

**Evaluation for the effect of Personal Protective Equipment on the isometric force of the Craniocervical flexor muscle in dental practitioner during COVID-19 pandemic by using custom-made load cell device: A Comparative Analysis**

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**Conflicts of Interest:** Nil

**Abstract**

**Background:** Coronavirus disease 2019 (COVID-19) is an emerging infectious disease of pandemic proportions. Dental practitioners were mandated to wear personal protective equipment (PPE) such as an N95 face mask and protective eyewear while attending to patients.

**Aim:** Evaluation for the isometric force of the Craniocervical flexor muscle using a custom-made load cell device in dental practitioners working under PPE during the COVID-19 Pandemic.

**Method:** Isometric force of craniocervical flexor muscle was evaluated in 29 dental practitioners. Evaluation for the effect of Personal Protective Equipment on the isometric force of the Craniocervical flexor muscle by using custom – made load cell device.

**Results:** The value of the isometric force of craniocervical flexor muscle in dental practitioners at rest was significantly different from the isometric force after dental procedure under PPE.

**Discussion:** Musculoskeletal disorders are common in the dental profession and can include pain, weakness, impaired sense of touch as itching, and numbness. Isometric forces of the neck flexor group of muscles were evaluated using a custom-made load cell device, which is a digital device that measures the force generated by muscles when the neck flexes against resistance. It was observed that the mean value of Cranio Cervical flexor muscle without PPE at rest was 3.97 kg and with PPE was 3.20 kg with P-value <0.05 showed test results were statically significant.

**Conclusion:** Use of PPE alters the hemodynamic changes which can lead to increased chances of musculoskeletal strains in dental professionals.

**Keywords:** PPE, PAPR, Covid -19

### **Introduction**

The Craniocervical flexion area is the most sensitive region of the cervical spine providing panoramic visual, vestibular functions, and controlling head and neck posture.<sup>1</sup> The Craniocervical flexion area is reinforced by several muscles like longus colli (superior portion), longus capitis, hyoid muscles, and ractus capitis providing the forward bending of the neck during the dental procedures.<sup>2</sup> Craniocervical flexor muscle groups are critical muscles to keep the neutral posture from and maintain cervical lordosis.<sup>3</sup>

Researchers have found that symptoms of discomfort for dental workers occurred in the neck is 68.5%. The common predisposing factors for work-related neck pain in dentists are awkward postures, repetitiveness, lack of rest periods, and ergonomics and psychological stress were reported during the dental practices. It has been found in studies that 30 degrees of forwarding neck flexion can cause significant impairment in the blood circulation within the neck region<sup>4</sup>.

In late December 2019, reports emerged from the city of Wuhan, in Hubei Province, China, of a cluster of severe acute respiratory illnesses. By January 2020, the condition was known as coronavirus disease 2019 (COVID-19), attributed to the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which had rapidly spread from Wuhan to other regions.<sup>5</sup>

During the escalation of the COVID-19 outbreak in India, frontline healthcare workers and dental professionals were mandated to wear personal protective equipment (PPE), while caring for suspected or confirmed COVID-19 patients, which involved the donning of close-fitting N95 face masks, protective eyewear (mainly goggles), gowns, surgical gloves, and the use of powered air-purifying respirators (PAPR). In real-world practice, donning the PPE is often felt cumbersome and uncomfortable by the frontline healthcare workers, especially if a long period of exposure to such equipment is necessary during the outbreaks of emerging infectious diseases.

### **Aim**

Evaluation for the isometric force of the Craniocervical flexor muscle using custom-made load cell device in dental practitioner working under PPE during COVID-19 Pandemic.

### **Method**

Isometric force of Craniocervical flexor muscle was evaluated in 29 asymptomatic dental practitioners (age 27.5 +- 5.51 years, body weight 65.75 +- 9.43). Exclusion criteria were neck or shoulder pain, history of cervical trauma or surgery, history of musculoskeletal or neuromuscular diseases, history of neck and shoulder pain in the previous six months, participation in sports activities, cardiorespiratory problems, and temporomandibular joint disorders.

For measuring the isometric force of the Craniocervical flexors muscles, a custom-made load cell device was developed. This custom-made load cell device consists of a digital load cell resting on the nape of the neck with one end attached to the cranium with the help of self-adjusting straps and the other with a self-adjusting strap on chest circumference as shown in Fig 1 and Fig 2.

For measuring the isometric force of the Craniocervical flexor, participants were requested to sit on a stool, hips at 90 degrees of flexion, knees at 90 degrees of flexion, feet on the floor, and both hands resting on thighs.

