

**Evaluation of Efficacy of Novel Proximity Indicator Device for Proper Ergonomics of Dentists - A Clinical Study**<sup>1</sup>Dr Bhavna Dave, <sup>2</sup>Dr. Bhavana Inderchand, <sup>3</sup>Dr Malhar Gaur, <sup>4</sup>Dr Lipsa Shah<sup>1-4</sup>KM Shah Dental College & Hospital, Vadodara, Gujarat - 391760**Corresponding Author:** Dr. Bhavana Inderchand, KM Shah Dental College & Hospital, Vadodara, Gujarat - 391760**Citation of this Article:** Dr Bhavna Dave, Dr. Bhavana Inderchand, Dr Malhar Gaur, Dr Lipsa Shah, “Evaluation of Efficacy of Novel Proximity Indicator Device for Proper Ergonomics of Dentists - A Clinical Study”, IJDSIR- May - 2022, Vol. – 5, Issue - 3, P. No. 459 – 465.**Copyright:** © 2022, Dr. Bhavana Inderchand, et al. This is an open access journal and article distributed under the terms of the creative commons attribution non-commercial License. Which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.**Type of Publication:** Original Research Article**Conflicts of Interest:** Nil**Abstract**

**Introduction:** Work related musculoskeletal disorders are one of the most common health problems among the dentists and the most common reason for early retirement from dentistry because in dentistry, clinically, working field is confined to a very small area (oral cavity). Ergonomics is highly relevant to preventive and occupational medicine, management of musculoskeletal injuries and rehabilitation. Aim of this study is evaluation of efficacy of Novel Proximity indicator device for proper ergonomics of dentists

**Material and Methods:** This was a interventional study, conducted among 90 Post Graduate students of KM Shah Dental College and hospital, The study involves the use of new device -Position Indicator Device and access its impact on ergonomic of the operator. The information regarding the device and direction of use will be explained in detail to the participants by the co-investigator, he recorded the number of beeps during the

complete oral examination procedure and questionnaire was given at the end of 15 days.

**Result:** Majority of subjects i.e., 67.89% needed novel Proximity Indicator device is and 94.57% said that novel Proximity Indicator device is efficient. 75.57% students and 82.13% practitioners accepted that practicing dentistry without ergonomics principles can cause musculoskeletal disorders. Only 95.6% participants said no discomfort with novel Proximity Indicator device and only 8.92% practitioners were strictly following the principles of operator’s position, patient’s position and dental chair’s position while treating patients in dental clinic in general practice. 98.71% participants said it is going to be helpful for proper ergonomics of operator.

**Conclusion:** The key for dental clinicians for staying healthy and fit is to adopt an ergonomic position all the times and adopting yoga/exercise in their daily routine thus preventing them from developing MSDs. The novel proximity indicator is efficient in improving the ergonomics of the operator. Faculty in the institutions

are required to teach these principles on 'need for dentist's health' basis as a curriculum since BDS first year so that prevention of MSDs can be implemented at primary level.

**Keywords:** Novel proximity Indicator, Ergonomics, Musculoskeletal Disease, Physical Distancing

### **Introduction**

In dental profession there the most close proximity with the patient which leads to maximum cross infection and Musculoskeletal disorders are common among medical professionals and more prevalent among dentists due to different postures during procedures, repeated work, prolonged stature, groundless sitting, and grasping smaller and thin instruments for longer periods of time.<sup>1</sup> Limited access during dental procedures is also known to be the one of the reasons for causing musculoskeletal disorders.<sup>2</sup>

Literature suggests that the incidence of the musculoskeletal pain in dentists, dental hygienist & dental students range from 64 to 93% (Gross & Fuchs, 1990).<sup>3</sup> The most common work-related musculoskeletal disorders are low back pain, tendonitis, epicondylitis, bursitis, carpal tunnel syndrome. (Shugars, Miller, Williams, Fishburne & Srickland, 1987).<sup>4</sup>

Staying in close contact for a prolonged periods is prime cause COVID-19 spread. It happens when an infected person droplets from their mouth or nose comes in contact to people nearby. Recent studies indicate that people who are infected but do not have symptoms likely also play a role in the spread of COVID-19. It is important to stay at least 6 feet away from others as people can spread the virus before they know they are sick. Social distancing is especially important for dentists who are at higher risk as they work in close proximity with patient.

