Types of Dental Stools Used in Dentistry: Emphasis on Occupational Health

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ABSTRACT

Aims: This study aimed to perform a literature review on the types of stools used in Dentistry with emphasis on maintaining occupational health.
Study design: Literature review.
Place and Duration of Study: Department of Social Dentistry, São Paulo State University (UNESP), School of Dentistry of Araraquara, São Paulo, Brazil, between January 2023 to July 2023.
Methodology: The literature used in this review was obtained from databases (Science Direct, National Library of Medicine [MEDLINE] e Scientific Electronic Library Online), and only articles published between 1980 and 2022 were considered. The main keywords were “Dental Stool”, "Ergonomic Stool”, “Occupational Health”, and “Saddle Seat.” Each abstract was read to determine whether the information in the article included informationon the use of stools duringdental procedures.
Results: The most studied dental stools were the normal and adapted conventional stool and the normal and adapted saddle seat in the 13 articles that met the inclusion criteria.
Conclusion: The use of a saddle seat can help maintain healthy working posture and prevent musculoskeletal disorders in dentistry.

Keywords: Dental stool, Occupational Health, Ergonomic in Dentistry, Dentistry.

1. INTRODUCTION

In the last few years, there has been greater concern about musculoskeletal disorders due to an increase in the number of cases [1],being these one of the most common occupational disorders in dental practice [2, 3].

Dentistry is a profession that incorporates the execution of lengthy procedures in a restricted work field, requiring the adoption of static and prolonged postures and the performance of repetitive movements, resulting in high physical demands [4, 5, 2, 1, 6, 7, 8, 9]. The difficulty in visualizing and accessing the operative field compromises the maintenance of a neutral posture with consequent adoption of inappropriate postural habits, such as flexion, rotation, and/or torsion of the spine [10, 7, 6, 11, 4, 5, 12, 13]. Both static postures and inappropriate postural habits can compromise the musculoskeletal system;thus,they should be avoided [10, 7, 6].

Strategies to minimize the risk of developing musculoskeletal disorders shouldbe implemented during the professional training phase [14, 2]. These strategiesinclude the adoption of ergonomic postures, improving the visualization of the operative field with the use of magnification systems, and use of adequate equipment [15,16].

Among the dental equipment used by dentists, stools have a significant influence on the posture of dentists who work in a sitting position, as they can determine the adoption of

postural habits owing to the need to obtain a more comfortable and/or functional position [13].

Some modifications have been proposed for dental stools with the aim of reducing the development and worsening of musculoskeletal disorders in dental professionals, mainly related to the design of the seat and backrest [12]. Thus, the analysis of stools available in the dental market and their advantages and disadvantages concerningoccupational health are extremely important in aiding their indication/selection.

Therefore, this study aimed to perform a literature review on the types of dental stools used in dentistry, with an emphasis on maintaining occupational health.

2. MATERIAL AND METHODS

This literature review was performed using the Science Direct, National Library of Medicine (MEDLINE), and Scientific Electronic Library Online (SCIELO) databases, which included articles published between 1980 and 2022. The research focused on dental stools and the main keywords used were "Dental Stool", "Ergonomic Stool", "Saddle Seat", and "Occupational Health." A total of 26 articles were collected.

The included articles were published in English, focusing on stools used specifically for dentistry. Thirteen articles were included in this analysis.

3. RESULTS AND DISCUSSION

The papers evaluated are presented in Chart 1

Chart 1.Scientific studies that evaluated the use of dental stool.

