervical spondylosis. (1)

> *... 'the literature suggests there are 3 mechanisms for visual dysfunction including cervical spondylosis. This paper proves an overview to guide clinicians in their diagnostic and therapeutic approaches'.*

In individuals with cervical spondylosis and chronic ophthalmological diseases, chiropractic spinal manipulation has consistently been shown to improve visual impairment. (2) Furthermore, with accordance to the patient's aetiology and preference, cervical treatment with chiropractic manipulation, anterior cervical discectomy and fusion, cervical complete disc replacement, or laminoplasty has been demonstrated to reduce headache, (3) vertigo, (4) and gastrointestinal discomfort. (5)

Visual dysfunction is defined as a partial functional loss of vision that cannot be corrected with eye surgery, medicine, or optical lenses. It can cause mild to severe blurred vision or even total blindness. Between 3.0% and 22.4% of other unusual symptoms are visual impairment brought on by cervical spondylosis. (6)

According to a recent meta-analysis, 2.6% of people experience blurred vision as a result of cervical spondylosis. (1) The pathoanatomical causes of the visual dysfunctions in patients with cervical spondylosis have not yet been determined. Furthermore, there has not been a consensus

on the diagnostic tests and criteria for this condition. Thus, the underlying mechanisms of the accompanying visual improvement are not entirely understood.

This article aims to provide a narrative overview on visual dysfunction seen in associated cervical spondylosis. We examined researches regarding the efficacy of surgical and spinal manipulative therapies on visual impairment. In a later section of the article, we will discuss the potential underlying processes of visual dysfunction brought on by cervical spondylosis, along with the corresponding anatomical, genetic, and protein abnormalities.

Methods

A literature review was conducted by using the terms 'chiropractic', 'cervical spondylosis', 'blurred vision', 'visual impairment', 'spinal decompression', and 'spinal manipulation' on PubMed and MEDLINE. The search timeframe was set at the inception of the database up to August 2022. References for this review were also identified from the personal libraries of the authors, supplemented by the reference lists of recent reviews and book chapters. The selection and identification of relevant articles on cervical spondylosis and visual impairment were based on the author's expertise, with the goal to create a summary of the current understanding of how cervicalgia and visual impairments impacted the population. The reviewed studies were mostly in the form of questionnaires.

Results

The researches, and the information currently available, were grouped and presented based on the type of intervention, and described based on the efficacy in treating visual dysfunction.

Spinal manipulation and visual dysfunction

Several studies conducted in the 1990s showed improved vision following spinal manipulation. Studies have documented cases of successful ophthalmological recovery in suspected optic nerve ischemia, microvascular spasm of the optic nerve, bilateral simultaneous optic nerve dysfunction following periorbital trauma, congested visual fields, monocular visual loss following closed head trauma, and severe glaucoma visual field deficit after spinal manipulation. (3, 7, 8, 9) A group of authors reported instances where a substantial improvement in vision occurred in both eyes after spinal manipulation. (9) Another group of researchers in Asia had also reported a case of resolution of myopic *retinoschisis* after spinal manipulation spontaneously. (10) Additionally, a single cohort prospective trial assessing the immediate effects of spine manipulation found that after receiving chiropractic care, visual acuity significantly improved. (11) Different spinal manipulation techniques suggested varying correlations in clinical studies.

A feasibility randomised sham controlled study using chiropractic treatment, i.e. instrument-assisted manipulation, to treat non-specific dizziness and neck discomfort in community-dwelling elderly individuals offered positive results. (12) Another however reported the reverse effect, where higher spinal manipulation caused ophthalmological side effects with an unknown frequency. (13) Unfortunately, no comprehensive evidence on the subject could be found, but it does seem possible that spinal manipulation and chiropractic treatment can potentially offer some degree of relief to patients experiencing vision impairment in the absence of a specific aetiology.

