

Changes in gait parameters, muscle tone, and radiographic parameters in post-ischemic stroke patients following chiropractic care

Chin Wui Ling

Abstract: This retrospective chart review was performed to assess the effect of chiropractic intervention in patients with post-ischemic stroke. Seven patients with a history of ischemic stroke who underwent chiropractic adjustment were retrospectively evaluated.

A chart review was performed to extract age, medical history, and treatment interventions. The magnitude of spinal subluxation was determined using standing radiography (X-ray). A comparison of measurements from pre- and post-treatment radiographs revealed that cervical lordosis had improved. Additionally, sensorimotor function of the upper and lower extremities, muscle activation, gait parameters, and quality of life improved in all patients.

These results suggest that chiropractic care can be an effective part of post-stroke rehabilitation.

Indexing Terms: Chiropractic; post ischemic stroke; gait parameters; spinal manipulation.

Introduction

Stroke is the second leading cause of death worldwide, with increased chronic disability in 50% of survivors. In the United States specifically, the prevalence of stroke is approximately 3% in the adult population, accounting for 7 million individuals. (1) Of all stroke cases, approximately 87% are ischemic stroke cases, with hemorrhagic stroke accounting for 10%, and only 3% for subarachnoid haemorrhages.

With age, the incidence of stroke increases dramatically, doubling each decade after the age of 55 years. This translates to 30–120 cases per 100,000 people per year for those aged 35–44 years, and 670–970 per 100,000 people per year among adults aged 65–75 years. (2)

The most common complications of stroke are spasticity, weakness, and unilateral paralysis, resulting in poor coordination, balance, and requiring rehabilitation. (3) Previous post-stroke studies are lack of chiropractic care involvement and only one study showed that early post-stroke rehabilitation (from the first week until the first month post-stroke) enhances neural plasticity. (3) Many case reports identifying the benefits of chiropractic therapy for visual disturbance, (4, 5) and

... This study of post-stroke patients who received early Chiropractic care shows positive changes in radiological and sEMG findings and on walking cyclograms ...'



dizziness. (6, 7, 8, 9) As a result of its effect on the central nervous system, chiropractic therapy may facilitate motor recovery in stroke survivors. (10, 11, 12) Thus, due to the increase in the aging population and prevalence of stroke, this study aimed to investigate whether chiropractic treatment can be part of a multidisciplinary team to reduce the burden of stroke.

Materials and methods

A retrospective chart review was conducted for post-stroke patients who were treated for neck pain between January 2021 and March 2022 in 37 chiropractic clinics in Hong Kong.

Patients with history of stroke who received chiropractic treatment for a minimum of 6 months were included. Chiropractic sessions were received two to three times weekly and consisted of rehabilitation exercises, flexion-distraction spinal traction, and spinal manipulation.

Radiography images (X-rays) were taken before and after chiropractic treatment to analyse the cervical gravity line. A walking cyclogram was used to track the patient's progress before and after the chiropractic treatment, and surface electromyography (sEMG) was used to investigate muscle activation and fatigue.

The *Fugl-Meyer Assessment* (FMA) scale was used as an index to assess improvements to sensorimotor impairment of the upper and lower extremities in individuals with a history of stroke. Additionally, the *World Health Organization's Quality of Life Scale* (WHOQOL-BREF) was used to record changes in a patient's quality of life before and after chiropractic treatment. The WHOQOL-BREF is used to study the domains of quality of life, including physical health, psychological health, social relationships, environmental health, and perception of health.

Descriptive statistics as means and percentages were used to calculate continuous variables and frequencies for the categories.

Results

A total of seven post-ischemic patients, three male and four female, were included in the retrospective analysis. Table 1 shows the clinical characteristics of the patients; mean age was 66.42 years and the mean history of stroke was 6.49 years.

The average duration of chiropractic treatment was 11.57 months. Treatments included chiropractic manipulation, flexion-distraction spinal traction, and rehabilitation exercises, which included sit-to-stand, passive and active range of motion exercises, bird dog stretches, and supine bridges.

