

# Integrating Ergonomics into Dental Education: A Literature Review and Curriculum Framework

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**Abstract:** *Ergonomics in dental professionals has been highly neglected. Long working hours dispose of them to multifactorial problems. Therefore, the understanding and applications of ergonomics in routine dental practices should be included in the dental curriculum. The sooner it is practiced, the better the prognosis will be. A literature review to gain a deeper knowledge was conducted using databases such as Academic Search Ultimate, MEDLINE (PubMed) and Google Scholar. Boolean operators and special symbols were employed to concentrate the search on dental professors, teaching practices, ergonomics, operator positions and dental students. Results obtained from the literature review encompass two major concepts of how professors can incorporate ergonomics in dental curriculum; they include curricular and extra - curricular methods. Thus, as the students are made aware of ergonomic issues and their implications, they will become more inclined towards practicing healthy habits.*

**Keywords:** dental ergonomics, operator position, dental curriculum, musculoskeletal disorders, four - handed dentistry

## 1. Introduction

Ergonomic posture is of paramount importance in dentistry. "Physical ergonomics is a field of science that comprises designing equipment, devices, and processes that fit the human body" (International Ergonomics Association, 2019, as cited in Leinonen et al., 2020, p.490). When a proper posture is maintained, it not only helps in performing the dental procedures effectively but also prevents health complications that most dentists face later in their professional careers. Hence, the knowledge of ergonomics and its application in routine dental practice needs to be incorporated in the undergraduate dental curriculum. This will help in inculcating the right habits from the beginning as it will be easier for students to adapt to new practices.

Dental professionals are at a high risk of developing work - related musculoskeletal disorders (WMSDs) due to working for longer hours in static positions (Khan & Chew, 2013; Partido & Wright, 2018; Carpentier et al., 2019). "Work - related MSDs are conditions in which work - related tasks affect the nerves, tendons, muscles and supporting structures" (Michalak - Turcotte, 2000, as cited in Partido & Wright, 2018, p.223). Prolonged sitting leads to cervical and lumbar intervertebral disc deterioration, which is a result of increased pressure (Faust et al., 2020). Musculoskeletal pain varies between 64% and 93% in dental professionals (Carpentier et al., 2019).

Practicing dentists suffer from pain majorly in the back and neck regions (Hayes et al., 2009, as cited in Santucci et al., 2021) while dental hygienists experience arm, wrist and hand pain (Faust et al., 2020; Hayes et al., 2009, as cited in Santucci et al., 2021). Such musculoskeletal pain can eventually convert to musculoskeletal disorders (MSDs) (Partido & Wright, 2018). In addition, there are other factors that pose a risk for the development of MSDs. They include genetic predisposition, aging and emotional stress. These injuries to a large extent cause negative social, economical and political complications (Dabaghi - Tabriz et al., 2020).

The intense, precision based, psychomotor skills required by dentists may also lead to complications (Faust et al., 2020). In addition, while performing procedures most practitioners do not pay attention to the posture in which they are working. The poor ergonomic posture may be due to the difficulties faced in visualising and accessing the oral cavity (Garcia et al., 2017 & Presoto et al., 2016, as cited in Neves et al., 2018). This can be a consequence of their work ethics as students. Musculoskeletal pain affects students as soon as they begin their pre - clinical sessions (Santucci et al., 2021). These habits may continue even in professional practice despite the knowledge of the severe implications (Partido & Wright, 2018). Hence, if the work ethics are not corrected, dental practice may be interrupted and may lead to retirement earlier than expected (Carpentier et al., 2019; Dable et al., 2014).

In spite of poor ergonomics being a global concern for the dental community, it is not taught in many undergraduate dental schools. Personally, during my undergraduate studies ergonomic posture was an unknown concept for me as there was no guidance on how to effectively maintain it. Due to the lack of knowledge there were unavoidable effects, whose cause was difficult to determine. In addition, there is a gap between knowledge and clinical application of effective ergonomic posture among dental students (Partido & Wright, 2018). Therefore, this paper will review the effective methods that the dental professors can use to promote the use of effective ergonomics among dental students.

## 2. Methods

A review of the literature was conducted to identify scholarly research focusing on how dental educators can promote the accurate use of ergonomics among dental students. The databases that were included to search for peer reviewed articles are: Academic Search Ultimate, MEDLINE (PubMed) and Google Scholar. The keywords used to search the databases with the Boolean "AND" to combine the search terms are as follows: dental educators OR professors OR teach\*, teaching practices, ergonomics

OR operator positions, and dental students. The articles were manually screened for relevance and attainability. While most of the searches were irrelevant, 15 articles were relevant to this review.

