

## Research article (Award paper)

**Effect of compression of fourth ventricle on the respiratory capacity in the post COVID patients**

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Corresponding author: **Tirthankar Ghosh**. Email: tirthankar.g@srisriuniversity.edu.in**ABSTRACT**

**Introduction and Aim:** Post-covid syndrome is the group of nonspecific symptoms which are seen among the patients who have been recovered from COVID-19 and that persist over 4 weeks. Symptoms involve fatigue, breathlessness, cough, cognitive disturbances, depression and anxiety, many organs related symptoms, and the prominent features involve shortness of breath and inability to return to baseline activity level. Studies show that Pneumonia which is associated with the COVID-19 infections can lead to long-standing damage to the alveoli in the lungs and as a result scar tissues may develop which in the future can lead to long-term breathing problems. The aim of this study is to assess the effectiveness of osteopathic CV4 technique in post covid patients.

**Materials and Methods:** This is a pre-test and post-test experimental study conducted at Sri Sri University. In this study, 20 subjects both male and female, having mean age of  $23.3 \pm 2.81$  years were taken. After assessment of all inclusion and exclusion criteria, a brief history regarding COVID-19 and if present other respiratory disorders was taken. Following this, a 5 minutes window period was given to all participants before the collection of pre-test data.

**Results:** When CV4 osteopathic technique was given to post-covid patients, there was a significant change in FVC, FEV1, PEF and pulse rate when compared to the pretest intervention data. However, the changes in oxygen saturation levels were not statistically significant.

**Conclusion:** The results show that osteopathic CV4 technique alters the respiratory capacity in post covid patients.

**Keywords:** CV4 (compression of fourth ventricle); Post COVID; FVC (forced vital capacity); FEV1 (forced expiratory volume in 1 sec); PEF (peak expiratory flow); SPO2; pulse rate; spirometer; pulse oximeter.

**INTRODUCTION**

Coronaviruses are a group of viruses that affects mammals and leads to pathologies from the common cold to SARS. And many studies show that multiple systems are also affected (1). Post-covid syndrome is the group of nonspecific symptoms which are seen among the patients who have been recovered from covid-19. Symptoms that persist over 4 weeks are identified as a post- COVID syndrome or long-COVID. Symptoms involve fatigue, breathlessness, concentration and sleep abnormality, dizziness on standing, poor appetite, cough, cognitive disturbances, depression and anxiety, joint and muscle pain, many organ related-symptoms, and decline in quality of life (2). Out of which most prominent features involve shortness of breath and unable to return to baseline activity level (2).

Castro *et al.*, conducted a systematic review and found that post-covid patients showed impairment in lung function, especially the diffusion capacity of the lungs (3). Boutou *et al.*, reviewed to investigate the prevalence of the respiratory function abnormalities during follow-up sessions of post-covid patients. Results showed that in a short-term follow-up, patients present with reduced lung diffusion and a restrictive pattern (4). Studies show that pneumonia which is associated with the COVID -19 infections can lead to

long-standing damage to the alveoli in the lungs and as a result scar tissues may develop which in the future can lead to long-term breathing problems (5). A lot of research has been performed to know the long-term complications of COVID -19. However further investigations are needed to observe how COVID -19 is having a long-term influence on recovered patients.

Osteopathy is a science of healing process having a holistic approach and mainly depending on the palpatory diagnosis of the practitioners. In osteopathy, the body is considered one unit where all structures and its functions are interdependent and consist of its own self-regulatory and healing process (6).

Compression of the fourth ventricle (CV4) is a very widely used cranial technique in osteopathy developed by Sutherland and has a very widespread physiological effect on the human system. Sutherland believed that on performing CV4 all the vital centers located in and around the fourth ventricle are affected (7).

CV4 effects and indications:

- Autonomic control of respiration and the diaphragm is affected.
- Tonus reduction of the sympathetic nervous system with a significant effect on stress, insomnia, anxiety.