Surgical intervention and visual dysfunction

The literature review discovered discrepancies in the surgical treatment reports of cervical spondylosis patients. Several findings indicate that double-door laminoplasty might considerably improve atypical symptoms such as blurred vision, (14) while another documented that artificial disc replacement relieved atypical symptoms like blurred vision. (15) Even though anterior cervical discectomy and fusion (ACDF) considerably decreased atypical symptoms associated

with cervical *spondylotic myelopathy*, including dizziness, headache, nausea, and palpitations, (16) alleviation from symptoms such as impaired vision, tinnitus, and memory are generally debatable. Sharma et al (4) had discovered that the intensity and frequency of tinnitus, palpitations, and impaired vision did not improve significantly following ACDF. A meta-analysis of 27 studies on the influence of cervical spine surgery on unusual symptoms released in September 2021 revealed that five studies associated cervical spondylosis with impaired vision. The meta-analysis discovered that cervical decompression is beneficial in reducing headache, dizziness, and tinnitus, but it had no impact on nausea, impaired vision, memory loss, gastrointestinal discomfort, palpitations, or hypertension. (1)

Some other researchers employed *Functional magnetic resonance imaging* (fMRI) to investigate their surgical outcome and its effect on visual dysfunction. A cross-sectional research comparing healthy people to patients with cervical spondylotic myelopathy found that following spinal surgery, patients had considerable recovery of functional connectivity in the visual cortex and posterior cingulate lobe with cerebellum compensation. (17,18) One other research using multimodal fMRI observed that the visual cortex of individuals with acute incomplete cervical spinal cord trauma were altered structurally and functionally. (18) These findings suggest that individuals with cervical spondylosis may have functional along with possible anatomical impairment to the visual cortex of the brain. Other regions of the brain may compensate for the visual deficiencies.

Sympathetic nerve location and its relationship to visual dysfunction

The sympathetic nerve's position has long been considered a crucial element in the development of impaired vision linked to cervical spondylosis. The *posterior longitudinal ligament* (PLL) is thought to have a contribution anatomically in the development of blurred vision with cervical spondylosis. The sympathetic preganglionic neurons are found inside the central nervous system. At the base of the skull, the sympathetic cell bodies emerge, and they extend into the spinal column. The PLL also contains sympathetic nerve fibres. These nerve fibres resemble the nerve fibres of the cardiovascular and gastrointestinal systems in terms of anatomical structure and immunohistochemical characteristics. (19) This could explain why atypical symptoms of cervical spondylosis can manifest in the digestive and cardiovascular systems. (20) After anterior cervical surgery, these sympathetic atypical symptoms are alleviated, according to a prospective study. This could be because the PLL was surgically removed from the cervical region and affected its input aforementioned neurological influence. (21).

