Research Paper

INTERNATIONAL JOURNAL OF CURRENT ADVANCED RESEARCH
ISSN: O: 2319-6475, ISSN: P: 2319-6505
Available Online at www.journalijcar.org
Volume 14; Issue 10; October 2025; Page No.546-552
DOI: http://dx.doi.org/10.24327/ijcar.2025.0552.0087

Subject Area : Oral Medicine and Radiology

ERGONOMICS AND ITS UPHILL: A CROSS-SECTIONAL STUDY ON KNOWLEDGE OF EQUIPMENT ERGONOMICS AMONG DENTAL PROFESSIONALS

Dr. Syeda Arshiya Ara, Dr syed Zakaullah and Dr Reva Taskeen

PDA College of Engineering,585102, India

ARTICLE INFO

Received 15th September,, 2025
Received in revised form 26th September, 2025
Accepted 18th October, 2025
Published online 28th October, 2025

Key words:

Ergonomics, musculoskeletal disorders, dental professionals, occupational health, equipment ergonomics

ABSTRACT

Background: Dentists are at high risk of musculoskeletal disorders (MSDs) due to prolonged static postures, repetitive motions, and suboptimal equipment ergonomics. Despite advancements in ergonomic design, many dental professionals lack adequate knowledge and application of ergonomic principles. **Aim:** To assess knowledge and awareness regarding equipment ergonomics among interns, postgraduates, faculty, and practitioners in Kalaburagi city, Karnataka, India. **Materials and Methods:** A cross-sectional survey was conducted in October 2022 among 100 participants, including interns, postgraduates, and practitioners. A 21-item validated questionnaire was administered through Google Forms, assessing basic knowledge of ergonomics, equipment design, and frequency of health-promoting behaviours. Data were analysed using SPSS v13.0. Chi-square test assessed group-wise significance, while Mann-Whitney test compared mean scores. A p-value ≤0.05 was considered significant. **Results:** Of 100 participants, 39% were interns, 6% postgraduates, and 55% practitioners. While 55% of practitioners were aware of ergonomics, only a minority followed ergonomic practices routinely. Nearly 39% of interns and 6% of postgraduates reported exposure to ergonomics for the first time through this survey. Awareness regarding correct working distance, operator posture, chair height, and illumination was significantly lacking across groups. Most respondents agreed that ergonomic training should be integrated into the undergraduate curriculum. **Conclusion:** Knowledge and practice of ergonomics were inadequate among participants, highlighting the urgent need for structured ergonomic training in dental education. Emphasis on chairside exercises, microbreaks, and correct use of ergonomically designed equipment can significantly reduce the risk of MSDs and improve dentist well-being.

INTRODUCTION

Dentists require both intellectual and physical effort to perform precise clinical procedures within a confined working area. Prolonged static postures, repetitive hand movements, and inadequate ergonomic practices contribute significantly to the development of musculoskeletal disorders (MSDs) [1,2, 3,4]. Globally, the prevalence of MSDs among dental professionals ranges between 64–93%, with the neck, shoulders, and lower back being the most affected regions [5].

Ergonomics, defined as the science of adapting the workplace and equipment to human needs, plays a crucial role in preventing MSDs [6]. Although ergonomically designed chairs, stools, and instruments are now widely available, evidence suggests that their adoption and correct use remain limited among dental professionals [7]. This study aimed to assess the knowledge of equipment ergonomics among interns, postgraduates, and practitioners in Kalaburagi, India.

*Corresponding author: **Prof. Dr. Syeda Arshiya Ara**

PDA College of Engineering,585102, India

MATERIALS AND METHODS

A cross-sectional survey was conducted in the month of October 2022 amidst interns, postgraduates (PGs) and practitioners of Kalaburagi city, Karnataka, India. The data was collected using 21-custom designed questions through google forms comprising questions evaluating student's and practitioner's basic knowledge about equipment ergonomics and the frequency of health promoting behavior.

The data were coded, tabulated, and analyzed using Statistical Package for Social Sciences (SPSS statistics version 13.0)

software. Nonparametric tests were used to determine statistical significance. The level of significance was fixed at 5% (α= 0.05). Chi-square test was adopted to assess whether there was any statistical significance in the responder's knowledge with a significance level of $P \leq 0.05$. Mann-Whitney test was implemented to correlate the total mean scores.