- Tonus reduction of the whole connective tissue system thereby benefiting in acute and chronic musculoskeletal dysfunction.
- Effective in hypertension, tachycardia, arthritic disorders, neuroendocrine disturbances, and many more.
- Also effective during inflammations and infections (6,7).

The outcomes of the CV4 seem to enhance the fluid movements within the skull, the amplitude of the CRI (cranial rhythmic impulse), rhythms of the diaphragms and increases the temperature in the suboccipital region (8). According to Upledger & Vredevoogd, CV-4 affects diaphragm activity and autonomic control of

respiration and seems to relax the sympathetic nervous system to a significant degree. Autonomic functional improvement is always expected as a result of still point induction (9).

Activities of the respiratory muscles are mainly controlled by the rhythmic discharge of motor neurons from the brainstem, especially from the medullary respiratory centers. The area in the medulla that is responsible for generating the rhythmic impulse is known as the central pattern generator (CPG). CPG is in the pre-Bot zinger complex in the medulla and neurons from here discharge rhythmically to generate rhythmic motor activities in the phrenic nerve, hypoglossal nerve, and intercostal nerves (10,11).

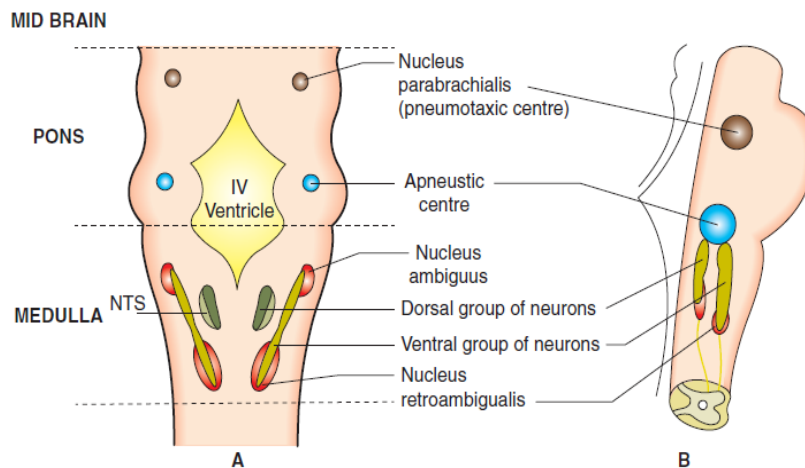


Fig.1: Respiratory centres in pons and medulla (13)

The neural control of respiration is thus affected by respiratory reflexes which are initiated from the stretch receptors, irritant receptors, chest wall receptors, j-receptors, and affected by chemical control mechanisms by alteration in arterial pO<sub>2</sub>, pCO<sub>2</sub>, and H<sup>+</sup> concentration (10,11).

The polyvagal theory was formulated by Porges to understand the behaviour of the human system. According to the polyvagal theory, when a person is feeling safe-not in danger-and if the body is healthy and functioning well, one can physiologically enjoy the state that supports spontaneous social engagement behaviours. According to the theory, the autonomic nervous system has three divisions involving the activity of the ventral branch of the vagus nerve, the activity of the dorsal branch of the vagus nerve, and sympathetic activity from the spinal chain. Before the polyvagal theory, the two branches of the vagus nerve were not differentiated and were considered together as a single 'vagus nerve'. The dorsal vagal branch supplies the motor fibers to the organ below the respiratory diaphragm and the ventral branch of the vagus supplies motor fibers to the organ above the diaphragm. And all three parts of ANS affect the vital functions of breathing and circulation.

The ventral vagus stimulates the rhythmic contractions of the bronchioles, facilitating the extraction of oxygen

whereas the area in the brainstem controlling the dorsal vagus may lead to chronic constrictions of the airways such as in cases of COPD, asthma, chronic bronchitis. With the ventral vagus, there is an act of the rhythmic opening of the airways: they are moderately open during inspiration and moderately closed during expiration. The ventral branch of the vagus along with the four cranial nerves i.e., CN V, VII, IX, and XI, all originating from the brainstem, must function properly to attain a rest and calm state that leads to a desirable social engagement, allowing us to be more creative, positive, productive, and happy (12).

