
FLEXIBLE PARTIAL DENTURES “THERMOSENS”. A QUESTIONNAIRE SURVEY.

R. Radev¹, M. Yankova, PhD², I. Dzhondrova³, D. Kirov, PhD⁴, N. Apostolov, PhD⁵

¹Assistant professor, Department of Prosthetic Dental Medicine, FDM, MU-Sofia, Bulgaria

²Chief assistant professor, PhD, Department of Prosthetic Dental Medicine, FDM, MU-Sofia, Bulgaria

³Assistant professor, Department of Prosthetic Dental Medicine, FDM, MU-Sofia, Bulgaria

⁴Associate professor, PhD, Department of Prosthetic Dental Medicine, FDM, MU-Sofia, Bulgaria

⁵Associate professor, PhD, Department of Prosthetic Dental Medicine, FDM, MU-Sofia, Bulgaria

Introduction. Advances in prosthetic dental medicine have led to the more frequent use of removable partial dentures made from thermoplastic resins.

Aim. To survey the opinion of the general dental practitioners regarding the use of flexible dentures "ThermoSens".

Materials and methods. An anonymous survey (written and online) was conducted among general dental practitioners, it includes 14 questions related to the use, advantages and disadvantages of flexible "ThermoSens" dentures, as well as their polishing and disinfection. Additional information on gender, working experience and specialization among dental practitioners was collected. The results were analyzed using statistical methods.

Results. According to the respondents, the disadvantages of the materials for removable dentures are related to the retention and stability of the dentures (31.6%), change in color (25.7%), appearance of defects on the surface (17.1%) and change in volume (11.8%). 32% of respondents define "ThermoSens" dentures as flexible, 51.1% believe that they provide greater stability and retention compared to conventional dentures, and only 23.9% use them in their clinical practice. 77.2% believe that dentures stomatitis does not occur with flexible dentures. To clean flexible dentures, 44.0% of respondents recommend cleaning tablets, 31% - toothbrush and soap, and 19% - toothbrush and toothpaste. 59% found a change in the color of the flexible dentures after a period of use. Denture surface treatment according to 78.3% is done using material-specific finishing, followed by conventional polishing (12%) and varnish coating (4.3%). 53.3% of respondents do not think that flexible dentures replace conventional dentures in the daily practice.

Conclusion. The survey shows insufficient understanding of the general dental practitioners regarding the application of "ThermoSens" flexible dentures in the daily dental practice.

Keywords: flexible dental resins, partial dentures, "ThermoSens"

Introduction

The use of flexible removable dentures has increased in Bulgaria over the last decade with the introduction of “ThermoSens” on the market as an alternative to other flexible materials such as “IFlex” and “Valplast”. A large portion of the adult population suffers from partial or complete edentulism (1) caused by caries, periodontal problems, traumatic injuries, impactions, and cystic lesions (2–4). The fabrication and use of removable partial dentures remains as a viable and more affordable option for the restoration of the functional and aesthetic aspects of the patient’s oral health (5, 6).

Prosthetic dental medicine has observed significant progress in recent years, and flexible dentures are presented as an alternative (6) to conventional prosthetic materials. Among them, “ThermoSens” a thermoplastic polyamide resin, has demonstrated better properties and more potential benefits to the patients when compared to conventional polymethyl methacrylate (PMMA) removable dentures.

Traditional dental prostheses, typically made from PMMA, provide satisfactory results (7,8) but may come with limitations such as susceptibility to fractures, discomfort, challenges in achieving precise fit and negative biological properties (9,10). In contrast, the use of thermoplastic materials has shown improved flexibility, patient comfort, aesthetics, and biocompatibility (11–16).

The lack of information and research about the flexible material “ThermoSens” in Bulgaria is one of the reasons we conducted this anonymous survey.

Aim

The aim of the study is to analyse and summarize the results acquired from conducting an anonymous survey amongst dentists in Bulgaria regarding their knowledge on the advantages and disadvantages of flexible dentures “ThermoSens” compared to conventional PMMA dentures, as well as their disinfection, mechanical, physical properties, and any problems regarding their use in the daily practice.