RESULTS

A total of 100 subjects participated in this survey, 39% interns, 6% postgraduates and 55% practitioners, where 72% were females and 28% males. The questionnaire focused on the basic principles of ergonomics, their application with respect to dental chairs, operative light and hand instruments

A total of 100 participants responded to the survey, of which 39% were interns, 6% postgraduates, and 55% practitioners. Females constituted 72% of the study population, while 28% were males. The questionnaire assessed knowledge and awareness regarding ergonomic principles, equipment use, and preventive practices (Table 1, Graph 1).

Most respondents (61%) disagreed that ergonomic principles apply only to the operator's position and not to equipment, indicating recognition of the role of equipment design in ergonomics. Similarly, 50% disagreed that musculoskeletal problems are unrelated to equipment ergonomics, and 77% rejected the statement that dental chair ergonomics is unnecessary for maintaining operator neutrality. These responses highlight awareness that both operator posture and equipment contribute to musculoskeletal health (Table 2, Graph 2).

A large proportion (87%) agreed that ergonomics maximizes patient accessibility and visibility during procedures. Likewise, 73% acknowledged the importance of ergonomically designed operator stools (such as saddle or tri-shaped seats) in preventing low back pain. Additionally, 84% of respondents agreed that sharp instruments are essential to reduce excessive forces during instrumentation, while 89% emphasized the relevance of precise angulation of hand instruments for accessibility (Table 3, Graph 3).

Regarding glove ergonomics, 63% of participants agreed that poorly fitting gloves cause hand pain. Further, 71% disagreed that proper operating light position is non-critical, underlining its importance for shadow-free illumination. Similarly, 72% rejected the statement that ergonomically designed rotary instruments are ineffective, and 52% agreed that the operator chair height should be adjusted so that the hips are slightly higher than the knees (Table 4, Graph 4).

The role of advanced technologies was also acknowledged: 78% agreed that lasers offer an ergonomic advantage by reducing treatment time and increasing comfort, and 83% supported the practice of taking microbreaks to reduce fatigue. However, only 43% reported having practiced chairside exercises in clinical settings, suggesting a gap between knowledge and application (Table 5, Graph 5).

When asked about curricular emphasis, 76% of respondents felt that equipment ergonomics is inadequately addressed in the current dental curriculum. A large majority (83%) supported its inclusion as a separate subject before students enter clinics, and 93% agreed that improper ergonomics and associated musculoskeletal disorders should be emphasized more strongly in the curriculum (Table 6, Graph 6).

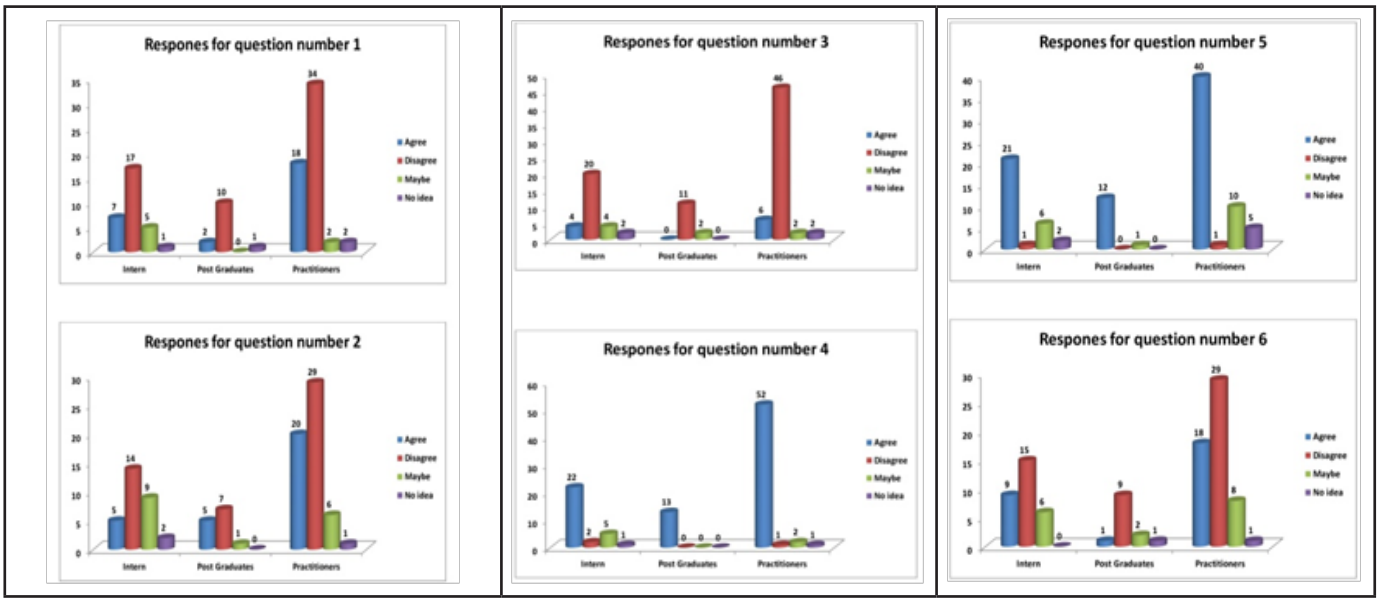
Knowledge regarding working distance and illumination was inconsistent. While 47% of participants reported that the ideal distance between the operator's eye level and the patient's mouth is 12–14 inches, 32% opted for 14–16 inches, and only 11% suggested 10–12 inches. A majority (75%) felt that all dental equipment—including dental chairs, hand instruments, and syringes—should incorporate ergonomic design (Table 7, Graph 7). With respect to illumination, 32% believed that fiber-optic handpiece light should be higher than that of the overhead light, 22% felt it should be lower, 24% had no idea, and 21% thought it should be the same, reflecting lack of clarity on this aspect (Table 8, Graph 8).