Autor	Types of stools	Target Audience	Response variable	Independent variable	Evaluation method	Results	Observations
Hardage et al. 1983	- Conventional stool.	- Dental students; - Professors.	- Muscle Activity.	- Lumbar support (absent or present); - Thigh/ leg angle (105°, 90º,75°).	- Surface electromyography: a. lower back b. upper back.	- Lumbar support reduced upper and lower back muscle activity; - Muscle activity in the upper back was greater than in the lower back; - There was no significant difference in the muscle activity for the different thigh/leg angles.	- Use of lumbar support to promote muscle balance and neutralize the force of gravity.
Parsell et al. 2000	- Conventional stool, - Stool with stationary dual arm supports; - Stool with a floating dual arm and front chest supports.	- Dentists.	- Muscle activity; - Perception of comfort; - Ability to use and adjust.	- Arm supports (absent or present; fixed or mobile); - Chest support (absent or present).	- Surface electromyography: a. Trapezius b. Paraspinal muscle group; - Questionnaire with a scale from 0 to 10 for comfort and facility of use and adjustment.	- The use of a stool with a fixed and adjustable arm support significantly reduced muscle activity in the upper trapezius; - The use of arm support alone or with chest support did not significantly reduce muscle activity in the paraspinal muscle group; - Low score concerningthe perception of the ability to use stools with arm supports and chest support.	Use of a stool with fixed arm support can reduce the muscle load on the upper trapezius; - Introducing additional components, such as an armrest and chest support, into the stool design requires a training and adjustment period.

Gandavadi et al. 2007	- Conventional stool with backrest; - Saddle seat without backrest.	-Dental students.	- Working posture.	- Type of dental stool (conventional or saddle seat).	- Rapid Upper Limb Assessment – RULA; - Photographic images	- A higher risk score for musculoskeletal disorders in the upper limbs was observed with the conventional stool; – The saddle seat allowed the maintenance of an acceptable working posture.	- The saddle stool allows the maintenance of the lumbar lordosis curve, resulting in a healthy spine posture.
Haddad et al. 2012	- Conventional stool with backrest; - Conventional stool modified with arm support and thoracic support.	- Dental students; - Dentists.	- Muscle activity; - Perception of comfort; - Adjustability; - Facility of use; - Facility of maintenance.	- Type of dental stool (conventional or modified).	- Surface electromyography: a. Upper trapezius b. Middle trapezius - Questionnaire with 18 items with Borg scale (score from 0 to 10) for comfort, adjustability, use and maintenance ability.	- The use of the modified stool resulted in less activity in the upper and middle trapezius muscles; - A preference for the modified stool was observed in the study population, although difficulty in adapting to its use has been reported.	- The use of the modified stool can reduce discomfort and prevent the development of musculoskeletal disorders; - The thoracic rest allows less trunk flexion; - The difficulty in adapting to the modified stool is owingto be accustomed to using the conventional stool for many years; - The adoption of the modified stool is suggested to individuals in the professional training phase to prevent the development of deleterious postural habits.
Dable et al. 2014	- Conventional stool with backrest; - Conventional stool without backrest; - Saddle seat without	- Dental students.	- Working posture.	- Type of dental stool (conventional with or without backrest or saddle seat without backrest); - Magnification	- Rapid Upper Limb Assessment – RULA; - Posture recording with video obtained usinga digital camera.	- The saddle seat presented the lowest risk scores for developing musculoskeletal disorders when compared to the conventional stool; - Participants were more comfortable using the magnification system	- The use of the saddle stool associated with the magnification system resulted in a lower risk of developing musculoskeletal disorders.