The articles were either kept or eliminated based on inclusion and exclusion criteria. The articles were selected based on the following criteria: 1) be published between 2010 - 2021, 2) be written in the English language, 3) be peer - reviewed and published in academic journals, 4) be accessible through the university's library and 5) should provide efficient techniques that can effectively promote the use of accurate ergonomics among dental students. On the contrary, the articles eliminated were based on the following criteria: 1) did not depict the usefulness of a particular technique, 2) were vaguely related to the question and 3) were published before 2010. Of the 15 articles identified, 11 met the inclusion criteria and were used in the review.

### 3. Results

#### Curricular Methods

##### *Teaching Methodologies*

Ergonomics should be included in the undergraduate programme of dental students (Khan & Chew, 2013). This will improve their knowledge and application in clinical practice. It can be facilitated by providing ergonomic courses in addition to other courses by the faculties of all departments of dentistry (Dabaghti - Tabriz et al., 2020). Live lectures have a comparable impact on the understanding of students to viewing videos. Using these methods similar results have been yielded in the learning of dental ergonomics. However, even with an improved theoretical learning, very few students were able to implement correct ergonomics into their practice (Leinonen et al., 2020; Garcia et al., 2017, as cited in Neves et al., 2018). Majority of the students are not completely satisfied with the conventional teaching methods (Jain et al., 2014, as cited in Leinonen et al., 2020).

Therefore, there is a need to implement new methods in order to promote proper ergonomics amongst dental students (Leinonen et al., 2020). Hence, in addition to creative tutorial videos, hands - on instructions should be provided to students prior to their commencement of clinical practice (Faust et al., 2020). In addition, "continual feedback opportunities must remain part of the cumulative dental curriculum" (Faust et al., 2020, p.8).

##### *Self - assessment*

Partido and Wright (2018) stated that self - assessment can prove to be the strongest tool for promoting accurate ergonomics among dental students. The authors suggest the use of photographs for self - assessment to provide dental educators with a more practical approach for promoting the use of ergonomics. This will assist students become more aware of their posture that may be deviated from ideal while performing dental procedures and in turn improve musculoskeletal health. On incorporation of self - assessment using photographs in ergonomic training ergonomic scores improved, that is, the posture of the

students moved more towards being ideal (Partido & Wright, 2018).

Despite the increase in accurate ergonomic self - assessments, improvement in agreement levels was not significant (Partido & Wright, 2018). The probable reason for this could be that the photographs are taken from a single point, not revealing all the variations in the operator's positions. Hence, in a single image the vision of all the sides of ergonomic compliance could not be captured properly (Faust et al., 2020). Through this we can comprehend that self - assessment remains an underdeveloped skill in the educational programmes (Partido & Wright, 2018). The evolution of improvement in the effectiveness of ergonomic posture assessment will take place when its prevalence increases in the dental curriculum (Faust et al., 2020).

Self - assessment will improve when there are continual opportunities to reflect on the errors and faculty feedbacks (Partido & Wright, 2018). Faculties can observe students when they are performing procedures on either mannequins or patients in the clinic. These observations should happen over a course of a few weeks where the faculties provide the students with feedback immediately. This will aid in improving ergonomic habits (Santucci et al., 2021). In addition, videos of the students should be recorded along with capturing photographs. This will provide students with an improved understanding of their mistakes in the posture.

#### Extra - curricular Methods

##### *Social Media*

Social media has become a common platform amongst all ages. Its use can be put forward for teaching students the use of proper ergonomics. The rapidly increasing popularity of social media has encouraged its use for educational purposes among dental professors to improve teaching and learning along with communicating and collaborating (Arnett et al., 2013). In addition, students are familiar with the technology; hence, its implementation will awaken in them the interest to learn new concepts (Barbosa Souza et al., 2019).

Furthermore, faculty members may not use social media all day but there are reports of many of them using it either several times a day or weekly, making it a familiar concept for them along with the students (Arnett et al., 2013). On the contrary, "approximately one - quarter of the respondents indicated that they were not registered on any social media applications" (Arnett et al., 2013, p.1409). However, Arnett et al. (2013) stated that due to the popularity, faculty members are likely to be inclined towards using it as an educational platform. This contradicts Barbosa Souza et al. (2019), who mentioned that "teachers may be reluctant to adopt such tools when communicating with students" (p.3). These faculties might become more inclined towards using it when they are shown the benefits of incorporating social media in education (Arnett et al., 2013).

Nonetheless, it is necessary to provide them with training on improving their sophistication level in using the media. The training should include everything beginning from setting up an account to posting content (Arnett et al., 2013). Additionally, professional, legal and ethical issues need to

be considered because using social media for education can render the institution at risk. Privacy settings should be applied on these sites along with an agreement with the Health Insurance Portability and Accountability Act (HIPAA) and the Family Educational Rights and Privacy Act (FERPA) (Arnett et al., 2013).

There has been no significant increase in the results of students since the use of social media as an education platform (Barbosa Souza et al., 2019). This can be because not all students who watch videos on these sites use them for their coursework (Arnett et al., 2013). However, incorporating social media for educating students did not lead to negative results (Barbosa Souza et al., 2019). Hence, the use of social media should be promoted; eventually, when everyone becomes accustomed to it, there will be better results.