Overall, the study revealed that while knowledge of ergonomics was reasonably good in areas such as posture, equipment design, and the need for curricular inclusion, practical implementation—particularly related to chairside exercises,

Question	Designation	Response				
		Agree	Disagree	Maybe	No idea	Total
1) Ergonomic principles apply only to operator's position, but not to equipment's	Intern	07	17	05	01	30
	Postgraduates	02	10	00	01	13
	Practitioners	18	34	02	02	56
	Total	27	61	07	04	99
	P value	0.2207(NS)				
2) Do you consider that the musculoskeletal problems are not related to wrong equipment ergonomics?	Intern	05	14	09	02	30
	Postgraduates	05	07	01	00	13
	Practitioners	20	29	06	01	56
	Total	30	50	16	03	99
	P value	0.1267(NS)				
3) Dental chair ergonomics is not needed for maintaining the operator's neutral position	Intern	04	20	04	02	30
	Postgraduates	00	11	02	00	13
	Practitioners	06	46	02	02	56
	Total	10	77	08	04	99
	P value	0.3499(NS)				

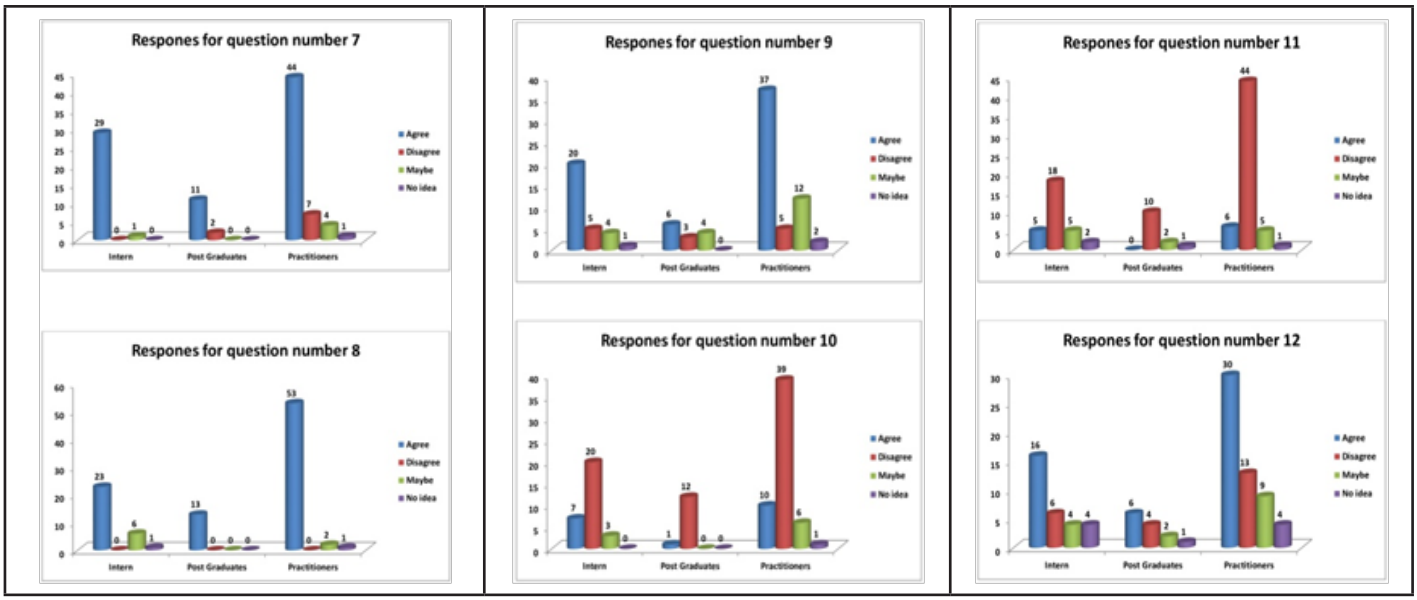
4) Ergonomics maximizes patient accessibility and visibility for the operator during the procedure	Intern	22	02	05	01	30
	Postgraduates	13	00	00	00	13
	Practitioners	52	01	02	01	56
	Total	87	03	07	02	99
	P value	0.1515(NS)				
5) New ergonomically designed operator stools such as saddle or tri-shaped seats etc., prevents low back pain	Intern	21	01	06	02	30
	Postgraduates	12	00	01	00	13
	Practitioners	40	01	10	05	56
	Total	73	02	17	07	99
	P value	0.7737(NS)				
6) Lightweight instruments do not help to reduce the muscle work-load	Intern	09	15	06	00	30
	Postgraduates	01	09	02	01	13
	Practitioners	18	29	08	01	56
	Total	28	53	16	02	99
	P value	0.4157(NS)				