	backrest.			system (absent or present).		withthe saddle seat.	
De Bruyne et al. 2016	- Conventional stool with backrest; - Saddle seat without backrest; - Ghopec stool with backrest.	- Dental students; - Dentists.	- Muscle activity; - Lumbar posture.	- Type of dental stool (conventional, saddle seat or ghopec).	- Surface electromyography: a. latissimusdorsi; b. iliocostalislumborum thoracic part; c. multifidus; d. gluteus maximus; e. rectus femoris; f. internal abdominal oblique; g. external abdominal oblique. - Lumbar posture in the sagittal plane: BodyGuard™.	- The activity of the thoracic part of the iliocostalislumborum muscle was significantly higher with the conventional stool; - Activity of the internal abdominal oblique muscles was significantly lower with the conventional stool; - The activity of the left external abdominal oblique muscle was lower with the Ghopec stool. - The Ghopec stool presented a lumbar posture closer to neutral posture when compared to the conventional and saddle stools.	- As most of the compressive force acting on the lumbar spine arises from tension in the back muscles, the increased activity of the thoracic partof the iliocostalislumborum, as occurred with the conventional stool,would result in an increased load on the spine, as muscle tension acts to a large extent. Part of the compressive force exerted on the lower back has been associated with lower back pain. - The increased spreading of the thighs, which occurs with the saddle seat, causes the pelvis to tilt forward and may lead to lumbar hyperlordosis; - The Ghopecstool allowed the maintenance of the neutral posture.
Tran et al. 2016	- Conventional stool without backrest; - Conventional stool modified with thoracic support.	- Dental students.	- Muscle activity.	- Thoracic support (absent with 90º trunk/thighs; absent with 80º trunk/thighs; present with 80º trunk/thighs).	- Surface electromyography: a. Longissimusthoracis; b. Iliocostalislumborum	The activity of the assessed muscles was higherin the absence of thoracic support with 80º trunk/thighs; - Iliocostalislumborum and Longissimusthoracis muscle activity decreased by 33% and 50%, respectively,	- The use of thoracic support in the dental stool reduced muscle activity in the lumbar region, which may promote the reduction of tension in this region.

						when thoracic support was used.	
Gouveia et al. 2018	- Conventional stool with backrest; - Conventional stool without backrest; - Saddle seat.	- Dental students.	- Ergonomic risk.	- Type of dental stool (conventional with backrest, conventional without backrest, saddle seat).	- Rapid Upper Limb Assessment – RULA; - Posture recording with video obtained with a digital camera and images obtained from photographs.	In this systematic review it was found that: - Saddle seat provided less ergonomic risk than conventional stools fordental students; - Conventional stool demonstratedan intermediate to high ergonomic risk score.	- An improvement was observed in the group that used the saddle seat compared to the conventional stool, owing to the maintenance of lumbar lordosis; - The maintenance of the natural curves of the lumbar spine in seated work results in a neutral posture, allowing the muscles and intervertebral discs to alternate between relaxation and load; - Neutral posture is beneficial to occupational health as it nourishes the muscles and intervertebral discs potentially reducing ergonomic risks.
Plessas et al. 2018	- Conventional stool; - Saddle stool.	- Dental professionals	- musculoskeletal pain; - musculoskeletal pain disorders; - Postural changes	- Type of stool (conventional or saddle seat); - Magnification system (absent or present).	- Rapid Upper Limb Assessment – RULA (Posture recording with video obtained usinga digital camera and images excluded by photographs); - Lumbar posture in the sagittal plane: BodyGuard™.	- All the studies in this review assessed the impact of the stool on the working posture, but no study investigated the benefits of stool in pain relief or incidence of musculoskeletal disorders; - The use of the saddle seat significantly improved the working posture when compared to the	- The use of the saddle seat facilitates the adoption of a neutral posture of the lumbar spine; - An additive effect can occur when the use of magnification loupes is associated with the saddle seat, which is being beneficial for both posture and comfort; - Although the cost of magnification loupes and