Overall, there was a 72.8% improvement in FMA upper extremity sensorimotor function and a 71.8% improvement in FMA lower extremity sensorimotor function, which showed improvement in the active/passive ranges of motion and coordination in the upper and lower extremities. All patients showed 80% improvement in their quality of life. The majority of patients reported having an increased sense of support, satisfaction with their health, satisfaction with their ability to perform activities of daily living, satisfaction with accessibility to health services, and decreased negative feelings.

Discussion

This study reported positive changes in post-stroke patients after receiving chiropractic care. Generally, the most common musculoskeletal complication of stroke is spasticity and hypertonicity, (1) and research has shown that 60% of stroke patients present with symptoms related to spasticity, which results in stiffness, loss of movement, and pain. (14) In a Cochrane review, spasticity occurred in 25% of patients within two weeks following stroke. After one year, the overall prevalence of spasticity increased to 38% in patients who had survived their first stroke.

Table 1: Clinical patient characteristics

Abbreviations: FMA UE, Fugl-Meyer Assessment upper extremity; FMA LE, Fugl-Meyer Assessment lower extremity; WHOQOL-BREF, World Health Organisation's Quality of Life Scale

Case	Sex	Age	History of stroke (years)	Months of chiropractic treatment	FMA UE		FMA LE		WHOQOL-BREF	
					Pre	Post	Pre	Post	Pre	Post
1.	M	68	0.42	9	47	63	22	30	77	82
2	F	60	10	14	40	52	25	33	70	80
3	F	78	5	11	45	60	20	33	65	75
4	F	77	10	10	45	62	23	32	60	80
5	F	56	3	9	48	62	24	33	68	86
6	M	56	5	13	33	55	25	33	62	80
7	M	70	5	15	40	55	24	33	60	80

As illustrated in Figure 1, Case 1 had a history of stroke 5 months previously. He showed the greatest improvement among all patients.

Figure 1: Cervical radiograph of Case 1. **(A)** Prior to treatment, the sagittal radiograph showing a forward head posture, and degenerative spondylosis with ankylosis of the C5/6. The cervical gravity line (white dotted line) just touches the anterior C2 vertebra. **(B)** Repeat cervical radiographs 9 months later showing improved posture. The cervical gravity line touches both the C3 and C4 vertebrae.

