



Contents lists available at ScienceDirect

The Saudi Dental Journal

journal homepage: www.ksu.edu.sa
www.sciencedirect.com

Original Article

Ergonomic interventions and endodontic treatment outcomes: An analysis of dentist working posture and error rates

Ruslan Ratushnyi^{a,*}, Olha Stakhanska^b^a Department of Surgery with a Course in Stomatology, Vinnytsya National Pirogov Memorial Medical University, 21018 Vinnytsia, Ukraine^b Department of Orthopedic Dentistry, I. Horbachevsky Ternopil National Medical University, 46001 Ternopil, Ukraine

ARTICLE INFO

Keywords:

Stomatology
Root canal treatment
Musculoskeletal system
Endodontics
Occupational disorders

ABSTRACT

Purpose: Dentists spend a long time the day in the position. It is possible that this leads to discomfort that may translate to procedural errors during treatment, such as root canal treatment. This study aims to investigate the relationship of working posture and procedural errors in endodontic manipulations.**Materials and Methods:** 32 dentists (17 men, 53.13%, and 15 women, 46.88%) from the University Dental Polyclinic of Uzhhorod National University (Uzhhorod, Ukraine) were included in the study. REBA, RULA, frequency of procedural errors were analysed using regression.**Results:** This study revealed a surprising trend where a decrease in errors during endodontic treatment was associated with higher RULA and REBA scores, contrary to the expected increase in errors with higher ergonomic stress. Additionally, the research highlighted the significant impact of a dentist's handedness and tooth position in the dental arch on treatment ergonomics and efficiency, as observed and analyzed through ergonomic assessments and statistical methods.**Conclusions:** The study conclusively demonstrated that optimal positioning and alignment during dental procedures significantly contribute to a reduction in procedural errors, underscoring the importance of ergonomics in clinical dentistry.

1. Introduction

Errors that occur during endodontic treatment in dentistry are often the cause of an unsuccessful outcome for both the dentist and the patient (Koshy et al., 2017; Blume et al., 2021; Ohlendorf et al., 2021; Holzgreve et al., 2022). Complications arising during root canal treatment, such as iatrogenic perforation, root canal blockage, and separation of a part of the instrument, affect the outcome of endodontic treatment. If clinicians understand how each of the possible complications occurs, they will be able to prevent treatment complications in advance (Godovanets et al., 2020). Procedural errors occur because of lack of training, experience, time and also posture position (Holzgreve et al., 2022). Assessment of probable factors that determine the prognosis of treatment is important for choosing the correct method of intervention and correctly informing the patient about the consequences of treatment and complications (Godovantes et al., 2020). D. Chenna et al. (2022) note in their study that a high prevalence of work-related musculoskeletal disorders was noted among dentists, approximately seven out of ten had this pathology

in the past. This highlights the need for physicians to be aware of and adopt appropriate ergonomic postures early in their careers to minimize work-related musculoskeletal disorders (Sakaguchi et al., 2022). Endodontic treatment is one of the more intricate and demanding procedures in dentistry. Root canal treatments, especially for molars or complicated cases, can typically take anywhere from 90 min to several hours (Aliiev, 2022).

Ergonomics is fundamental in dentistry to ensure the well-being of the practitioner and to optimize clinical outcomes (Slivkina et al., 2020). Measuring and addressing ergonomics in dentistry and specifically in endodontics is essential for the long-term health and efficiency of the practitioner (Slivkina et al., 2020). The RULA and REBA tools provide structured methods to assess and improve upon these ergonomic practices.

Interpreting RULA and REBA Scores:

- Scores 1–2: Acceptable posture;
- Scores 3–4: Further investigation, change might be needed;

* Corresponding author at: Department of Surgery with a Course in Stomatology, Vinnytsya National Pirogov Memorial Medical University, 21018, 56 Pyrohov Str., Vinnytsia, Ukraine.

E-mail address: ruslanratushnyi2@ukr.net (R. Ratushnyi).