Materials and methods

For the completion of the aim, a survey was conducted among 315 dentists, who participated in forums organized by the Bulgarian Dental Association. The voluntary and anonymous survey was carried out between December 2022 and March 2023, and responses were collected both on paper and electronically through an online dental medicine research forum.

A questionnaire method was used to establish the level of familiarity of dental practitioners in Bulgaria with the technology of flexible dentures. The questionnaire aimed to determine whether these dentures are perceived to be more precise and capable of displacing conventional methods, as well as to identify the perceived advantages and disadvantages of prosthetic dentures made from the flexible material “ThermoSens”. The questionnaire consists of 14 questions, providing information about the following categories:

- General information about the respondent: age, work experience and specialty.
- Advantages and disadvantages between conventional PMMA removable dentures and flexible dentures “ThermoSens” regarding their mechanical and physical properties.
- The usage of flexible dentures in the daily dental practice.
- Methods for polishing and disinfection of flexible and conventional dentures.

The results of the survey were statistically analysed, the methods used were descriptive statistics.

Results

After analysing the opinion of dental practitioners, some important conclusions can be made regarding the level of knowledge regarding the advantages and disadvantages of flexible dentures “ThermoSens” as well as their usage, polishing and disinfection.

A total of 315 dental practitioners were surveyed, of which 110 men (34.8%) and 215 women (65.2%) (Fig.1), they were divided in two groups depending on whether they have a specialty in Prosthetic dental medicine and in four groups depending on their work experience.

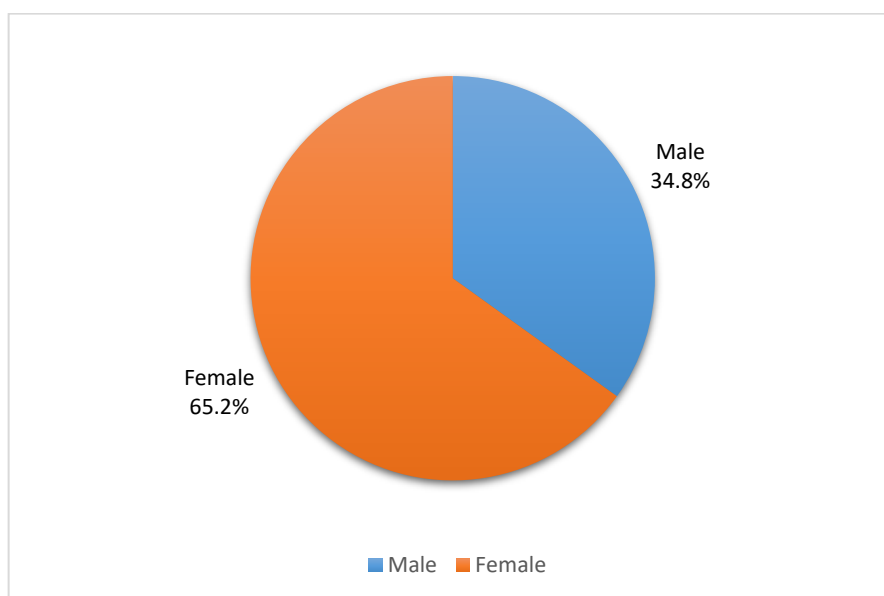


Figure 15. Distribution of respondents by gender.

The next question is whether the respondents have attained a specialty in the field of Prosthetic dental medicine or not. Of the 315 respondents, only 25 (8%) respond that they have this specialty and the other 290 (92%) do not have it (Fig. 2).