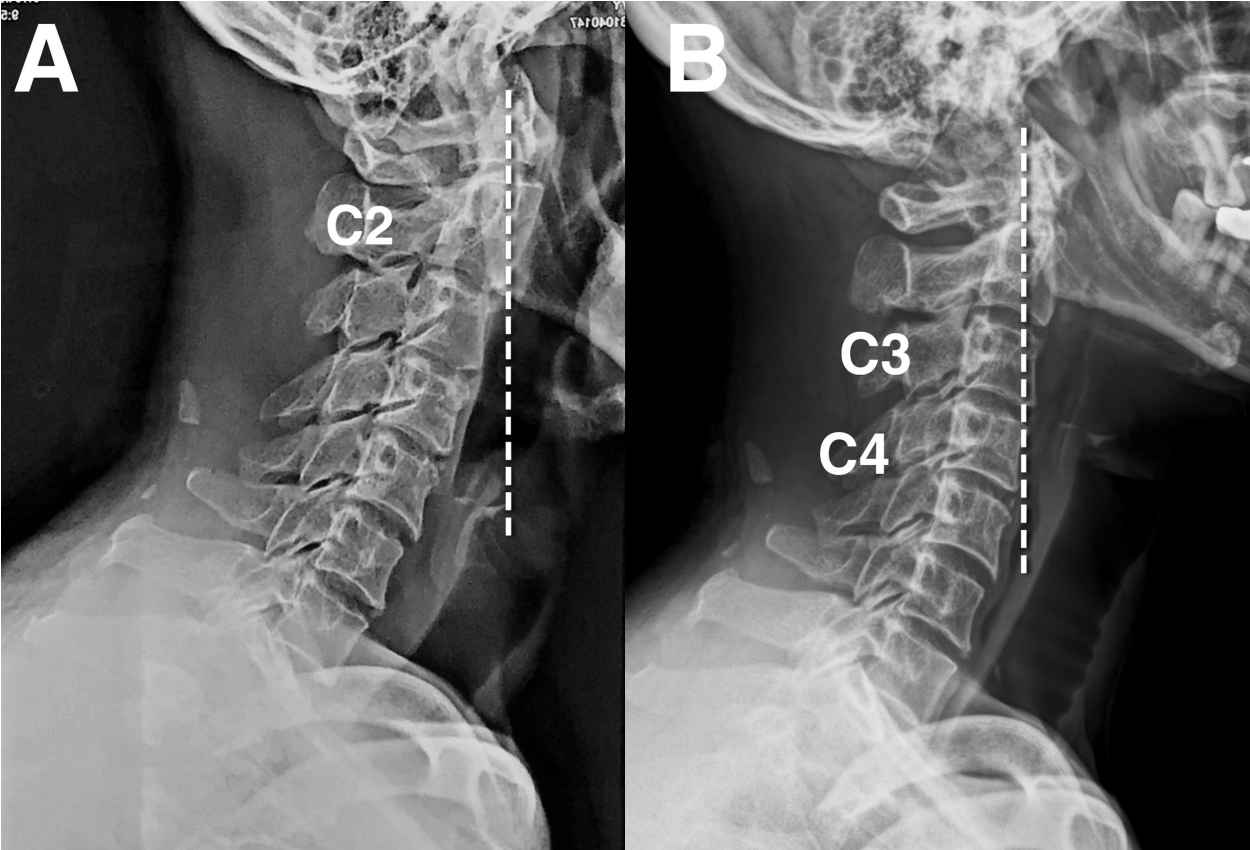
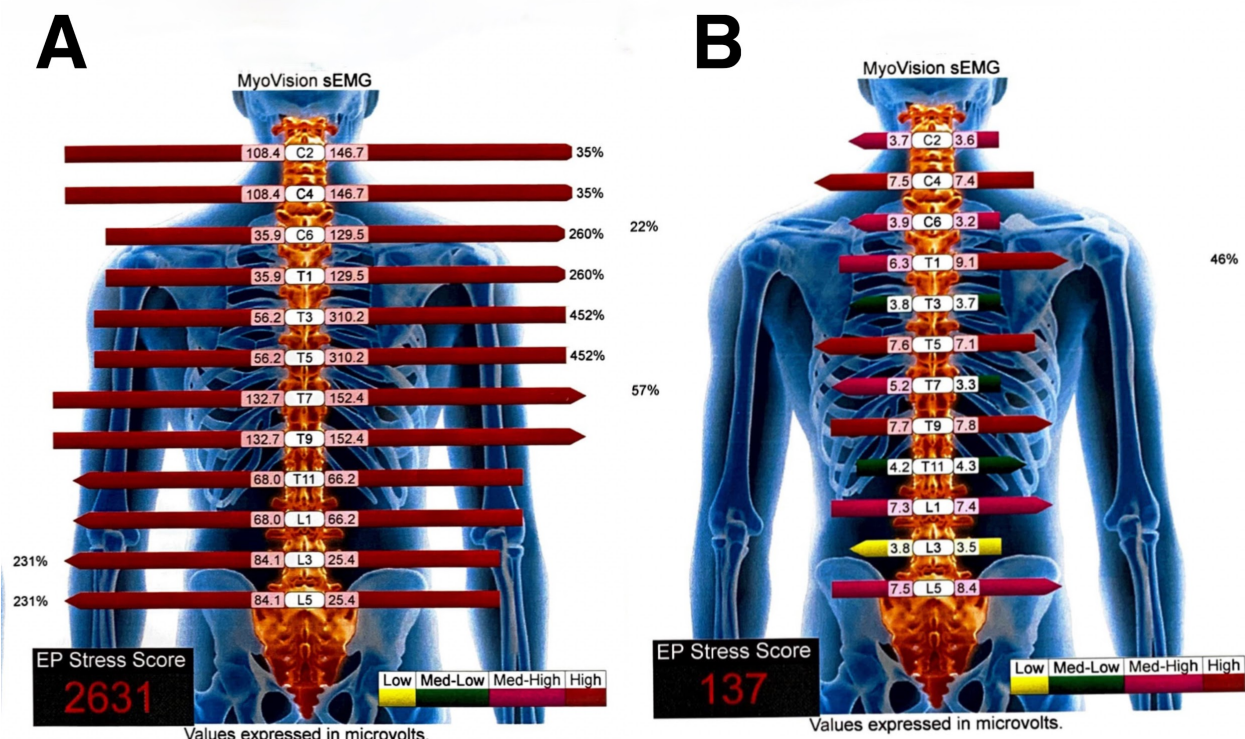