<https://doi.org/10.1016/j.sdentj.2023.12.006>

Received 7 August 2023; Received in revised form 14 December 2023; Accepted 18 December 2023

Available online 20 December 2023

1013-9052/© 2023 THE AUTHORS. Published by Elsevier B.V. on behalf of King Saud University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

- Scores 5–7 (RULA) or 5–8 (REBA): Changes are likely required;
- Scores 7+ (RULA) or 9–15 (REBA): Immediate action is required (Blume et al., 2021).

The goal of this study is to find out how ergonomic factors (measured by the RULA and REBA scores) affect the number and types of mistakes made at different stages of endodontic treatment. Specifically, this research aims to establish a predictive model that correlates ergonomic scores with the frequency and types of endodontic treatment errors, while acknowledging the influence of other contributing factors, to provide a more holistic understanding of error reduction in dental practice.

2. Materials and methods

This retrospective study included 32 dentists (17 men, 53.13 %, and 15 women, 46.88 %) from the University Dental Polyclinic of Uzhhorod National University (Uzhhorod, Ukraine). Participants were selected based on their regular involvement in endodontic treatments. Each provided informed consent, with 4 withdrawing due to time constraints. The remaining participants were evenly divided into a research group and a control group, each comprising 14 dentists, with a balanced distribution of demographics and experience.

In this study, out of the 600 radiographs analyzed, 300 were taken before the ergonomic intervention and 300 after, to effectively compare the quality of endodontic treatments pre- and post-intervention. The retrospective nature of the study arises from analyzing past radiographs taken during routine dental procedures, which were then evaluated for treatment quality and procedural errors. Regarding procedural errors post root canal therapy (RCT), it was found that of the 300 post-intervention radiographs, 45 showed signs of procedural errors. It's important to note that all the root canal treatments in this study were initial treatments performed by the dentists in the research group, ensuring that no other dental professionals had previously accessed

these teeth. This approach was crucial to accurately assess the impact of ergonomic adjustments on the quality of RCT and the prevalence of procedural errors.

Both groups were monitored for changes in ergonomic compliance using RULA and REBA criteria. A trained ergonomics expert observed the dentists, noting their postures, the duration in particular postures, equipment positioning, and patient-dentist alignment. The ideal position of working describes in Fig. 1.

The SPSS Statistics software (IBM SPSS, USA) was utilized for data analysis. We employed non-parametric statistical methods, including Student and Mann-Whitney tests for assessing reliability differences and regression analysis for prognostication. Significance was set at a probability error of $p < 0.05$.

3. Results

3.1. Radiographic results

At the stage of categorization of errors and complications during endodontic treatment, 389 cases of clinical errors and complications were investigated and divided into two categories. The first category is at the obturation stage: inhomogeneous obturation, under obturation, extrusion of filling material. The second category is at the stage of overexpansion of the endodontic space, separation of the instrument, perforation, transposition of the apex area, and missed canal. The survey made it possible to single out the most common reasons: lack of awareness, according to 13 doctors (40.63 %), impossibility of practical implementation (without detailing the reasons), according to 8 doctors (25 %), lack of time, according to 22 doctors (68.75 %), lack of material and technical support, in the opinion of 14 doctors (43.75 %), peculiarities of the clinical situation, in the opinion of 27 doctors (84.38 %), personal unfitnes, in the opinion of 17 doctors (53.14 %).

In the study, to determine the specificity of indicators of compliance with the parameters of the ergonomics of doctors' work, the