Isometric force of the Craniocervical flexor muscle at rest reading was obtained from a dental practitioner in early morning hours when the muscle was in a state of minimum fatigue. Three maximal voluntary isometric values at rest were obtained from each subject instructing them to flex against resistance without significant neck movement.

Each PPE donned dental practitioner after obtaining isometric force of Craniocervical flexor muscle at rest were instructed to provide emergency endodontic treatment to patients who were reported with severe pain. After the completion of primary emergency endodontic treatment, the isometric force of Craniocervical flexor muscle postoperative was obtained from PPE donned dental practitioner using the same methodology for measuring the isometric force of Craniocervical flexor muscle at rest.



Fig 1



Fig 2.

### Results:

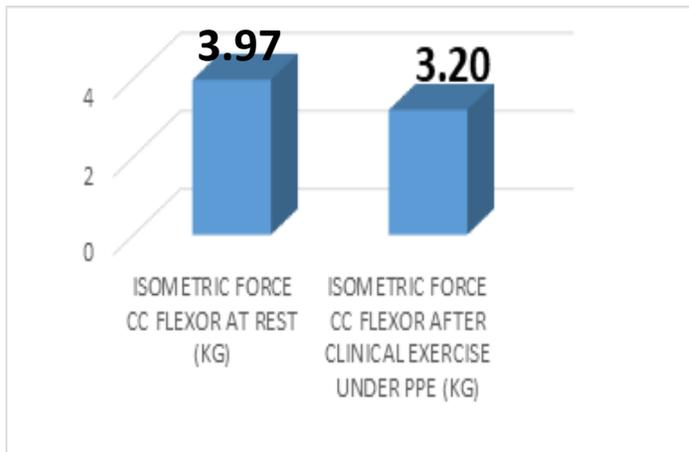
Statistical analysis- Statistical analysis was done by using descriptive and inferential statistics using Paired t-test to test the relative change concerning time. P-value was less than 0.05 considered as significant at a 95% confidence level. The statistical software SPSS 24.0 was used in the analysis.

It was seen that the mean value of CC flexor muscle without PPE at rest was 3.97 kg and with PPE was 3.20 kg with P-value <0.05 shows test results from baseline rest value shows statically significant. Maximum muscle fatigue was seen when PPE was used.

Table1

	N	Mean	Std. Deviation	t-value	p-value
Pair 1 Isometric force of craniocervical at rest(kg)	29	3.97	0.40	20.079	<0.001
Isometric force of craniocervical after clinical procedure under PPE (kg)	29	3.20	0.43		

Graph 1



**Discussion**

Musculoskeletal disorders are common in the dental profession and can include pain, weakness, impaired sense of touch as itching, and numbness. Dental surgeons suffer more frequently from work-related Musculoskeletal Disorders as compared to other health professionals. The reason might be that prolonged Forward Neck Posture increases stress on the non-contractile structures and the posterior cervical structures, thereby causing NP, as was reported by Chris Ho Ting et al.<sup>6</sup>

According to Watson and Trott, another reason might be the painless, insidious nature of repetitive minor trauma, like the sustained flexed posture of head and neck, that affects the length-tension relationship of cervical musculature, which causes an increase in flexion moment of the head.<sup>7</sup>

During the escalation of the COVID-19 outbreak in India, frontline healthcare workers and dental professionals were mandated to wear personal protective equipment (PPE), while caring for suspected or confirmed COVID-

19 patients, which involved the donning of close-fitting N95 face masks, protective eyewear (mainly goggles), gowns, surgical gloves, and the use of powered air-purifying respirators (PAPR).<sup>8</sup>

The pathogenesis of PPE-associated neck pain could have several etiological considerations, which include mechanical factors, hypoxemia, hypercarbia, or the associated stress. Pressure or tractional forces from the mask and/or goggles together with the accompanying straps may lead to local tissue damage and the development of taut bands in deep cervical neck muscles.<sup>9,10</sup>

In our study, isometric forces of the neck flexor group of muscles were evaluated using a custom-made load cell device, which is a digital device that measures the force generated by muscles when the neck flexes against resistance.

It was seen that the mean value of CC flexor muscle without PPE at rest was 3.97 kg and with PPE was 3.20 kg with P value <0.05 shows test results from baseline rest value shows statically significant.

It was observed a statistically significant reduction in isometric force of Cranio cervical muscles after clinical exercise in dental practitioners compared to baseline isometric forces at rest.



Fig 3: Awkward neck and back posture.

## Conclusion

Use of PPE alters the hemodynamic changes which can lead to increased chances of musculoskeletal strains in dental professionals. PPE also restricted dental practitioners from the usage of ergonomic tools like dental microscopes and loupes. On photographic analysis, awkward neck posture was evident in the dental practitioner as showed in Fig 3.

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