Figure 2: sEMG measurements documented at pre- and post-treatment. The intensity of muscle tones is recorded with the color and length of the bars in the schematic representation. The EP stress score is the measurement of paraspinal muscle activity, measured in microvolts. (A) High intensity in red indicated spasm in the cervical, thoracic, and lumbar paraspinal muscles at initial presentation. (B) Normalized sEMG measurement of the paraspinal muscular activity and reduced EP stress score are positive correlations with symptom improvement after the nine-month treatment.

Abbreviations: sEMG, Surface electromyology; EP, electrophysiological



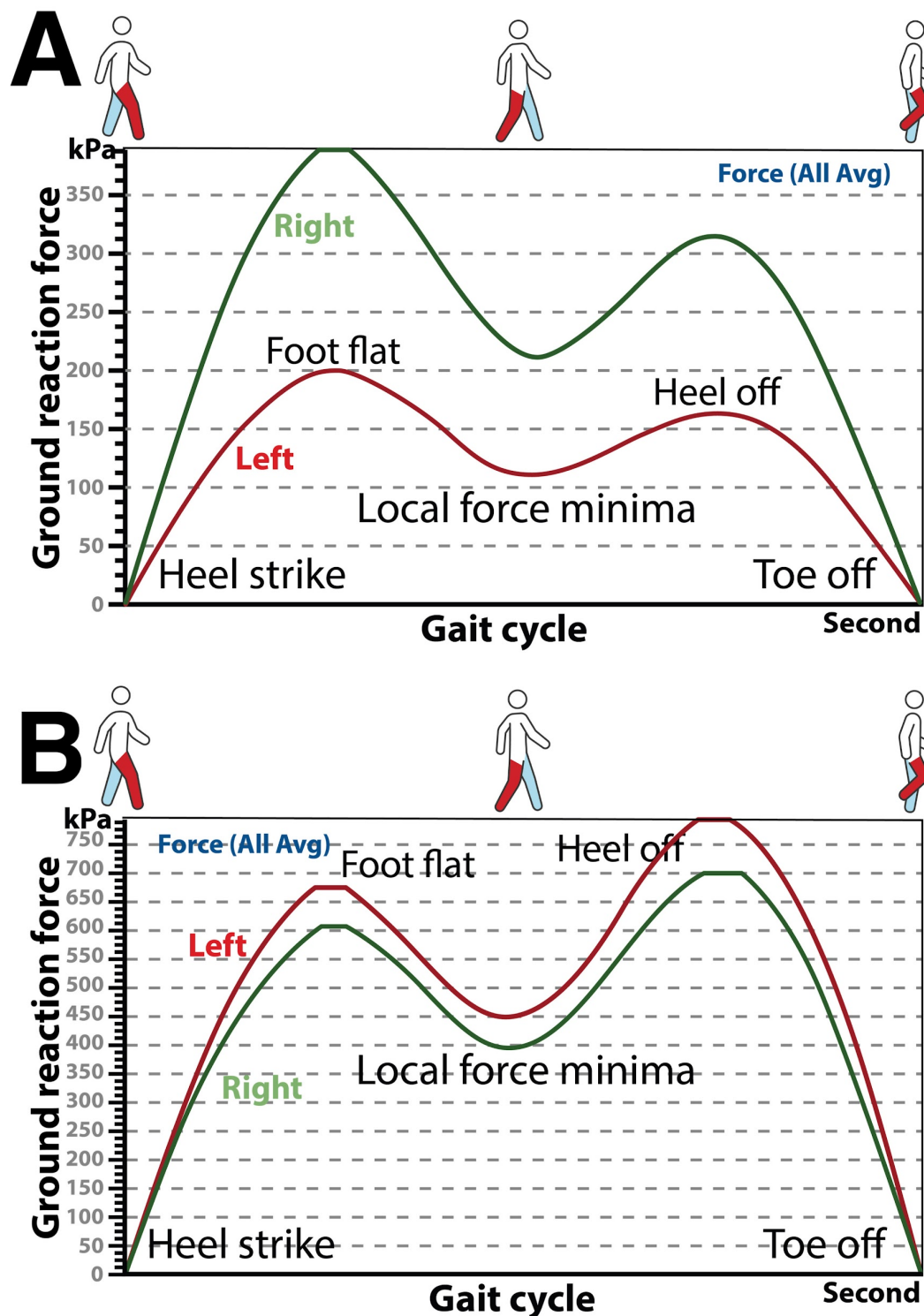
Chiropractors often provide managements for neuromusculoskeletal disorders and accompanying pain. They employ a number of manual therapies, such as spinal adjustments, manipulations, and mobilisation, to treat a wide range of ailments. Additionally, they advise patients on how to alter their lifestyles for optimal treatment outcomes. By administering targeted treatments, chiropractors can help neuromusculoskeletal disease patients reduce pain and enhance their quality of life.