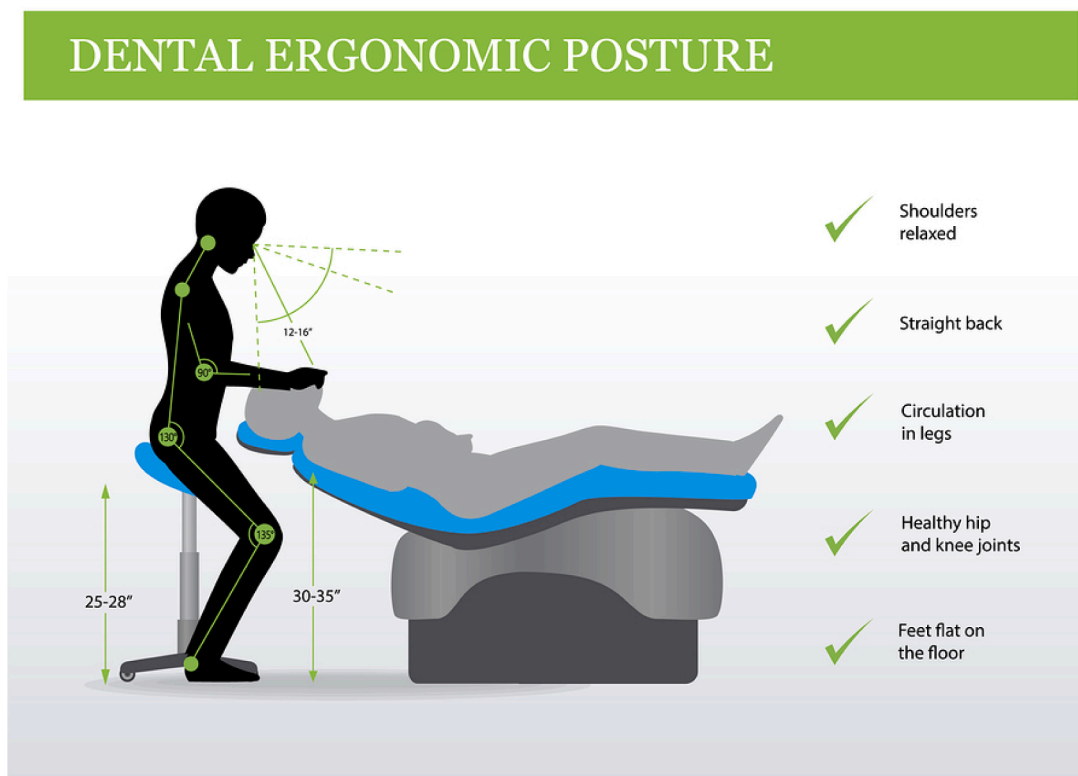


Fig. 1. The ideal working position.

Source: Why is Ergonomics Important in Dentistry? (n.d.).

redistribution of groups was monitored in accordance with the RULA and REBA criteria, depending on the time spent on work. When performing endodontic interventions on average for up to 3 h per day, REBA indicators at the level of 1 point were noted when analysing the work of 1 dentist (14.29 %), at the level of 2–3 points – when analysing the work of a dentist. 2 dentists (28.57 %), at the level of 4–7 points – when analysing the work of 3 dentists (42.86 %), at the level of 8–10 points – when analysing the work of 1 dentist (14.29 %), at the level of 11 points and more – not registered.

3.2. Retrospective survey results

According to REBA scores, the study found significant ergonomic risks in dentists' working positions during endodontic treatments without a microscope. While operating microscopes improved ergonomic positions, they did not eliminate high-risk scenarios. Additionally, binoculars or other magnifying devices often lead to less ergonomic compliance. The analysis revealed that many dentists violated basic ergonomic principles, suggesting a need for improved working conditions to reduce musculoskeletal diseases. Furthermore, while most dentists used rotary and manual endodontic instruments, a few did not meet optimal usage criteria, and the use of optical magnification equipment was not fully adhered to by all. The reasons for not fully adopting ergonomic practices in endodontics include unawareness, impracticality, time constraints, material limitations, specific clinical circumstances, and personal incompatibility. Even taking into account the fact that 26 dentists worked with the help of an assistant, in 2 cases, non-compliance of the work with the recommended ergonomics protocol was noted. The non-compliance was likely identified through the analysis of ergonomic parameters using the RULA and REBA criteria.

127 cases of registered errors that occurred during the endodontic treatment of molars of the upper jaw were characterized in Table 1.

The range of RULA 1–2 indicators registered among doctors who performed endodontic treatment accounted for 10.03 % of all errors noted in the studied sample during the implementation of iatrogenic interventions in the structure of root canals, including 0.77 % in the treatment of incisors, 0.51 % in the treatment of canines, 3.34 % in the treatment of premolars, and 5.40 % in the treatment of molars. 14.14 % of all errors made during endodontic interventions were noted among doctors whose ergonomic features of work corresponded to the range of RULA 3–4 indicators: 1.29 % in the treatment of incisors, 1.03 % in the treatment of canines, 4.37 % in the treatment of premolars, and 7.46 % in the treatment of molars.