## MATERIALS AND METHODS

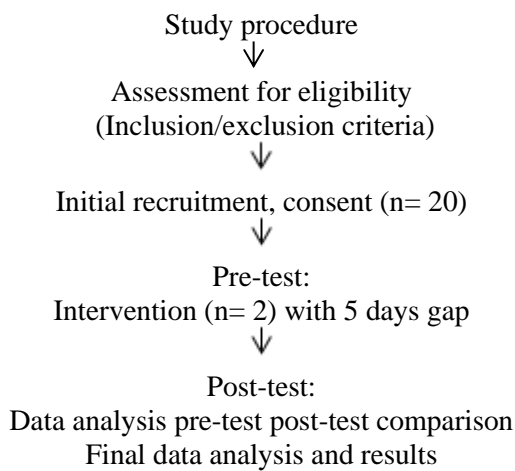
This is a pre-test and post-test experimental study conducted at Sri Sri University. In this study, 20 subjects both male and female, having mean age of 23.3 ± 2.81 years were taken. After assessment of all inclusion and exclusion criteria, a brief history regarding covid-19 and if present other respiratory disorders were taken. Following this, a 5 minutes window period was given to all participants before the collection of Pre-test data. Spirometer was used to measure FVC, FEV<sub>1</sub>, PEF and Pulse oximeter was used to measure SPO<sub>2</sub> and Pulse rate was measured manually.

**Study inclusion and exclusion**

Both male and female subjects with mean age  $23.3 \pm 2.81$  years were taken. Post- COVID patients with or without any history of respiratory disorders were taken.

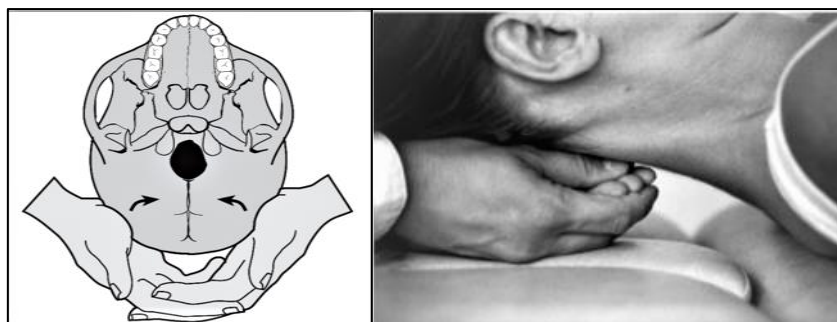
Subjects having major cerebral bleeding, malignancy, hypertension, head injuries, pregnancy, neurological disorders which is a contraindication for CV4 were excluded. Smokers and elderly patients above 50 years were also excluded.

**Study procedure**



**Osteopathic CV4 technique**

1. The subject lies supine, and the practitioner is seated at the head of the table with both forearms resting on the table, establishing a fulcrum and well grounded.
2. The practitioner crosses or interlaces the fingers of both hands, cradling the subject’s occipital squama.
3. The practitioner places the thenar eminences posteromedial to the subject’s occipitomastoid sutures (OMJ).
4. The practitioner encourages extension of the subject’s occiput by following the occiput as it moves into extension.
5. The practitioner resists flexion by holding the subject’s occiput in extension with bilateral medial forces.
6. This force is maintained until the amplitude of the cranial rhythmic impulse (CRI) or primary respiratory mechanism (PRM) decreases, a still point is reached, and/or a sense of release is felt (a sense of softening and warmth on the region of the occiput.)
7. As the CRI resumes, the practitioner slowly releases the force, allowing the CRI to undergo newfound excursion.
8. The rate and amplitude of CRI are retested to assess the effectiveness of the technique (6)