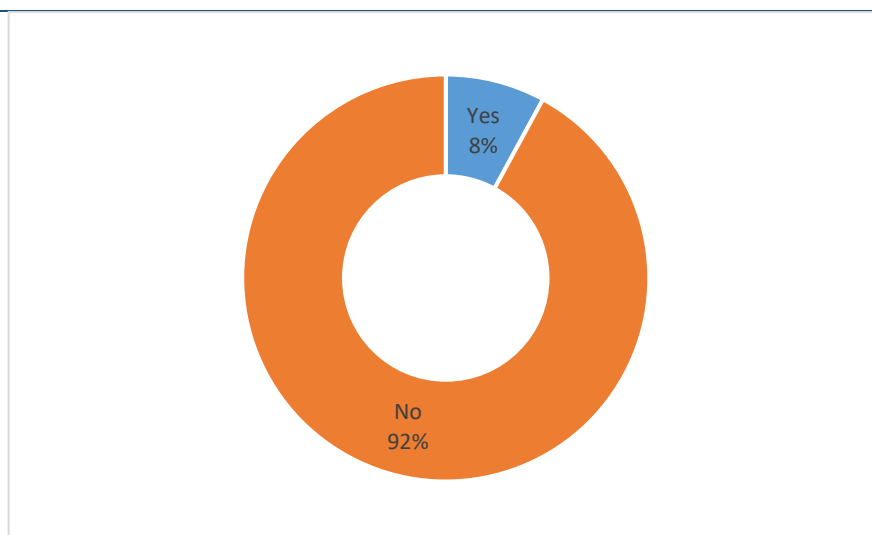


Figure 16. Distribution of respondents by specialty.

The largest number of respondents 137 (43.5%) have work experience of over 25 years, followed by those who have between 6 and 15 years of work experience 75 (23.9%), those who have between 16 and 25 years of work experience 72 (22.8%) and the fewest respondents are those with up to 5 years of work experience 31 (9.8%) (Fig. 3). The majority of the respondents have over 15 years of work experience.

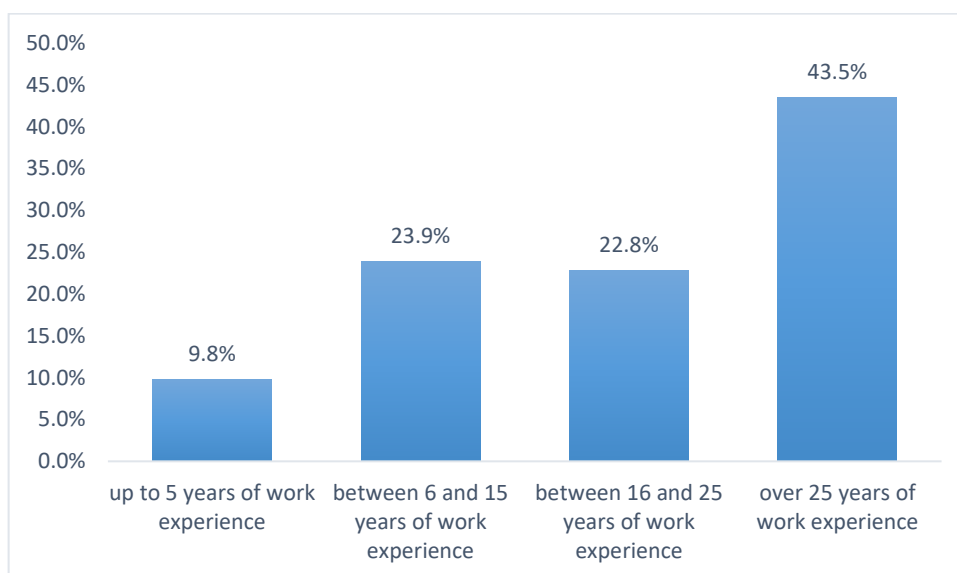


Figure 17. Distribution of respondents by work experience.

Regarding the most observed disadvantages when using removable dentures in their daily practice, 163 (31.6%) of respondents respond that the change in the retention and stability is most commonly observed, followed by change in the color – 132 (25.7%), change in the surface roughness – 88 (17.1%). Those who have no

negative observations – 71 (13.8%) and those who observe a change in the volume of the denture material – 61 (11.8%) (Fig. 4)