To avoid Work related Musculoskeletal Disorders and protect from COVID-19 infection we designed a novel position indicator device which is going to alert the operator when his/her position is wrong to come back to correct position and maintain a safe distance with patient in the current Covid 19 era. So the aim of our study was to Evaluate of efficacy of Novel Proximity indicator device for proper ergonomics of dentists.<sup>5</sup>

### **Methodology**

It is an observational study design started after receiving approval from the institutional Ethics Committee (SVIEC/ON/Dent/RP/21014). It included 90 Post Graduate students of all Departments of KMSDCH, Piparia, Vadodara based on the selection criteria. Those who were apprehensive to use the novel position indicating device & those who did not give feedback after using the device were excluded.

Participants were informed regarding the study to be conducted. Written consent was taken from the participants. The information regarding the device and direction of use was explained in detail to the participants by the co- investigator along with the standard ergonomic guidelines. The co-investigator oriented the operator with the device. The sensor which is incorporated in band (fig-1), beeped as the operator leaned/bent forward towards patient when the distance is less than 40cm which will indicate the operator to have a safe distance and correct the ergonomics. The co-investigator stood in front of the chair to record the number of beeps during the complete oral examination procedure (fig-2) in intervals of 5 mins, 10mins and 15 mins.

At the end of 15 days the operator was asked for the feedback on how efficient was it to work with the device and if the device helped in having proper ergonomics and safe distance with the patient with a self-prepared

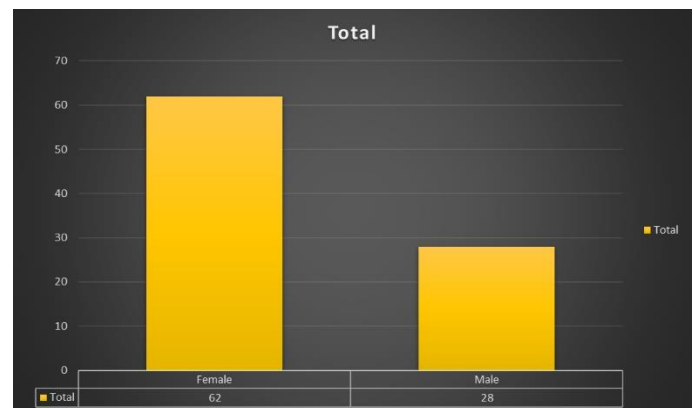
questionnaire. It was validated and reliability was checked using chi- square test. Validation was done by the Professors, Readers and Senior Lecturers of the Department of Pediatric & Preventive Dentistry of the same institute. Data collected was entered into a computer and analyzed using the SPSS software. Descriptive and inferential statistical analyses was carried out and presented on Mean SD and results on categorical measurements presented in Number (%). Level of significance was fixed at  $p=0.05$  and any value less than or equal to 0.05 considered to be statistically significant. The significance of research parameters on a categorical scale was determined using Chi square analysis.



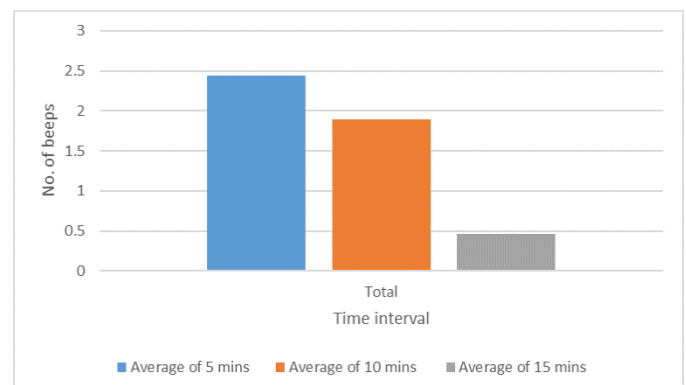
Fig 2: oral examination wearing novel novel proximity indicator device



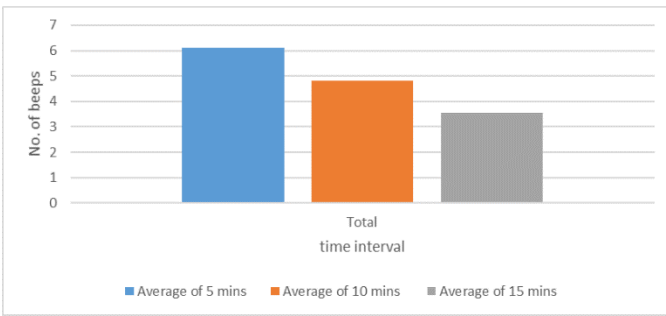
Fig 1: Novel head band sensor designed with IR sensor and battery.