3.3. RIBA/RULA results

A regression analysis evaluated the influence of dentists' work ergonomics on error frequency during endodontic treatments. The research looked at incisors, canines, premolars, and molars and found that errors could be predicted at different RULA (Rapid Upper Limb Assessment) ergonomic levels. Notably, molars showed the highest error rate during endodontic treatment, but no clear trend of increasing errors

Table 1
Errors during the endodontic treatment of molars in the upper jaw.

Error Category	Number of Cases	Percentage (%)
Inhomogeneous obturation	15	11.81
Under obturation to the level apical narrowing	22	17.32
Extrusion of filling material into the subapical space	30	23.62
Overexpansion of the endodontic space	12	9.45
Separation of the endodontic tool	14	11.02
Perforation of the tooth root wall	12	9.45
Apex transposition	11	8.66
Missed root canal	11	8.66

with higher RULA scores was observed (as detailed in Table 2).

The study's regression analysis utilized RULA and REBA scales to predict errors in endodontic treatment for various tooth types. The results indicate the effectiveness of these ergonomic scales in forecasting treatment errors, particularly the higher frequency of errors in molar treatments. Both RULA and REBA were found to be suitable for assessing dentists' ergonomics in clinical settings. Detailed parameters of these relationships are presented in Table 3.

In the constructed model, we assessed the impact of forecasted variables on the likelihood of developing complications at different stages of root canal treatment. This was achieved by incorporating correction coefficients, represented by numerical values, alongside RULA (Rapid Upper Limb Assessment) and REBA (Rapid Entire Body Assessment) indicators. Additionally, we considered the prognostic impact of other variables in relation to patterns of body posture deviations and specific elements of the musculoskeletal system, which were identified through discrete-event modeling and had ergonomic relevance. Consequently, by factoring in these ergonomic indicators, it becomes feasible to predict and potentially prevent errors related to posture during endodontic treatment.

In this study, the analysis of the impact of a dentist's handedness and tooth position in the dental arch revealed that right-handed dentists experienced fewer ergonomic-related errors when treating teeth on the patient's right side, and similarly, left-handed dentists showed better ergonomic efficiency on the left side. The REBA and RULA assessments also indicated that improper positioning of dental equipment and patient alignment significantly increased the risk of procedural errors, particularly in less accessible areas of the dental arch.

4. Discussion

This is one of the first studies to combine different approaches and techniques to compute a digital assessment of work-related physical strain, which can be utilized in medicine to examine the work patterns of healthcare professionals. This study shows a gradual transition from a general high-level calculation, such as regression analysis using RULA and REBA indicators, to the application of these calculations in practice. The RULA score shows the overall ergonomic load on the doctor. The novelty of the study is also the establishment of relationships between the ergonomic components of the dentist's work and the risk of errors during root canal treatment.

F. Holzgreve et al. (2022) found that endodontists and orthodontists spend less time with higher risk indicators compared to general dentists or maxillofacial surgeons, due to the more specialized and controlled nature of their procedures which often involve less physically demanding or invasive techniques. Consequently, the researchers suggest that dentists should consistently engage in ergonomic or strength exercises to enhance their practice. These results collectively underscore the role of ergonomics not only in preventing musculoskeletal disorders but also in improving the precision and efficiency of dental treatments, including endodontic procedures.

D. Ohlendorf et al. (2021) researched 475 dentists across various workplaces, finding that both dentists and assistants worked with high ergonomic risk (highest RULA score) for 95–97 % of their working hours. The study showed that the dentist's posture is more influenced by

Table 2
Levels of prediction and standardized residual variables (standardized deviations of goodness-of-fit) according to RULA criteria.

Points for RULA	Number of errors, cases			
	Incisors	Canines	Premolars	Molars
1–2	12.5	4.3	15.2	17.1
3–4	15.6	6.4	29.8	75.8
5–6	7.3	6.9	37.2	105.2
7	6.61	4.3	17.6	26.7

Table 3

Levels of prediction and standardized residual variables (standardized deviations of fit) according to REBA criteria.