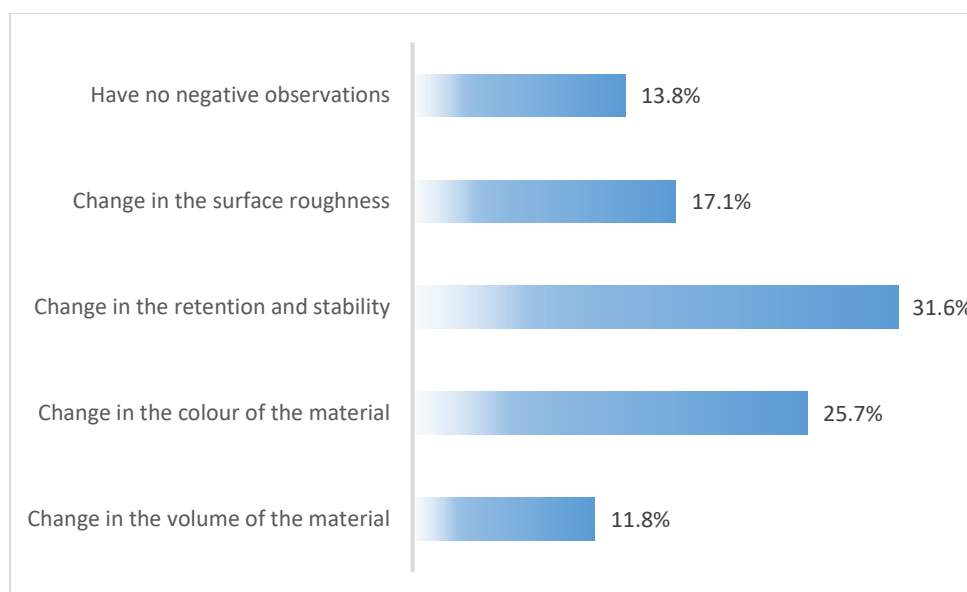


Figure 18. Distribution of respondents by the most commonly observed disadvantages of the materials used for partial dentures in their daily practice.

Regarding the most commonly used type of removable dentures in the daily practice, 212 (67.4%) of respondents answered with conventional PMMA dentures, 75 (23.9%) responded with flexible dentures, 14 (4.3%) responded with metal-frame dentures and 14 (4.3%) responded with other (Fig. 5).

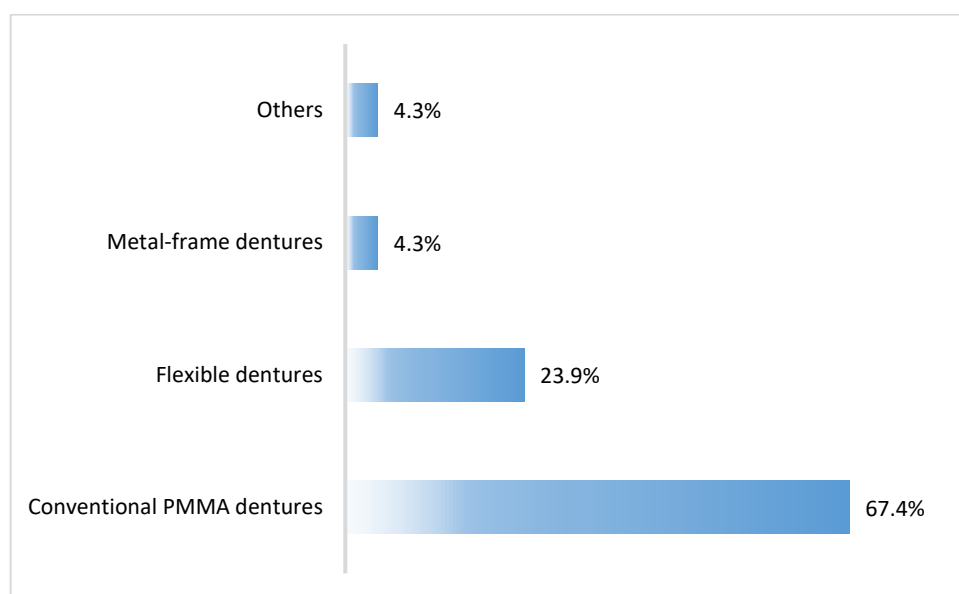


Figure 19. Distribution of respondents by the most commonly used removable dentures in their daily practice.