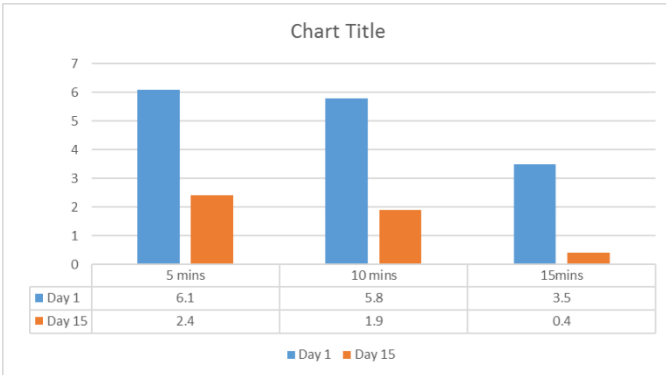
Graph 1: Gender wise distribution of the sample



Graph 2: Average of Total number of beeps on DAY 1



**Graph 3: Average of Total number of beeps on DAY 15**



**Graph 4: Comparison of Average of Total number of beeps on DAY 1 & DAY 15**

**Results**

Amongst 90 participants 62(69%) were females and 28 (31%) were males (Graph 1) shows gender wise distribution of the sample. On day one when the participants used Novel proximity indicator average number of beeps in first 5 minutes was 6.1 times and in next five minutes it was 4.8 times and after 15minutes when it was recorded it 3.5 times which indicates that the participants improvised on their ergonomics. On day one when the participants used Novel proximity indicator average number of beeps in first 5 minutes was 2.4 times and in next five minutes it was 1.9 times and after 15minutes when it was recorded it 0.4 times which indicates that Novel proximity indicator helped the participants improvised on their ergonomics. There was drastic drop in number of beeps nearly when compared on Day 1 and day15 which clearly shows that Novel

proximity indicator efficacious for maintaining proper ergonomics of dentists

Feedback on efficiency of the device through an electronic questionnaire revealed 85 participants feel the novel Proximity Indicator device is efficient Maximum participants 97 % (87) dint feel any discomfort with it 85 felt it will be helpful for proper ergonomics for the operator.

Sn.	Question	Yes	No
1	Do you feel the novel Proximity Indicator device is needed	92%	8%
2	Do you feel the novel Proximity Indicator device is efficient	94%	6%
3	Did you feel any discomfort with novel Proximity Indicator device	97 %	3%
4	Distraction due to novel Proximity Indicator device while performing procedure	90%	10%
5	Do you think it will be helpful for proper ergonomics and safe distance for the operator	94%	6%

Table 1: Results of feedback questions.

**Discussion**

Dentists must have excellent visual acuity, hearing, depth perception, psychomotor skills, manual dexterity, and the ability to maintain long-term work postures.<sup>6</sup> Deterioration in any of these talents has an impact on the practitioner's performance and output. Despite considerable developments in dentistry, several occupational health issues continue to plague modern dentistry.<sup>7-13</sup> MSD has a moderately high prevalence (78%) among dental practitioners in India, and other countries such as Saudi Arabia (59.2 percent)<sup>14</sup>, Australia (87.2 percent)<sup>[15]</sup>,

Lithuania (86.5 percent)<sup>16</sup>, and Turkey (94 percent)<sup>16</sup> have also documented a high prevalence.

According to Muralidharan D et al, MSD incidence was highest among orthodontists (100%) and oral medicine (100%), followed by periodontics and endodontics (67%), prosthodontics (55%), and oral surgeons and Pedodontist (55%). (50 percent). As a result, we included volunteers from all disciplines in our study. The most usually affected area, regardless of qualification or speciality, was the neck.<sup>17</sup> Hence we devised a head band sensor which will control unnecessary flexion of the neck and spine. This will avoid excessive leaning/bending forward towards the patient, which will help in two ways: first, good ergonomics will be maintained, and second, a safe distance will be maintained throughout this covid era.