working distance, and illumination—was inadequate.



Question	Designation	Response				
		Agree	Disagree	Maybe	No idea	Total
7) Sharp instruments are necessary for reducing excessive forces during instrumentation	Intern	29	00	01	00	30
	Postgraduates	11	02	00	00	13
	Practitioners	44	07	04	01	56
	Total	84	09	05	01	99
	P value	0.3351(NS)				
8) Is the precise angulation of hand instruments and accessibility to the operating area relevant?	Intern	23	00	06	01	30
	Postgraduates	13	00	00	00	13
	Practitioners	53	00	02	01	56
	Total	89	00	08	02	99
	P value	0.0577(NS)				
9) Poor fitting gloves can cause pain in the hands	Intern	20	05	04	01	30
	Postgraduates	06	03	04	00	13
	Practitioners	37	05	12	02	56
	Total	63	13	20	03	99
	P value	0.5886(NS)				

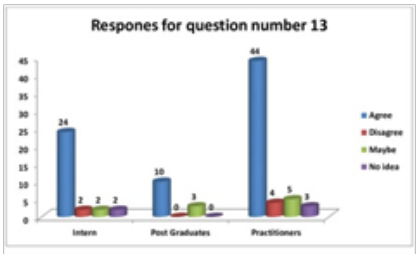
10) Proper operating light position is not a critical factor in producing an even, shadow free illumination	Intern	07	20	03	00	30
	Postgraduates	01	12	00	00	13
	Practitioners	10	39	06	01	56
	Total	18	71	09	01	99
	P value	0.6394(NS)				
11) Ergonomically designed rotary instruments are not effective in reducing treatment time and muscle fatigue	Intern	05	18	05	02	30
	Postgraduates	00	10	02	01	13
	Practitioners	06	44	05	01	56
	Total	11	72	12	04	99
	P value	0.4242(NS)				
12) Should the operator chair height be adjusted so that the hips are slightly higher than knees	Intern	16	06	04	04	30
	Postgraduates	06	04	02	01	13
	Practitioners	30	13	09	04	56
	Total	52	23	15	09	99
	P value	0.9581(NS)				