When asked if the flexible dentures will replace the conventional PMMA removable dentures in the daily dental practice the majority of respondents 168 (53.3%) respond that they will not replace the conventional dentures, 99 (31.5%) respond that they will replace the conventional dentures and 48 (15.2%) cannot answer (Fig. 6).

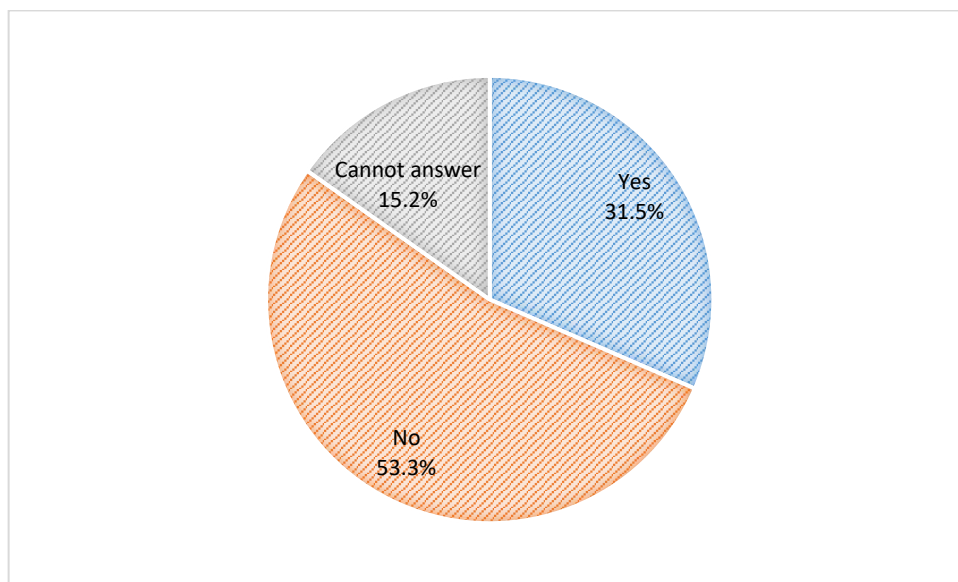


Figure 20. Distribution of respondents by their opinion whether the flexible dentures will replace the conventional PMMA ones in the daily practice.

The next questions focus on certain mechanical and physical properties of the flexible partial dentures "ThermoSens". When asked to classify the removable dentures "ThermoSens" based on their mechanical properties, 124 (40%) describe them as elastic, 101 (32%) as flexible, 68 (22%) as plastic and 22 (7%) as rigid (Fig. 7).

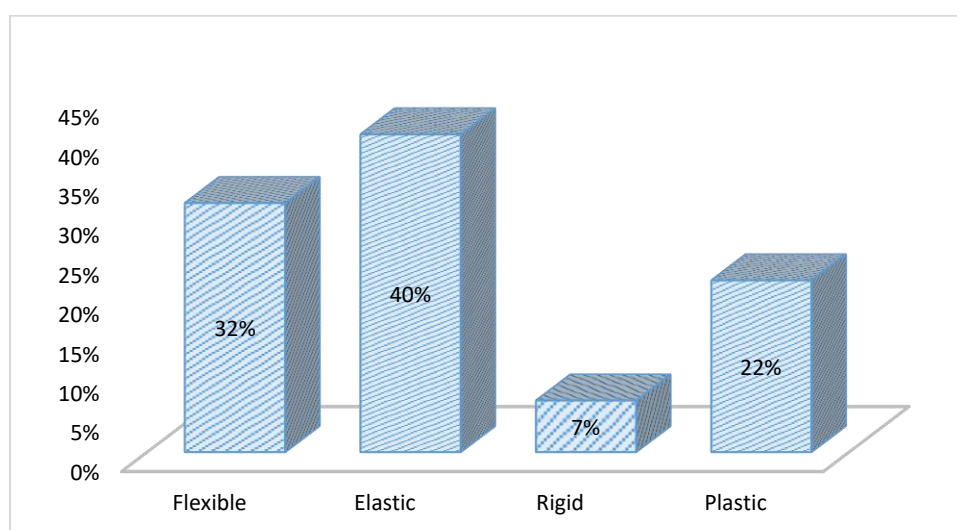


Figure 21. Distribution of respondents by how they classify the removable dentures "ThermoSens" based on their mechanical properties.