Although the prevalence of serious pathology with low back pain in chiropractic clinics is small, (13) severe cases of stroke will lead to the development of long-term complications, such as soft tissue contracture, limited function, and pressure sores if conditions continue to remain untreated. (14) Spasticity is frequently observed in the upper extremities, commonly developed in the elbow (79%), wrist (66%), and shoulders (58%). Common lower limb involvement includes the ankle plantar flexors, hip adductors, knee extensors, knee flexors, and hip internal rotators.

The current treatment approaches for spasticity include physical therapies such as long-duration stretching and positioning exercises and pharmaceutical intervention. (15) As the adverse event of chiropractic therapy is very rare, (16) the aims of physical interventions are to facilitate neural activity in the damaged cerebral hemisphere, minimise any changes to the viscoelastic properties of connective tissue and muscles surrounding the joint, alter the neural patterns of spasticity, and maintain levels of function in post-stroke survivors. (17) Improvement in balance from chiropractic treatments has been reported in neurodegenerative patients in case studies. (18, 19) Although chiropractic treatment in post-stroke patients is not considered common, a number of studies suggest positive synergistic effects of chiropractic treatment in

post-stroke patients. For example, a randomised controlled parallel-design study showed that individuals with chronic stroke and motor weakness in the lower limb demonstrated improvement in corticomotor excitability of the ankle dorsiflexor muscles as well as walking function after a single session of chiropractic spinal adjustment, as compared to the group exposed to a passive movement control intervention. (20) Further, another randomised study showed increased plantar flexor muscle strength and cortical drive to the affected limb in a group of stroke patients after one single chiropractic session. (21)

Figure 3: Graph comparing the gait pattern recorded by pressure foot sensors on vertical GRF, as the patient walked for 2 minutes with multiple gait cycles on the instrumented treadmill. (A) At initial gait cycle, the patient demonstrated a reduction in applied force of the left foot in the stance compared to the right foot. (B) The follow-up vertical GRF graph measured consistent stance phase and symmetric foot pressure. GRF peaks were demonstrated to increase following treatment.



Previous clinical studies have highlighted that early identification and treatment of at-risk patients will increase the quality of care, improve function and independence, and avoid long-term complications. (15) Primary care follow-up has also been suggested in the literature for patients who experienced stroke within the first 12 weeks following stroke. (15) Our study showed that Case 1, with early post-stroke history, showed a major improvement in terms of cervical lordosis, muscle tone, and walking stability compared to other patients

One previous study revealed that some post-stroke patients experienced a delay in care before receiving community rehabilitation, with some waiting for more than six months for services, or receiving none of the therapy that had been recommended at discharge. (22) This was due to the complex nature of recovery from stroke, which results in patients having contact with various services, providers, and healthcare professionals at varying stages of recovery and rehabilitation.