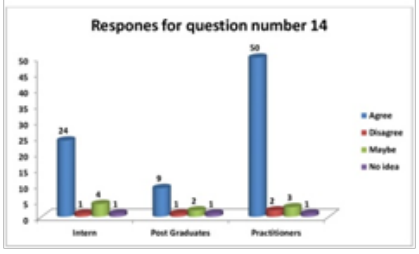


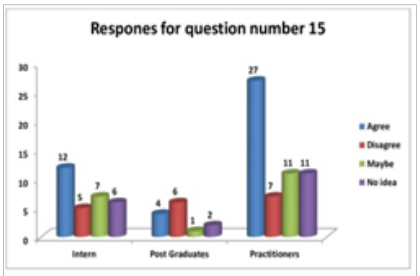
Question	Designation	Response				
		Agree	Disagree	Maybe	No idea	Total
13) Lasers gives us an ergonomic edge by reducing the treatment time and increasing patient and operator's comfort	Intern	24	02	02	02	30
	Postgraduates	10	00	03	00	13
	Practitioners	44	04	05	03	56
	Total	78	06	10	05	99
	P value	0.6306(NS)				
14) Should the dental surgeon take microbreaks to reduce excessive muscle fatigue?	Intern	24	01	04	01	30
	Postgraduates	09	01	02	01	13
	Practitioners	50	02	03	01	56
	Total	83	04	09	03	99
	P value	0.6327(NS)				
15) Have you ever used chairside exercises in your clinical work?	Intern	12	05	07	06	30
	Postgraduates	04	06	01	02	13
	Practitioners	27	07	11	11	56
	Total	43	18	19	19	99
	P value	0.1871(NS)				

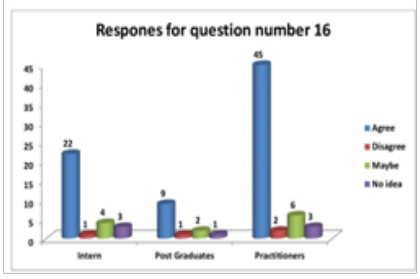
16) Emphasis about equipment ergonomics is less in the present dental curriculum	Intern	22	01	04	03	30
	Postgraduates	09	01	02	01	13
	Practitioners	45	02	06	03	56
	Total	76	04	12	07	99
	P value	0.9541(NS)				
17) It should be included as a separate entity in the syllabus before the students enter the clinic	Intern	29	00	00	01	30
	Postgraduates	11	00	02	00	13
	Practitioners	43	05	07	01	56
	Total	83	05	09	02	99
	P value	0.1571(NS)				
18) Improper equipment ergonomics and its related musculoskeletal problems should be properly emphasized in the curriculum	Intern	29	00	01	00	30
	Postgraduates	13	00	00	00	13
	Practitioners	51	00	04	01	56
	Total	93	00	05	01	99
	P value	0.6975(NS)				

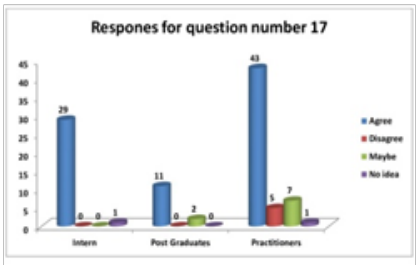
Question	Designation	Response				
		10-12	12-14	14-16	16-18	Total
19) The distance between the operator's eye level and the patient's mouth should be approximately how many inches?	Intern	06	13	08	03	30
	Postgraduates	01	08	04	00	13
	Practitioners	04	26	20	06	56
	Total	11	47	32	09	99
	P value	0.4690(NS)				