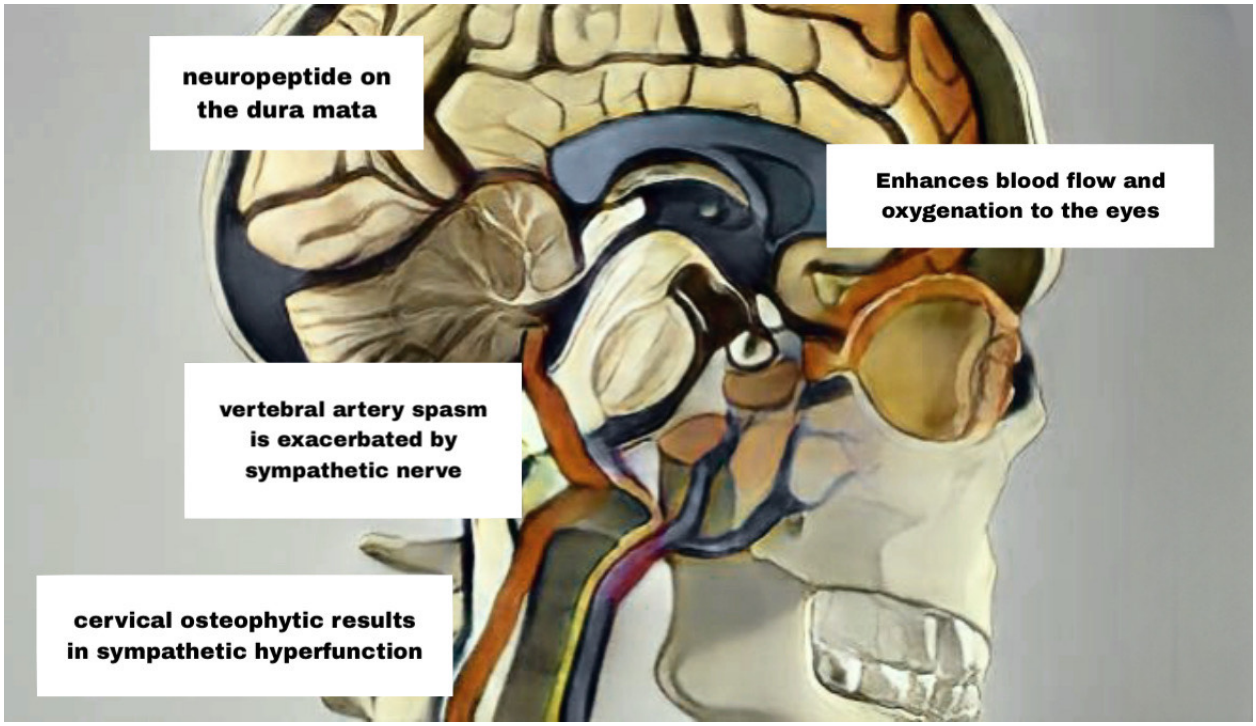
Conversely, there are few studies that support the theory that, rather than the PLL, the sympathetic nerve fibres that are activated are found in the dura and spinal cord. Accordingly, it has been demonstrated that the symptomatic alleviation rate of atypical symptoms in patients who received posterior cervical laminoplasty and the patients who got anterior cervical surgery were fairly similar. (22) Since all three surgical techniques focus on decompressing the dura and the spinal cord, which appears to be the major causes of atypical symptoms, it seems to be agreed that the atypical symptoms of cervical spondylosis can greatly improved with or without PLL removal. According to the current understanding, the cervical degenerative process that surrounds the dura and spinal cord, including PLL ossification, *ligamentum flavum* hypertrophy, osteophytosis of the vertebral body, disc degeneration, vertebral subluxation, and inflammatory reaction, provokes the atypical symptoms. However, because of the way their questionnaires were designed, the examined researches have significant limitations. Surgical anaesthetic, diabetes, hypertension, postoperative activities, and patient subjective characteristics all have a considerable impact on the study's findings.

Theoretical mechanisms for cervical spondylosis and vision dysfunction

with Figure 1 and Table 1

There are three different mechanisms currently offered explanations to the aetiology of visual dysfunction (blurred vision) in cervical spondylosis with physiological changes. (Figure 1)

Figure 1: Three mechanisms



The first hypothesised mechanism revolves around the neuro-ophthalmological changes. Retinal cells are demonstrated to survive at an ischemic level in a hibernating and less functional state in individuals with a history of ophthalmological ischemia. This demonstrates a relationship between retinal morphology and spinal manipulation. (10)

To put it briefly, the retinal cells hibernate in order to survive at an ischemia level below the threshold and remain alive. Additionally, a little increase in retinal circulation will result in a significant improvement in eyesight. Spinal manipulation is thought to trigger a change in the sympathetic response, enhance blood flow and oxygenation to the tissue that has hibernated, thus recover visual impairment. This pathophysiological process might explain instances where individuals with a history of visual problems restore their eyesight following spinal manipulation. (6, 7, 8, 9, 10)