It is hypothesised that central segmental motor control problems are caused by the stresses and strains of daily life, which impact central segmental motor control in the spine and can lead to a self-perpetuating motor control problem. (23, 24) Many complicated cases with dizziness have been treated by chiropractors. (25, 26, 27) Chiropractic can cause a neurobiomechanical change in the spine that cause ongoing maladaptive neuroplastic changes in the central nervous system. (28) This study showed that through the integration of chiropractic treatment into post-stroke care, patients may benefit from early treatment and avoid long-term complications. Engaging in this approach enables in post-minor stroke recovery and rehabilitation community to pursue more research and clinical application of chiropractic care.

However, this study was limited by its small sample size, retrospective design, and absence of a sham or control treatment group. Further, the authors measured all radiographs and scores. Thus, risks of bias may threaten the validity of its results. Hence, larger sample sizes are recommended in future studies.

Conclusion

In this study, positive changes were observed in radiological, sEMG, and walking cyclograms in post-stroke patients who received early chiropractic treatment. Therefore, chiropractors can play a crucial role in post-stroke rehabilitation to reduce the burden on patients, families, and society, while indirectly promoting long-term cost savings.

Chin Wui Ling

BSc(Hons)(Chiropr), MSc(PubHealth)

Private practice of Chiropractic

Malaysia

ivychinwuling@gmail.com

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References

- Ovbiagele B, Nguyen-Huynh MN. Stroke epidemiology: advancing our understanding of disease mechanism and therapy. *Neurotherapeutics* 2011;8:319-329.
- Roger VL, Go AS, Lloyd-Jones DM, Adams RJ, Berry JD, Brown TM, Carnethon MR, Dai S, De Simone G, Ford ES, Fox CS. Heart disease and stroke statistics—2011 update: a report from the American Heart Association. *Circulation* 2011;123:e18–e209.
- Louis RC, Scott EK, John FD. Patient Education: Ischemic Stroke Treatment (Beyond the Basics) Up to Date. Retrieved May 3, 2022 from <https://www.uptodate.com/contents/ischemic-stroke-treatment-beyond-the-basics>
- Leung KY, Chu ECP, Chin WL. Cervical Spondylosis and visual dysfunction: A brief overview *Asia Pacific Chiro J.* 2023 Jan 3;3:1-7
- Leung KY, Chu ECP, Chin WL. Cervicogenic visual dysfunction: an understanding of its pathomechanism. *Med and Pharm Rep.* 2022 Jan 95:2.
- Chu EC, Zoubi FA, Yang J. Cervicogenic Dizziness Associated With Craniocervical Instability: A Case Report. *J Med Cases.* 2021 Nov;12(11):451-454.
- Kendall JC, French SD, Hartvigsen J, Azari MF. Chiropractic treatment including instrument-assisted manipulation for non-specific dizziness and neck pain in community-dwelling older people: a feasibility randomised sham-controlled trial. *Chiropr Man Therap.* 2018 May 10;26:14.
- Chu ECP, Chin WL, Bhaumik A. Cervicogenic dizziness. *Oxf Med Case Reports.* 2019 Dec 9;2019(11):476-478.
- Chu EC, Wong AY. Cervicogenic Dizziness in an 11-Year-Old Girl: A Case Report. *Adolesc Health Med Ther.* 2021 Nov 26;12:111-116.
- Taylor H.H., Holt K., Murphy B. Exploring the Neuromodulatory Effects of the Vertebral Subluxation and Chiropractic Care. *Chiropr. J. Aust.* 2010;40:37.
- Waterstone T.S., Niazi I.K., Navid M.S., Amjad I., Shafique M., Holt K., Haavik H., Samani A. Functional Connectivity Analysis on Resting-State Electroencephalography Signals Following Chiropractic Spinal Manipulation in Stroke Patients. *Brain Sci.* 2020;10:644.