Points for REBA	Number of errors, cases			
	Incisors	Canines	Premolars	Molars
1	0.6	0.4	6.6	4.8
2–3	11.2	5.8	24.8	59.6
4–7	14.7	7.6	30.8	77.8
8–10	12.9	6.7	27.8	68.7

the complexity of the dental procedure than modern equipment, with a notable inverse correlation between the RULA index and errors in endodontic treatment, indicating ergonomic factors' impact on treatment outcomes. The current study complements the findings of D. Ohlendorf et al. (2021) by highlighting the impact of ergonomics on both practitioner well-being and procedural accuracy. This underlines the importance of ergonomic optimization in dental workstations not only for dentist health but also for enhancing treatment quality and patient outcomes.

In the analysed studies of other authors (McCabe and Dummer, 2012; Burya, 2014; Asgary and Talebzadeh, 2019; Rossi-Fedele et al., 2020; Lio et al., 2021), such a number of indicators of ergonomics of the dentist and the results of the endodontic treatment of patients as in the current study were not taken into account and compared. A detailed analysis of complications that arise during endodontic treatment helps to determine the main factors affecting the occurrence of errors (Cintra et al., 2021; Chaniotis and Chanioti, 2022; Wei et al., 2022). The current study was one of the first to show the relationship between ergonomic indicators and the presence of errors in root canal treatment.

In other studies, it has been demonstrated that stretching activities and in particular Yoga are beneficial for WMSDs (Kumar et al., 2014, Koneru and Tanikonda, 2015; Lauche et al., 2017, Gandolfi et al., 2021, Gandolfi et al., 2023) by promoting circulation by reducing muscle tension (Krzysztofik et al., 2022). Yoga resulted effective for back and neck pain (Michalsen et al., 2012, Cramer et al., 2013), shoulder pain (Gandolfi et al., 2023), wrist and forearm disorders (Gandolfi et al., 2023, Lauche et al., 2017), and tension headache and cervicogenic headache (Khalil et al., 2023, Gandolfi et al., 2023).

5. Conclusions

The research showed that using ergonomic parameters, such as REBA and RULA scales, the posture of the dentist can be measured. This research establishes a direct correlation between ergonomic practices and the accuracy of endodontic procedures, revealing that dentists with better ergonomic scores, as measured by RULA and REBA, tend to commit fewer procedural errors. The study specifically finds that dentists' handedness and the tooth's position significantly influence the treatment outcome, with right-handed dentists performing more efficiently on right-side teeth and vice versa for left-handed practitioners. Moreover, the proper alignment of dental equipment and patient positioning are crucial in minimizing error rates, especially in complex treatments involving molars. These insights highlight the necessity for dental practitioners to adopt ergonomic strategies tailored to individual treatment scenarios, enhancing both treatment precision and overall patient care.

Ethical statement

The study was conducted on the basis of the University Dental Polyclinic, as well as on other clinical bases of the Faculty of Dentistry of Uzhhorod National University. Each dentist provided informed consent to participate in the study.