						conventional stool; - The best posture was observed when the participantsused the stool and the magnification loupe simultaneously.	saddle seat is relatively high, the potential long-term benefits may outweigh the high cost.
Garcia-Vidal et al. 2019	- Conventional stool; - Ergonomic stool with lumbar support.	Postgraduate students; - Professors.	- Muscle activity.	- Type of dental stool (conventional or ergonomic); - Magnification system (absent or present).	- Surface electromyography: a. Upper trapezius; b. Middle deltoid; c. Anterior deltoid.	- The combination of the ergonomic stool with the magnification system promoted a significant reduction in the activity of the assessed muscles; - The activity of the deltoid muscles were similar in cases using the conventional and ergonomic stools, being lower in the ergonomic stool when combined with a magnification system.	- The use of ergonomic supports can facilitate the adoption of a straighter posture as well as the maintenance of lumbar lordosis; - The magnification system provides a better view of the work field, without the need to lean forward, reducing trunk flexion.
López-Nicolás et al. 2019	- Conventional stool; - Ergonomic stool.	Postgraduate students; - Professors.	- Muscle activity.	- Type of dental stool (conventional or ergonomic); - Magnification system (absent or present).	- Surface electromyography: a. medium trapezius from the dominant upper extremity; b. lumbar erector spinae.	- The muscular activity of the evaluated muscleswere significantly higher when using the ergonomic stool when compared to the conventional one, with or without the use of a magnification system.	- The studied ergonomic stool did not promote a decrease in the activity of the studied muscles, regardless of the type of procedure performed.
De Bruyne et al. 2021	- Conventional stool with backrest; - Saddle seat without	- Dental students, - Dentists.	- Muscle activity, -cervicothoracic posture.	- Type of dental stool (conventional, saddle seat or ghopec stool).	- Surface electromyography: Splenius Capitis; Sternocleidomastoids; Trapezius Pars	- There was no significant difference in the muscle activity and cervicothoracic posture between the studied stools.	- The different types of dental stool did not influence the muscle activity and posture in the cervicothoracic region.

	backrest; - Ghopec stool with backrest.				Descendent; Trapezius Pars Ascendents. - Cervicothoracic posture in the sagittal plane: BodyGuard™.		
Huppert et al. 2021	- Conventional stool without backrest; - Saddle seat without backrest; - Stool backrest removed, ventrally inclined, flexible in the front; - Stool without backrest, resilient, flexible, spring tension adjustable, lateral deflection adjustable; - Stool with backrest removed ventrally inclined, central elevation; - Stool with backrest removed, ventral inclination to max. 15°, central	- No dental education; - Dental students; - Dentists with less than 10 years of experience; - Dentists with 10 years or more of experience.	- Habitual sitting posture; - Dental work posture; - Comfort.	- Type of dental stool.	- ABW BodyMapper: light optical device based on videorasterstereography to measure the upper body position; - Questionnaire: subjective assessment of comfort for each dental stool using scores from 1 to 6 (1 and 6 corresponding to the lowest and highest comfort, respectively).	- The ergonomic design of the stool had no clinically relevant effect on the posture of the upper limbs and on the subjective assessment of comfort, both in the usual sitting and working postures.	- Although no measurable positive change in the upper body posture was observed, this does not indicate that individual musculoskeletal disorders cannot be reduced or prevented by adopting ergonomic stools; - Sitting work should be performed in a varied and dynamic wayto avoid static position of long duration.

Elevation.

The present study evaluated the types of stools used in dentistry with an emphasis on maintaining occupational health. The most studied stools were the conventional stools (with and without backrest, with and without armrest, and with and without lumbar support) and saddle seat.

The saddle seat was found to be the most beneficial for maintaining a neutral working posture [10, 2; 13; 6]. This stool is designed such that the pelvis assumes a lumbar lordosis posture, allowing the maintenance of the natural curvature of the lower back, keeping the shoulder and neck area straight, and relieving tension in the ischiotibial muscles [10, 4, 6, 5].