When asked whether they thought that the removable dentures “ThermoSens” exhibit better retention and stability during mastication compared to the conventional PMMA dentures, the majority 161 (51.1%) responded positively, 86 (27.2%) could not answer and 68 (21.7%) responded with no (Fig. 8).

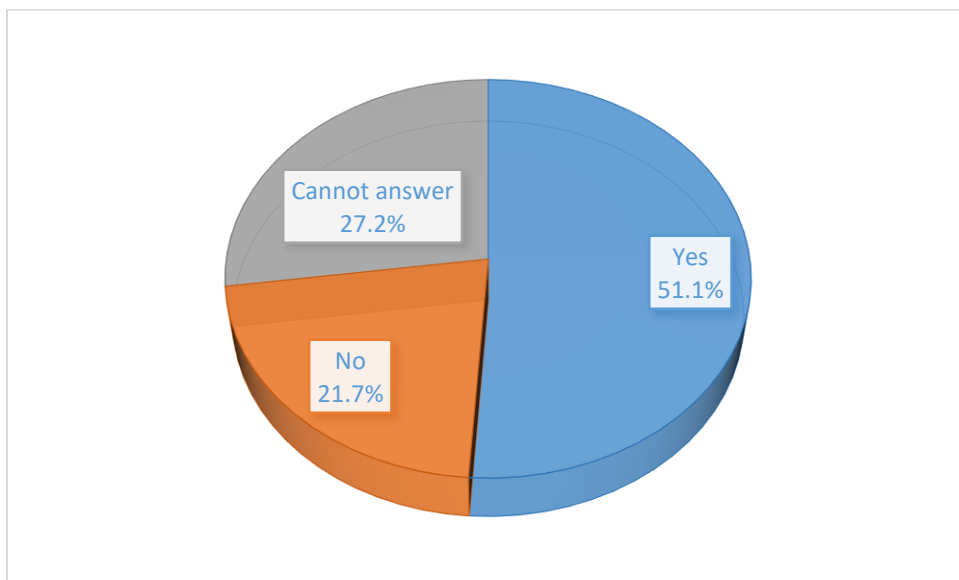


Figure 22. Distribution of respondents by whether they think that removable dentures "ThermoSens" offer better stability and retention during mastication compared to conventional PMMA dentures.

Regarding the changes observed in the color of removable dentures “ThermoSens” after prolonged period of use, the majority 186 (59%) say they observed changes in the color and 129 (41%) respond that they have not observed changes in the color (Fig. 9).