- Holt K., Niazi I.K., Nedergaard R.W., Duehr J., Amjad I., Shafique M., Anwar M.N., Ndetan H., Turker K.S., Haavik H. The effects of a single session of chiropractic care on strength, cortical drive, and spinal excitability in stroke patients. *Sci. Rep.* 2019;9:2673.
- Chu EC, Trager RJ. Prevalence of Serious Pathology Among Adults with Low Back Pain Presenting for Chiropractic Care: A Retrospective Chart Review of Integrated Clinics in Hong Kong. *Med Sci Monit.* 2022 Sep 27;28:e938042.
- Chohan SA, Venkatesh PK, How CH. Long-term complications of stroke and secondary prevention: an overview for primary care physicians. *Singapore Med J* 2019;60:616-620
- Bavikatte G, Subramanian G, Asford S, Allison R, Hicklin D. Early Identification, Intervention and Management of Post-stroke Spasticity: Expert Consensus Recommendations. *Journal of Central Nervous System Disease* 2021;1-8
- Chu EC, Trager RJ, Lee LY, Niazi IK. A retrospective analysis of the incidence of severe adverse events among recipients of chiropractic spinal manipulative therapy. *Sci Rep.* 2023 Jan 23;13(1):1254. doi: 10.1038/s41598-023-28520-4.
- Monaghan K, Horgan F, Blake C, Cornall C, Hickey PP, Lyons BE, Langhorne P. Physical treatment interventions for managing spasticity after stroke. *Cochrane Database Syst Rev* 2017;2017(2):CD009188. Published 2017 Feb 13.
- Chu ECP, Wong AYL, Lee LYK. Chiropractic care for low back pain, gait and posture in a patient with Parkinson's disease: a case report and brief review. *AME Case Rep* 2021;5:34.
- Chu EC, Chen AT, Chiang R. Chiropractic care of Parkinson's disease and deformity. *J Med Life.* 2022 May;15(5):717-722. doi: 10.25122/jml-2021-0418.
- Navid MS, Niazi IK, Lelic D, Amjad I, Kumari N, Shafique M, Holt K, Rashid U, Drewes AM and Haavik H. Chiropractic Spinal Adjustment Increases the Cortical Drive to the Lower Limb Muscle in Chronic Stroke Patients. *Front. Neurol* 2022;12:747261.
- Holt K, Niazi IK, Amjad I, Kumari N, Rashid U, Duehr J, Navid MS, Shafique M, Haavik H. The effects of 4 weeks of chiropractic spinal adjustments on motor function in people with stroke: a randomized controlled trial. *Brain Sci.* 2021;11:676.
- Hall P, Williams D, Hickey A, Brewer L, Mellon L, Dolan E, Kelly PJ, Shelley E, Horgan NF, ASPIRE-S study group. Access to rehabilitation at six months post stroke: A Profile from the action on secondary prevention interventions and rehabilitation in stroke (ASPIRE-S) study. *Cerebrovasc Dis* 2016;42:247-254
- Hart J. Analysis and Adjustment of Vertebral Subluxation as a Separate and Distinct Identity for the Chiropractic Profession: A Commentary. *J. Chiropr. Humanit.* 2016;23:46–52.
- The Rubicon Group . Definition and Position Statement on the Chiropractic Subluxation. The Rubicon Group; Oak Brook, IL, USA: 2017.

Chu EC, Trager RJ, Tao C, Lee LY. Chiropractic Management of Neck Pain Complicated by Symptomatic Vertebral Artery Stenosis and Dizziness. *Am J Case Rep.* 2022 Oct 19;23:e937991.

Chu ECP, Lin AFC. Relief of postural orthostatic tachycardia syndrome with chiropractic rehabilitation. *J Family Med Prim Care.* 2022 Jul;11(7):4006-4009.

Chu ECP, Lo FS, Bhaumik A. Plausible impact of forward head posture on upper cervical spine stability. *J Family Med Prim Care.* 2020 May 31;9(5):2517-2520. doi: 10.4103/jfmprc.jfmprc_95_20. PMID: 32754534; PMCID: PMC7380784.

Haavik H., Murphy B. The role of spinal manipulation in addressing disordered sensorimotor integration and altered motor control. *J. Electromyogr. Kinesiol.* 2012;22:768–776.