Author Statement

Both authors contributed equally to conceiving the study, analyzing the data, and writing this paper.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- Aliev, B.F., 2022. Choice of the optimal method of treatment of pulpitis depending on inflammatory changes in the pulp. *Azerb. Pharm. Pharmacother. J.* 22 (1), 66–77.
- Asgary, S., Talebzadeh, B., 2019. Intentional replantation of a molar with several endodontic complications. *J. Stomatol. Oral Max. Surg.* 120 (5), 489–492. <https://doi.org/10.1016/j.jormas.2018.11.019>.
- Blume, K.S., Holzgreve, F., Fraeulin, L., Erbe, C., Betz, W., Wanke, E.M., Brueggmann, D., Nienhaus, A., Maurer-Grubinger, C., Groneberg, D.A., Ohlendorf, D., 2021. Ergonomic risk assessment of dental students – RULA applied to objective kinematic data. *Int. J. Env. Res. Publ. Health* 18 (19), 10550. <https://doi.org/10.3390/ijerph181910550>.
- Burya, L., 2014. Physiological and hygienic characteristics of the working position of a dentist. *Herald Probl. Biol. Med.* 2 (109), 324–327. <http://repository.pdmu.edu.ua/handle/123456789/5164>.
- Chaniotis, A., Chanioti, A., 2022. Long-term complications of previously successful regenerative endodontic procedures after orthodontic movement: A report of 3 different complications after 4, 8, and 11 years. *J. Endodont.* 48 (7), 951–960. <https://doi.org/10.1016/j.joen.2022.04.002>.
- Chenna, D., Pentapati, K. C., Kumar, M., Madi, M., Siddiq, H., 2022. Prevalence of musculoskeletal disorders among dental healthcare providers: A systematic review and meta-analysis. *F1000Research* 11, 1062. [10.12688/f1000research.124904.2](https://doi.org/10.12688/f1000research.124904.2).
- Cintra, L.T.A., Gomes, M.S., da Silva, C.C., Faria, F.D., Benetti, F., Cosme-Silva, L., Samuel, R.O., Pinheiro, T.N., Estrela, C., González, A.C., Segura-Egea, J.J., 2021. Evolution of endodontic medicine: A critical narrative review of the interrelationship between endodontics and systemic pathological conditions. *Odontology* 109 (4), 741–769. <https://doi.org/10.1007/s10266-021-00636-x>.
- Cramer, H., Lauche, R., Hohmann, C., Lüdtke, R., Haller, H., Michalsen, A., Langhorst, J., Dobos, G., 2013. Randomized-controlled trial comparing yoga and home-based exercise for chronic neck pain. *Clin. J. Pain.* 29, 216–223.
- Gandolfi, M.G., Zamparini, F., Spinelli, A., Risi, A., Prati, C., 2021. Musculoskeletal Disorders among Italian Dentists and Dental Hygienists. *Int. J. Environ. Res.* 18, 2705.
- Gandolfi, M.G., Zamparini, F., Spinelli, A., Prati, C., 2023. Āsana for Neck, Shoulders, and Wrists to Prevent Musculoskeletal Disorders among Dental Professionals: In-Office Yōga Protocol. *J. Funct. Morphol. Kinesiol.* 8, 26. <https://doi.org/10.3390/jfmk8010026>.
- Godovanets, O.I., Kotelban, A.V., Hrynkevych, L., Romaniuk, D.G., Fedoniuk, L.Y., 2020. Potential effectiveness of poly-vitamins and probiotics among preschool children living within iodine deficiency territory to caries prevention. *Pesqui. Bras. Odontopediatr. Clin. Integr.* 21, 1–11. <https://doi.org/10.1590/pboci.2021.028>.
- Godovantes, O.I., Kitsak, T.S., Vitkovsky, O.O., Kuzniak, L.V., Godovantes, O.S., Chaikovska, N.M., Fedoniuk, L.Y., 2020. The Influence of Diffuse Nontoxic Goiter on the State of Protective Mechanisms of the Oral Cavity in Children. *J. Med Life* 13 (1), 21–25. <https://doi.org/10.25122/jml-2020-0013>.
- Holzgreve, F., Fraeulin, L., Betz, W., Erbe, C., Wanke, E.M., Brueggmann, D., Nienhaus, A., Groneberg, D.A., Maurer-Grubinger, C., Ohlendorf, D., 2022. A RULA-based comparison of the ergonomic risk of typical working procedures for dentists and dental assistants of general dentistry, endodontology, oral and maxillofacial surgery, and orthodontics. *Sensors* 22 (3), 805. <https://doi.org/10.3390/s22030805>.
- Khalil, A.Y., Ly, N., Murphy, P.B., 2023. Cervicogenic Headache. StatPearls Publishing.
- Koneru, S., Tanikonda, R., 2015. Role of yoga and physical activity in work-related musculoskeletal disorders among dentists. *J. Int. Soc. Prev. Community Dent.* 5 (3), 199–204. <https://doi.org/10.4103/2231-0762.159957>.
- Koshy, J.M., Archana, R., Markose, B., Johnson, W.M.S., Narayanan, S., Sathya Priya, B., 2017. Evaluation of working posture among the dentist using RULA and REBA. *Int. J. Curr. Res.* 9 (12), 63316–63320. <https://www.journalcra.com/article/evaluation-working-posture-among-dentist-using-rula-and-reba>.
- Krzysztofik, M., Trybulski, R., Trąbka, B., Perenc, D., Łuszcz, K., Zajac, A., Alexe, D.I., Dobrescu, T., Moraru, C.E., 2022. The impact of resistance exercise range of motion on the magnitude of upper-body post-activation performance enhancement. *BMC Sports Sci. Med. Rehab.* 14 (1), 123. <https://doi.org/10.1186/s13102-022-00519-w>.
- Kumar, D.K., Rathan, N., Mohan, S., Begum, M., Prasad, B., Prasad, E.R., 2014. Exercise prescriptions to prevent musculoskeletal disorders in dentists. *J. Clin. Diagn. Res.* 8, 13–16.
- Lauche, R., Schumann, D., Sibbritt, D., Adams, J., Cramer, H., 2017. Associations between yoga practice and joint problems: a cross-sectional survey among 9151 Australian women. *Rheumatol. Int.* 37, 1145–1148.
- Lio, F., Mampieri, G., Mazzetti, V., Leggeri, A., Arcuri, L., 2021. Guided endodontic microsurgery in apicoectomy: A review. *J. Biol. Reg. Hom. Agents* 35 (351), 47–55. <https://doi.org/10.23812/21-3suppl-7>.