#### **Ergonomic Aids**

The increasing posture problems among dental students and professionals need certain tools that will help maintain ideal posture. The use of magnification and ergonomic seats such as saddle stools can significantly augment visibility and help maintain proper distance which will in turn aid in adapting an ergonomic posture (Dable et al., 2014; Partido & Wright, 2018). Magnification devices that can be used are loupes, surgical microscopes and endoscopes (Carpentier et al., 2019). With the help of these modified equipments, maintaining ideal posture while performing dental procedures becomes relatively easy; hence, the development of MSDs is greatly impacted (Partido & Wright, 2018).

Most often students do not pay attention to their posture while performing procedures. Dentistry involves maintaining a neutral pelvic position that facilitates a natural low back curve. To achieve this position, it is necessary to not only adjust the height of the seat but also to slightly tilt the seat forward (Carpentier et al., 2019). Many students are not aware of the correct operator's and chair position (Dable et al., 2014). Hence, the benefits of maintaining the correct chair position are neglected. Therefore, it is necessary to teach students the correct way to adjust their chair which will help in achieving greater ergonomic benefits. The use of a chair that is ergonomically designed is important because sitting in a poorly constructed chair for prolonged periods causes poor lumbar support and lower back pain (Dable et al., 2014; Khan & Chew, 2013).

In addition to the legs and hips, magnification loupes have an effect on the posture of the operator (Carpentier et al., 2019). Using magnification loupes, the posture can be maintained as the vision becomes clearer and bigger (Dable et al., 2014). They usually help during restorative procedures where small cavities have to be prepared and restored (Neves et al., 2018). The loupes are mainly effective on the trunk, head and neck region with only a minor progress for the upper arms. Hence, although loupes solely may not be sufficient to avoid the development of MSDs, they aid in avoiding forward neck and trunk flexion (Carpentier et al., 2019; Dable et al., 2014).

Furthermore, four - handed dentistry should be inculcated in clinical practice. Four - handed dentistry is where the

operator has an assistant that aids with all the necessary instruments during the procedure. Studies have shown that students who were accustomed to this practice have fewer chances of elbow and forearm symptoms with no association of symptoms in other body regions. Moreover, working with arms over shoulder height and their forceful movements are associated with lower shoulder and forearm symptoms of WMSD (Khan & Chew, 2013).

Therefore, although magnification loupes have been associated with pain, vertigo, eye soreness or migraine (Carpentier et al., 2019) for students who are not well - versed with their use, they should be promoted. Once the students become accustomed, they will be useful. Along with the loupes, ergonomic chairs must be provided in schools and four - handed dentistry should be encouraged. When the combined use of these ergonomic aids will be encouraged in dental schools beginning from the pre - clinical sessions, prevalence of WMSD will decline significantly.

#### **4. Discussion**

The purpose of this paper is to address the question: How can dental educators promote accurate use of ergonomics among dental students? Dental students are unaware of the severe implications of poor ergonomic postures as it is not included in their undergraduate curriculum. The result of this neglect is that musculoskeletal pain begins as soon as students begin their pre - clinical training. Thus, more awareness needs to be created and accurate methods need to be implemented in dental schools.

This literature review has provided various insightful techniques that will aid dental professors increase awareness and promote its use among dental students. The students will be able to understand the severe implications of poor ergonomics when they are taught about it along with practical experience and self - assessment. Also, the use of other platforms which will develop further interest of students should be encouraged. This should happen continually as it will aid students understand and improvise the errors more effectively.

It is necessary to continue these methods for the entire duration of the student's curriculum. The effectiveness of these methods will be evident only when continuous feedback and self - assessment opportunities are provided by the faculty. This is important because there is a gap between the theoretical knowledge of students and their clinical application (Leinonen et al., 2020). Furthermore, there is a lack of understanding as to how the musculoskeletal pain can be treated once the symptoms are present. There are a few students who believe that rest is enough to cure the pain (Santucci et al., 2021). Thus, there is a need for increased research in this area.

Therefore, these findings will help both dental educators and students to focus on the important aspects of ergonomics and their implications. The earlier the students learn about the benefits and disadvantages of poor ergonomics, the easier it will be for them to adapt to the correct posture. Furthermore, dental professors need to identify the methods that will aid

students in applying their theoretical knowledge with ease in their clinical practice.

## 5. Conclusion

Dental students begin experiencing musculoskeletal pain immediately after they begin their pre - clinical training. This eventually progresses to musculoskeletal disorders if not corrected in due time. The students need to be educated and made aware of these consequences and how they can be prevented. Dental educators can assist the students more effectively as they observe them on a daily basis and can provide them with personalized feedback. Additionally, students should be encouraged to develop their self - assessment skills.

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