The second hypothesised mechanism postulates the involvement of neurons in the vision-blurring process. According to research (23, 24) cervical spondylosis stimulates the sympathetic nervous system, which results in the visual impairment. In simplest terms, the stimulation of sympathetic nerves in the neck caused by cervical osteophytic causes sympathetic hyper-function, which manifests as eye discomfort, dry eyes, hazy vision, weariness, larger eye clefts, and dilated pupils. The brainstem and occipital lobe visual cortex are both supplied with blood via the vertebral artery, and sympathetic nerve hyper-function exacerbates vertebral artery spasm, which escalates cerebral ischemia symptoms, reduces blood supply to the visual cortex, and exacerbates visual impairment. It may also be followed by parasympathetic signs such lacrimation, ptosis, and miosis.

The third hypothesised mechanism explain the phenomenon through using an immunohistochemistry. Neural fibre with rich in neuropeptide Y, vasoactive intestinal peptide, and tyrosine hydroxylase on the *dura mata* involved in the sympathetic stimulation of the digestive and cardiovascular systems, which can results in the unusual symptoms. (22) The atypical symptoms might also be brought on by alterations in gene and protein expression, such as those changes in C-fos. (25) Unfortunately, this hypothesis fell short in explaining the recovery of non-cardiovascular and non-gastrointestinal symptoms.

Table 1: Theoretical mechanisms for cervical spondylosis and vision dysfunctions

Type of Approach	Pathophysiological mechanisms	Effects
Neuro-ophthalmological	Patients with a history of ophthalmological ischemia have retinal cells that hibernate and survive at an ischemic level, resulting in a lower functioning state.	Retinal cells hibernate due to ischemia and thus remain alive. A small increase in retinal blood flow can result in a significant improvement in vision. Chiropractic spinal manipulation triggers a change in the sympathetic response, enhances blood flow and oxygenation to the tissue that has hibernated, and reawakens visual impairment.
Neuronal	Sympathetic/parasympathetic nerve stimulation	The stimulation of sympathetic nerves by cervical osteophytic results in sympathetic hyperfunction, which manifests as eye pain, dry eyes, impaired vision, weariness, enlarged eye clefts, and dilated pupils. The vertebral artery spasm is exacerbated by sympathetic nerve hyperfunction, which worsens the symptoms of cerebral ischemia, reduces blood supply to the visual cortex, and exacerbates visual impairment. It may also be followed by parasympathetic signs and symptoms such lacrimation, ptosis, and miosis.
Immunohistochemical	Neural fibre with rich in neuropeptide Y, vasoactive intestinal peptide, and tyrosine hydroxylase on the *dura mata* involved in the sympathetic stimulation of the digestive and cardiovascular systems, which can results in the unusual symptoms	The unusual symptoms could potentially be brought on by variations in gene and protein expression, such as those in C-fos.

Conclusion

In cervical spondylosis, atypical symptoms are rather uncommon. It is advised that individuals with visual impairment from cervical spondylosis have ophthalmological consultations first.

Cervicogenic visual impairment should be explored as a differential diagnosis when ophthalmological investigation is ruled out. Additionally, our research found that spinal manipulation and surgery were equally successful in addressing spinal related visual impairment, and that chiropractor can potentially play a role in managing cases where the severe pathologies had been ruled out.

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Cite: Leung KY, Chu ECP. Cervical Spondylosis and visual dysfunction: A brief overview. Asia-Pac Chiropr J. 2023;3.3
URL http://www.apcj.net/papers-issue-3-3/#LeungChuCervicalSpondylosis

Conflict of interests

The authors declare no potential conflict of interests.

Consent

Written informed consent was obtained from the patient whose files were used in this study.

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Huang KHK, Leung L, Chu ECP. Chiropractic management as conservative care for adolescent idiopathic scoliosis (Cases Report). Asia-Pac Chiropr J. 2021;2.2. URL http://www.apcj.net/papers-issue-2-2/#HuangScoliosis

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