**Fig. 2:** Demonstration of osteopathic CV4 technique

**RESULTS**

**Table 1:** t-Test before and after session for the oxygen saturation %, pulse rate, FVC, FEV1 and PEF

Parameters	Pre (Mean ± SD)	Post (Mean ± SD)	t-value	p-value
Oxygen Saturation in %	98.3± 0.73	98.5 ± 0.69	-1.285	0.09
Pulse rate	89.5 ± 8.71	83.65 ± 6.78	2.808	0.003
FVC in L	4.46 ± 1.15	4.85 ± 1.42	-2.359	0.009
FEV1	2.23 ± 0.8	2.69 ± 0.83	-5.052	0.0002
PEF in L/S	2.72 ± 1.25	3.26 ± 1.29	-2.727	0.004

The baseline mean value of oxygen saturation% was  $(98.3 \pm 0.73)$  and post intervention mean value of Oxygen Saturation% changed to  $(98.5 \pm 0.69)$  and was not significant. The baseline mean value of pulse rate was  $(89.5 \pm 8.71)$  and post intervention mean value of pulse rate was  $(83.65 \pm 6.78)$  and was significant. The baseline mean value of FVC was  $(4.46 \pm 1.15)$  and the post intervention mean value of FVC changed to  $(4.85 \pm 1.42)$  and was significant. The baseline mean value of FEV1 was  $(2.23 \pm 0.8)$  and post intervention mean

value of FEV1 changed to  $(2.69 \pm 0.83)$  and was significant. The baseline mean value of PEF was  $(2.72 \pm 1.25)$  and post intervention mean value of PEF changed to  $(3.26 \pm 1.29)$  and was significant (Table 1).

**DISCUSSION**

The objective of the study was to establish osteopathic CV4 intervention on the respiratory capacity. To the best of the authors’ knowledge, this is the first study

to look at the immediate effects of CV-4 in patients who have had COVID. One of the most essential approaches in the treatment of cranial osteopathy is the fourth ventricle compression technique (CV4). It is a fluid (CSF) based treatment technique where the intracranial pressure increases and leads to increase in motion and exchange of fluids. This improves supply to the cells, lymph motion, regeneration of tissues and stimulates the cranial nerve centers in the region of 4<sup>th</sup> ventricle. The outcome of the CV4 seems to enhance the fluid movement within the skull, the amplitude of CRI (cranial rhythmic impulse), rhythms of diaphragm and increases the temperature in the sub-occipital region. The data showed that the CV4 brought about a significant change in FVC, FEV1, PEF and pulse rate, when compared to baseline pre-intervention data. There was a slight change in oxygen saturation, but the difference was not statistically significant. Castro *et al.*, conducted a systematic review and found that post-covid patients showed impairment in lung function, especially the diffusion capacity of lungs.

Other research has found a correlation between the CV-4 technique and autonomic-related parameters such as heart rate, blood pressure, blood flow velocity, electroencephalography alpha power, and muscular sympathetic nerve activity. Previous research has used a variety of methods to examine the effects of the CV-4 methodology on the ANS, including microneurographic recording, skin conductance, skin temperature, and heart rate variability measurements.

According to the literature, CV-4 technique activates the parasympathetic nerve regions in the brain stem, which causes changes in all the analyzed variables. In contrast to prior research, the use of the CV-4 approach was linked to changes in pulse rate very mild in our investigation. Ng *et al.* showed changes in sympathetic nerve activity without changes in heart rate or blood pressure, indicating that the heart rate does not quantitatively reflect the degree of autonomic activation. This is an essential subject for additional investigation, especially as no clinical evidence for the CV-4 approach has been established. The considerable standard deviations identified in PR and FVC levels in the current study individuals could perhaps explain why no additional significant differences were discovered. Finally, our research involved post-COVID patients, and the use of CV-4 in persons.

## CONCLUSION

To summarize, this is the current study to show that the CV4 method alters the respiratory capacity in post-COVID patients. It describes how the compression of the fourth ventricle activates the respiratory centers and improves the respiratory capacity in individuals. It is a non-invasive treatment without the use of any drugs. In this study the sample size was limited and the

long-term change in the respiratory capacity could not be measured. Also, further study can be done on how CV4 can bring about a change in other pathological conditions which involves the respiratory system. More similar studies can be performed to overcome these limitations.

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## CONFLICT OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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