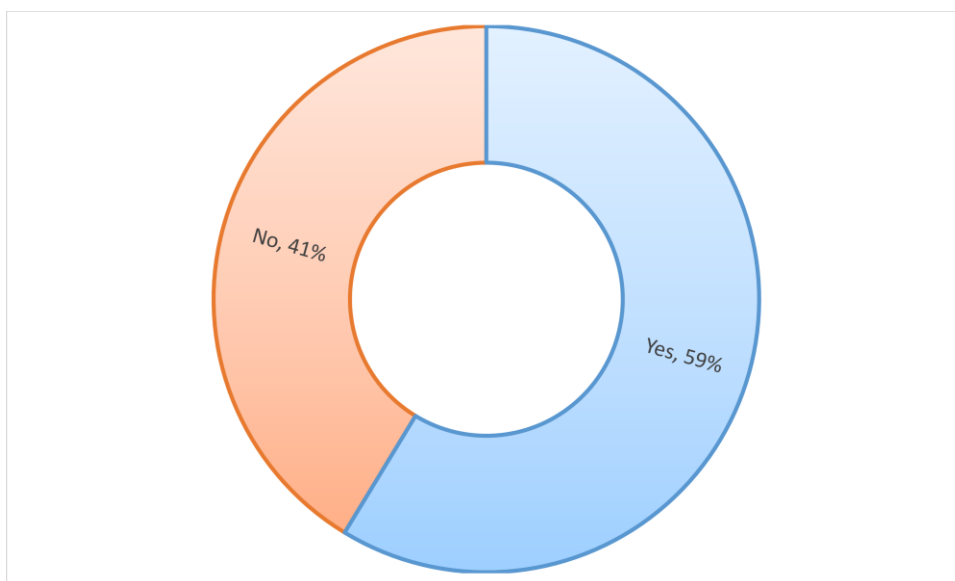


Figure 23. Distribution of respondents by whether they have observed changes in the color of dentures "ThermoSens" after a prolonged period of use.

The next questions are aimed at the respondents' knowledge of the biocompatibility, finishing and disinfection of the removable dentures "ThermoSens". When asked whether it is more likely to observe dentures stomatitis in patients treated with "ThermoSens" dentures, the majority 243 (77.2%) of respondents said that it is less likely while 72 (22.8%) responded that it is more likely to occur (Fig. 10).

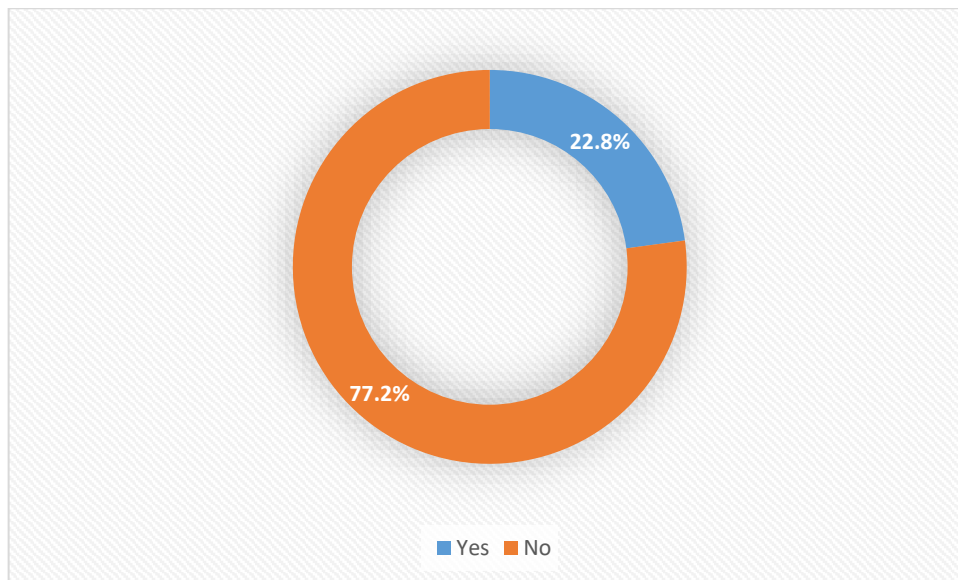


Figure 24. Distribution of respondents by whether it is more likely to observe denture stomatitis when using "ThermoSens" dentures.

When asked whether they know how exactly the surface of the "ThermoSens" denture is treated by their dental technician, 247 (78.3%) responded by using a specific for the material finishing material, 37 (12%) said by using conventional polishing techniques, 17 (5.4%) respond with other and 14 (4.3%) respond with lacquer finishing (Fig. 11).