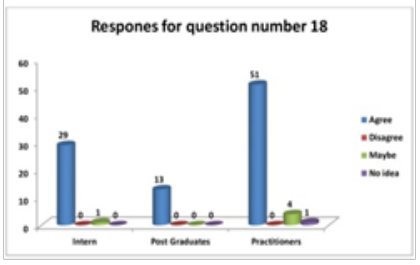


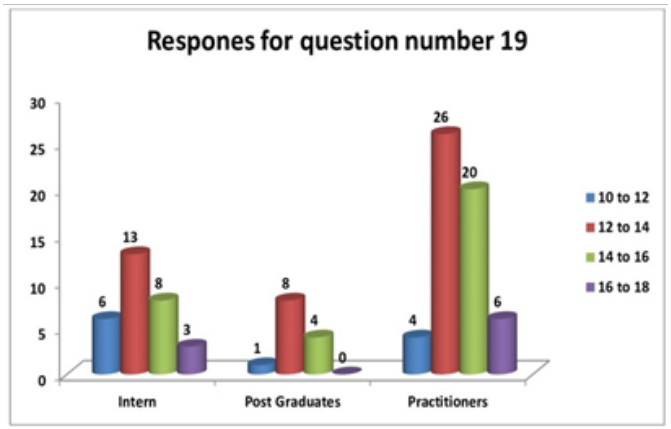




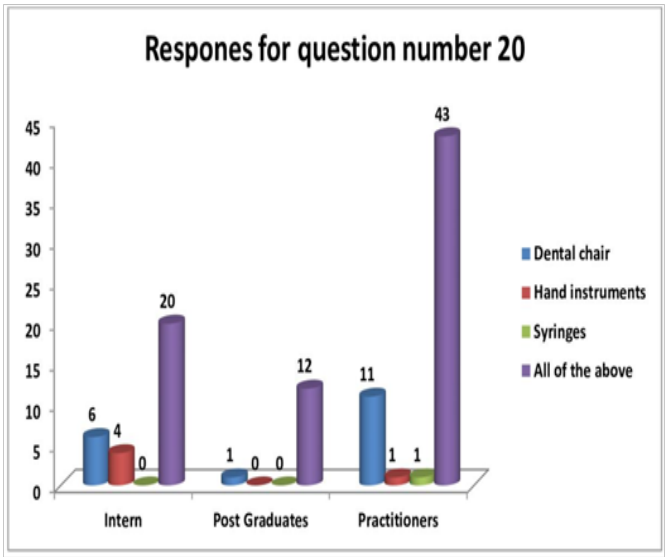




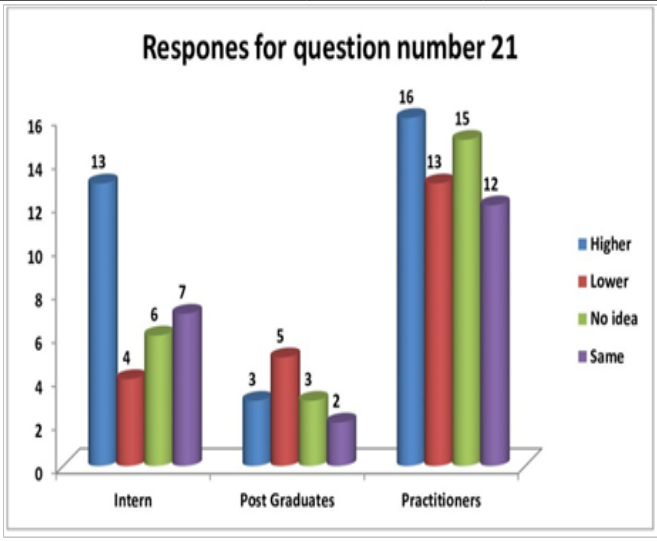




Question	Designation	Response				
		Dental chair	Hand instruments	Syringes	All of the above	Total
20) Which instruments do you think require these ergonomic designs?	Intern	06	04	00	20	30
	Postgraduates	01	00	00	12	13
	Practitioners	11	01	01	43	56
	Total	18	05	01	75	99
	P value	0.2107(NS)				



Question	Designation	Response				
		Higher	Lower	No idea	Same	Total
21) To minimize eye strain, light from a fiber optic handpiece should be at what intensity compared to that of the overhead operating light?	Intern	13	04	06	07	30
	Postgraduates	03	05	03	02	13
	Practitioners	16	13	15	12	56
	Total	32	22	24	21	99
	P value	0.5439(NS)				



DISCUSSION

Dentists usually are concerned about patient's comfort and less about themselves until they feel pain or discomfort, which on repetition leads to musculoskeletal injuries or disorders. Repetitive strain injuries are on the rise in dentistry. Many dentists/dental hygienists have been diagnosed with MSDs, and the majority have experienced some type of musculoskeletal pain in their shoulders and neck, hands and wrists, low back, or forearms and elbows but continue with such a posture. To end the occurrence of MSIs, self-realization and identification by the dental surgeons regarding their posture and working patterns, etc is the prime step. After recognizing the mistakes,the

dentists can neutralize their risk of developing MSIs[8,9].

The cross-sectional survey conducted was the foremost step in assessing the knowledge amongst interns, PGs and other practitioners. The survey shows that many students clearly had no clear knowledge about equipment ergonomics and wanted it to be included in their UG curriculum.

The students especially the PGs haven't been practicing agronomical methods like taking micro breaks between procedures or doing chairside exercises.

Many of them agreed that poorly fitting gloves cause hand pain but they don't realize that it's also because of their incorrect grasp and instrumentation, leading to higher incidences of carpel tunnel syndrome amongst dentists. When asked the distance between the operator's eye level and patient's mouth be how many inches, they weren't aware that it must be 12-16 inches.