Gandavadi et al. (2007) [10] verified that students who used the saddle seat maintained an acceptable posture for the upper limbs, trunk, and lower limbs owing to the anterior posture of the pelvis. However, students who used conventional stools had greater difficulty in maintaining proper posture and obtained higher risk scores for developing musculoskeletal disorders in the neck (hyperflexion), shoulder (elevated and abducted), and trunk (drooping/leaning forward). Dable et al. (2014) [2] observed that the saddle seat maintained the natural curvature of the lumbar region and greater spinal torsion when using conventional stools. According to these authors, repeated unilateral twisting can result in damage, muscle imbalance, and lower back pain. Gouveia et al. (2018) [13] also found that saddle seatsresulted ina lower risk of developing musculoskeletal disorders than conventional stools. Plessas et al. (2018) [6] observed that the use of this stool facilitates the adoption of a neutral posture in the lumbar spine and reinforced the idea that its use can help correct and maintain the posture of dental professionals.

Regarding the stool with arm support, Parsell et al. (2000) [15] observed that the use of fixed and adjustable arm rests significantly decreased upper trapezius muscle activity. In contrast, the stool with mobile armrests and the trunk did not reduce the muscle activity in the paraspinal group. According to the authors, this could have occurred because the mobile supports moved on a plane parallel to the floor, requiring greater muscle activity to maintain the arm position. They suggested that a fixed armrest can produce more positive results when combined with a chest support system, which can reduce the tension in the upper trapezius. Haddad et al. (2012) [1] also evaluated stools with armrests and thoracic support and observedless activity of the upper and middle trapezius muscles and less trunk flexion upon their use. Tran et al. (2016) [7] found that the use of stools with thoracic support significantly decreased the activity of the two main erector spinae muscles (longissimusthoracis and iliocostalislumborum) compared to conventional stools. The authors suggested that lumbar support can reduce the risk of lumbar injuries in dentists, permitting more comfortable and relaxed performance of dental procedures, although this support limits some movements and interferes with clinical care.

Another type of stool studied by De Bruyne et al. (2016, 2021) [4, 5] was the Ghopec (Utrecht Dental, Netherlands), which has adjustable lumbar support and a seat composed of a horizontal back support for the pelvis and a front support sloping downwards for the thighs. De Bruyne et al. (2016) [4] evaluated the work posture of the lumbar region using a conventional stool and saddle seat, and Ghopec, and found that the latter provided a posture closer to the neutral posture. In contrast, De Bruyne et al. (2021) [5] evaluated the posture of the cervicothoracic region and found no significant differences in the muscle activity when using the same dental stools. Nevertheless, considering the presence of lumbar support, Hardage et al. (1983) [17] found lower activity of the upper and lower back muscles when procedures were performed with lumbar support, thus reinforcing its importance.

Garcia-Vidal et al. (2019) [9] found that the activities of the anterior and middle deltoid muscles did not differ significantly upon the usage ofconventional and ergonomic stools. López–Nicolás et al. (2019) [8] observed that the medium trapezius and lumbar erector spinaemuscle activities weregreater during the use of ergonomic stools. Huppert et al. (2021) [12] found no clinically relevant effect on the upper limb posture when an ergonomically designed stool was used, suggesting that the adopted working posture may have a greater impact on the development of musculoskeletal disorders than the selected stool design.

Although several stools are available in the dental market, these stools should permit the adoption of a stable and relaxed posture, with a straight back posture and without twisting the spine or head, to enable maintenance of occupational health [12]. However, according to Hardage et al. (1983) [17] the ergonomic characteristics of dental stools may not achieve the expected results if the professional does not know how to position himself or herself correctly on the dental chair during dental procedures and sit properly on the stool. Thus, the importance of teaching ergonomics during the professional training phase is emphasized so that individuals can properly use dental equipment, especially the stool [1, 6].

In this literature review, among all the dental stoolsevaluated, the saddle seat seems to be more compatible with the biomechanics of the sitting position, as it allows the adoption of a posture with a slight anterior inclination of the lumbar spine and consequent maintenance of lumbar lordosis. According to Gouveia et al. (2018) [13], these characteristics may help reduce the incidence of lower back pain more efficiently.

4. CONCLUSION

The use of a saddle seat can help maintain a healthy working posture and prevent musculoskeletal disorders in dentistry.

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