- McCabe, P.S., Dummer, P.M., 2012. Pulp canal obliteration: an endodontic diagnosis and treatment challenge. *Int. End. J.* 45 (2), 177–197. <https://doi.org/10.1111/j.1365-2591.2011.01963.x>.
- Michalsen, A., Traitteur, H., Lütke, R., Brunnhuber, S., Meier, L., Jeitler, M., Büssing, A., Kessler, C., 2012. Yoga for chronic neck pain: a pilot randomized controlled clinical trial. *J. Pain.* 13, 1122–1130.
- Ohlendorf, D., Fraeulin, L., Haenel, J., Betz, W., Erbe, C., Holzgreve, F., Wanke, E.M., Brueggmann, D., Nienhaus, A., Maurer-Grubinger, C., Groneberg, D.A., 2021. Ergonomic comparison of four dental workplace concepts using inertial motion capture for dentists and dental assistants. *Int. J. Environ. Res. Publ. Health* 18 (19), 10453. <https://doi.org/10.3390/ijerph181910453>.
- Rossi-Fedele, G., Franciscatto, G.J., Marshall, G., Gomes, M.S., Doğramaci, E.J., 2020. Endodontic complications associated with orthodontic temporary anchorage devices: A systematic review of human studies. *Aust. Endodont. J.* 46 (1), 115–122. <https://doi.org/10.1111/aej.12375>.
- Sakaguchi, T., Tanaka, M., Sake, N., Latka, K., Fujiwara, Y., Arataki, S., Yamauchi, T., Takamatsu, K., Yasuda, Y., Nakagawa, M., Takahashi, N., Kishimoto, T., 2022. The Most Significant Factor Affecting Gait and Postural Balance in Patients' Activities of Daily Living Following Corrective Surgery for Deformity of the Adult Spine. *Med. (lithuania)* 58 (8), 1118. <https://doi.org/10.3390/medicina58081118>.
- Slivkina, N., Abduldavaya, A., Tardjibayeva, S., Doszhanova, G., Kuanyshbayeva, G., 2020. The health of the population, according to prenosological diagnostics. *Georg. Med. News* 303, 188–193. <https://pubmed.ncbi.nlm.nih.gov/32841204/>.
- Wei, X., Yang, M., Yue, L., Huang, D., Zhou, X., Wang, X., Zhang, Q., Qiu, L., Huang, Z., Wang, H., Meng, L., Li, H., Chen, W., Zou, X., Ling, J., 2022. Expert consensus on regenerative endodontic procedures. *Int. J. Oral Sci.* 14 (1), 55. <https://doi.org/10.1038/s41368-022-00206-z>.
- Why is Ergonomics Important in Dentistry? (n.d.) <https://hjtdesign.com/why-is-ergonomics-important-in-dentistry/>.