We know that to minimize eye strain, light from fiber optics must be higher than that of overhead operating light, but almost all had no idea regarding it or gave incorrect answers. Thus, showing the lack of knowledge on this subject.

A 2022 study by Anshasi et al[1] emphasized a **change management approach** to embed ergonomics into daily dental practice, showing improved compliance when institutional support was provided

A systematic review by Shrestha et al[5] reported that prevalence of MSDs among dentists globally ranges from **64–93%**, with neck, shoulders, and back being the most affected regions.

Research by Movahhed et al[4,10]found that **microbreaks of 1–2 minutes every 20 minutes** significantly reduced musculoskeletal strain and fatigue.

A recent intervention trial by Almalki et al 2023[11]demonstrated that **ergonomic training integrated into the undergraduate curriculum** improved posture awareness and reduced self-reported discomfort within 6 months.

Emerging ergonomic tools such as **saddle seats, prismatic loupes, and lightweight instruments** have shown measurable reductions in spinal load and muscle strain in a study done by Gupta et al2022[12].

These studies align with your findings, showing that although knowledge exists, practice lags. Your data strongly support the integration of ergonomics as a structured component of the dental curriculum, which is consistent with international recommendations.

There have been tremendous changes in the dental field regarding equipment ergonomics, all for the betterment of dentists and patients but they will be effective if the dentists use them properly and take good care of themselves between their procedures, maintain a good posture and religiously do the chairside exercises.

Interdisciplinary approach by collaborating between health care professionals (dentistry, medicine, physiotherapy, etc.) and efforts of all personnels from other disciplines like biomechanics, instrument designing, manufacturing, etc. can reduce the prevalence of musculoskeletal injuries or disorders.

CONCLUSION

Knowledge of ergonomics among dental professionals in Kalaburagi city was limited, and ergonomic practices were inadequately followed. Structured ergonomic training during undergraduate education, coupled with reinforcement during postgraduate training and continuing dental education programs, is essential to safeguard long-term practitioner health. Interdisciplinary collaboration with physiotherapists, occupational health experts, and equipment manufacturers will further strengthen preventive strategies.

References

1. Anshasi RJ, Alsyouf A, Alhazmi FN, AbuZaitoun AT. A change management approach to promoting and endorsing ergonomics within a dental setting. *Int J Environ Res Public Health.* 2022;19(20):13193.
2. Rajeswari SR, Gowda TM, Kumar TA, Arya K, Mehta DS. Assessment of interns and postgraduate dental students' knowledge regarding equipment ergonomics. *Indian J Dent Res.* 2016;27(3):256–61.
3. Nutalapati R, Gaddipati R, Chitta H, Pinninti M, Boyapati R. Ergonomics in dentistry and the prevention of musculoskeletal disorders in dentists. *Internet J Occup Health.* 2009;1(1):1–9.
4. Movahhed T, et al. Ergonomics in dentistry: prevention of musculoskeletal disorders. *Int J Occup Saf Ergon.* 2021;27(3):961–8.
5. Shrestha A, Shrestha S, Rimal J. Global prevalence of musculoskeletal disorders among dentists: a systematic review. *BMC MusculoskeletDisord.*2023; 24:76.
6. Gupta A, et al. Ergonomics in dental practice: necessity and strategies. *J Prosthet Dent.* 2022;128(4):701–8.
7. Khan SA, et al. Knowledge and practice of ergonomics among dental practitioners: a cross-sectional study. *J Dent Educ.* 2021;85(5):613–20.
8. Hayes MJ, et al. Musculoskeletal disorders and symptom severity among Australian dental hygienists. *BMC MusculoskeletDisord.*2019; 20:352.
9. Thornton LJ, et al. The role of ergonomics in preventing musculoskeletal disorders in dentistry: systematic review. *Work.* 2020;65(2):425–36.
10. Movahhed T, et al. Effect of microbreaks on musculoskeletal pain in dentists: a randomized trial. *Int J Occup Saf Ergon.* 2021;27(3):970–7.
11. Almalki A, et al. Impact of ergonomic training on dental students: a longitudinal intervention study. *J Dent Educ.* 2023;87(7):857–65.
12. Gupta S, et al. Effectiveness of ergonomic equipment in reducing musculoskeletal disorders among dentists. *J Clin Exp Dent.* 2022;14(6): e569–76.