According to Guidelines and recommendations for optimal posture during work (2017)<sup>18</sup>, the dentist's head may be inclined forward at a maximum of 25°. From the front to the upper body, the workspace should be orientated, with a spacing of 35 or 40 cm between the patients mouth and the dentist's eyes, or spectacles. At a distance of 20-25 cm, the work tools are positioned as far as feasible inside the professional's range of vision. To reach the appropriate spot near the dentist's head, the light beam should be kept parallel to the direction of observation, and the light rectangle should not be placed obliquely in the patient's face.

In our study, 69 % were girls and 31 % were males. However, with the increasing number of female dental students, a demographic shift is beginning to appear. In Germany, the number of female students is about double that of male students, and this trend is expected to continue. Hence it is critical to give special attention to the demands of female dentists. Unruh's analysis of gender differences in clinical pain experience found that

women in general were more likely to have a range of recurring pains (Daniela Ohlendorf), which was also found in our study.<sup>19</sup>

When the number of beeps was compared on Day 1 and Day 15, it was roughly one-third of the average count on Day 1, demonstrating that the Novel proximity indicator is effective in preserving optimum dental ergonomics. This could be because every time the operator bent more towards the patient, they were alarmed, and by the end of the 15th day, it had become their practise, as indicated by a lower number of beeps on day 15th, Close physical interaction between patients and Practitioners is required for the administration of dental healthcare. Physical distance (keeping 6 feet between persons) is a key technique for preventing SARS-CoV-2 transmission, according to CDC guidelines.<sup>20</sup>

Design and mechanics of the band The band incorporates a sensor. The key advantages of Infrared (IR) sensors are their low power consumption, simple construction, and handy functions. An infrared sensor is a type of electronic equipment that emits rays to detect certain features of its surroundings. The operation of an infrared sensor is similar to that of an object detection sensor. This sensor has an infrared LED and an infrared photodiode, which may be combined to make a photo-coupler. The resistance of the photodiode and the change in output voltage are proportional to the amount of infrared light received and detects the object ahead. This is the core functioning principle of an infrared sensor.<sup>21</sup> In our study, 92% of participants said the novel Proximity Indicator device is needed because it helps the activities by increasing awareness of ergonomic postural habits at work and a greater willingness to do work, increasing ability to detect postures that stress the muscles and joints to avoid them, and emphasising the significance of making postural adjustments during



clinical visits in order to prevent static stance and, as a result, muscular fatigue and 8%(7) dint feel its necessary as they felt that they were maintaining proper ergonomics even without the device.

94 % believe the novel Proximity Indicator device is efficient because the number of beeps was reduced by one-third on the 15th day compared to day one, and a few mentioned that the novel proximity indicator updated them even at the slightest change in their posture when it was incorrect, whereas 6% do not believe it is efficient because it felt like an extra attachment to their existing multiple PPE equipments after the pandemic era. The majority of participants, 97 percent, did not experience any pain with the device, and 3 percent had slight discomfort since they saw it as an additional part to their outfit.

While 90% of the participants were not distracted by the device, 10% were because they were unduly conscious of the beeping system and couldn't concentrate on clinical work. Most participants (94% ) thought the novel proximity indicator would be helpful for proper ergonomics for the operator, while 6% did not think it would be helpful for proper ergonomics because they saw it as an additional part that distracted them and caused discomfort even though they were aware of the personnel protective Equipment protocol.

### **Limitations**

This study should be conducted on a larger sample and more evidence should be pooled on this topic.

### **Recommendations**

Dental practitioners must always hold numerous posture s for extended periods of time; consequently, dental operations should be separated into many sessions to reduce t he time required.

### **Conclusion**

Pain in various body areas is affected by posture, time, and procedures to prevent work-related musculoskeletal disorders and keeping in mind the covid era, where its always preferable to keep a safe distance at work, because dentistry is a sector where operators have personal contact with patients the novel proximity indicator was devised.

It the Nis effective, increased safety and efficiency while improved performance by removing excessive effort. It also improved the patient's level of care.

### **References**

1. Gupta A, Bhat M, Mohammed T, Bansal N, Gupta G. Ergonomics in dentistry. *Int. J Clin. Pediatr. Dent.* 2014; 7:30-34.
2. Hauke A, Flintrop J, Brun E, Rugulies R. The impact of work-related psychosocial stressors on the onset of musculoskeletal disorders in specific body regions: A review and meta-analysis of 54 longitudinal studies. *Work Stress.* 2011; 25:243-256.
3. Lindfors P, von Thiele U, Lundberg U. Work characteristics and upper extremity disorders in female dental health workers. *J Occup. Health.* 2006; 48:192-197.
4. Bernard BP, Putz-Anderson V. *Musculoskeletal Disorders and Workplace Factors: A Critical Review of Epidemiologic Evidence for Work-Related Musculo skeletal Disorders of the Neck, Upper Extremity, and Low Back*; U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health: Cincinnati, OH, USA, 1997.
5. Bahl P, Doolan C, De Silva C, Chughtai AA, Bourouiba L, MacIntyre CR. Airborne or droplet precautions for health workers treating coronavirus

disease 2019? The Journal of infectious diseases. 2020 Apr 16.

6. Hayes MJ, Smith DR, Cockrell D. An international review of musculoskeletal disorders in the dental hygiene profession. *Int. Dent. J.* 2010; 60:343-152.

7. Rising DW, Bennett BC, Hursh K, Plesh O. Reports of body pain in a dental student population. *J Am. Dent. Assoc.* 2005; 136:81-86.

8. Nordander C, Ohlsson K, Åkesson I, Arvidsson I, Balogh I, Hansson GÅ, et al. Risk of musculoskeletal disorders among females and males in repetitive/constrained work. *Ergonomics.* 2009; 52:1226-1239.

9. Gupta A, Ankola AV, Hebbal M. Dental Ergonomics to Combat Musculoskeletal Disorders: A Review. *Int. J. Occup. Saf. Ergon.* 2013; 19:561-571.

10. Hayes MJ, Smith DR, Taylor JA. Musculoskeletal disorders in a 3-year longitudinal cohort of dental hygiene students. *J Dent. Hyg.* 2014; 88:36-41.

11. Dajpratham P, Ploypetch T, Kiattavorncharoen S. Prevalence and associated factors of musculoskeletal pain among the dental personnel in a dental school. *J Med Assoc Thai.* 2011; 93(6):714

12. Valachi B, Valachi K. Mechanisms leading to musculoskeletal disorders in dentistry. *JADA.* 2003; 134:1344-1350.

13. Khan SA, Yee Chew K. Effect of working characteristics and taught ergonomics on the prevalence of musculoskeletal disorders amongst dental students. *BMC musculoskeletal disorders.* 2013 Dec;14(1):1-8.

14. Shamim T (2017) Musculoskeletal disorders due to poor ergonomic practice in dentistry. *SJMMS* 5: 192.

15. Garbin AJ, Garbin CA, Diniz DG, Yarid SD (2011) Dental students' knowledge of ergonomic postural requirements and their application during clinical care. *Eur J Dent Educ* 15: 31-35.

16. Hokwerda O, Ruijter R, Shaw S (2006) Adopting a healthy sitting working posture during patient treatment. Groningen: NL.

17. Leggat PA, Kedjarune U, Smith DR (2007) Occupational health problems in modern dentistry: a review. *Ind Health* 45: 611-621.

18. Das H, Motghare V, Singh M. Ergonomics in dentistry: Narrative review. *Int J Appl Dent Sci.* 2018; 4:104-.

19. Rovida TA, Garbin AJ, Peruchini LF, Machado AC, Moimaz SA. Dental ergonomics: integrating theory and practice for teaching improvement. *Revista da ABENO.* 2015 Dec;15(4):37-44.

20. McFee RB. COVID-19 laboratory testing/CDC guidelines. *Disease-a-Month.* 2020 Sep;66(9):101067.

21. Mustapha B, Zayegh A, Begg RK. Ultrasonic and infrared sensors performance in a wireless obstacle detection system. In 2013 1st International Conference on Artificial Intelligence, Modelling and Simulation 2013 Dec 3 (pp. 487-492). IEEE.