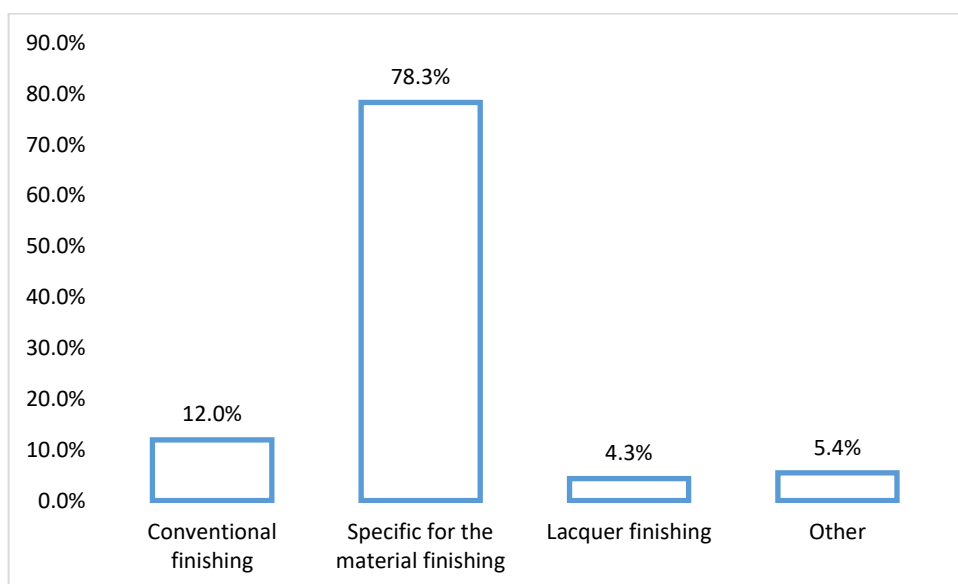


Figure 25. Distribution of respondents by their opinion on how their dental technician treats the "ThermoSens" denture surface.

The respondents were asked two separate questions in order to compare their recommendations of the different disinfection techniques in both conventional PMMA dentures and “ThermoSens” dentures. For the conventional dentures, the most recommended method is using cleaning tablets (44.4%), followed by soap and brush (26.9%), toothpaste and brush (22.2%), ultrasonic bath (5.3%) and others (1.2%) (Fig. 12).

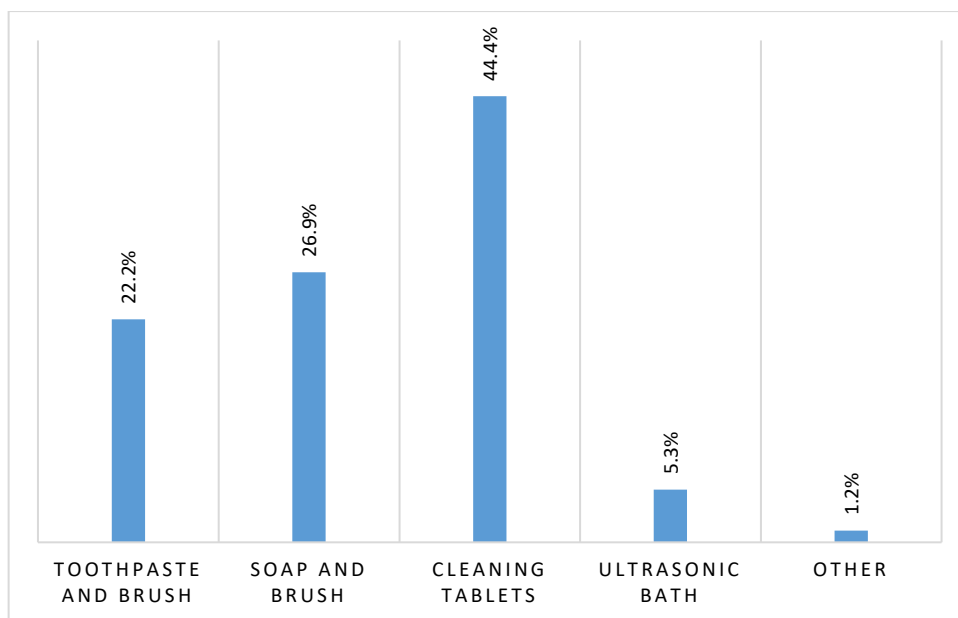


Figure 26. Distribution of responses based on which method of disinfection is most recommended when it comes to conventional PMMA dentures.

For the “ThermoSens” removable dentures, the most recommended method is again the cleaning tablets (44%), followed by soap and brush (31%), toothpaste and brush (19%), ultrasonic bath (4.8%) and others (1.2%) (Fig. 13).

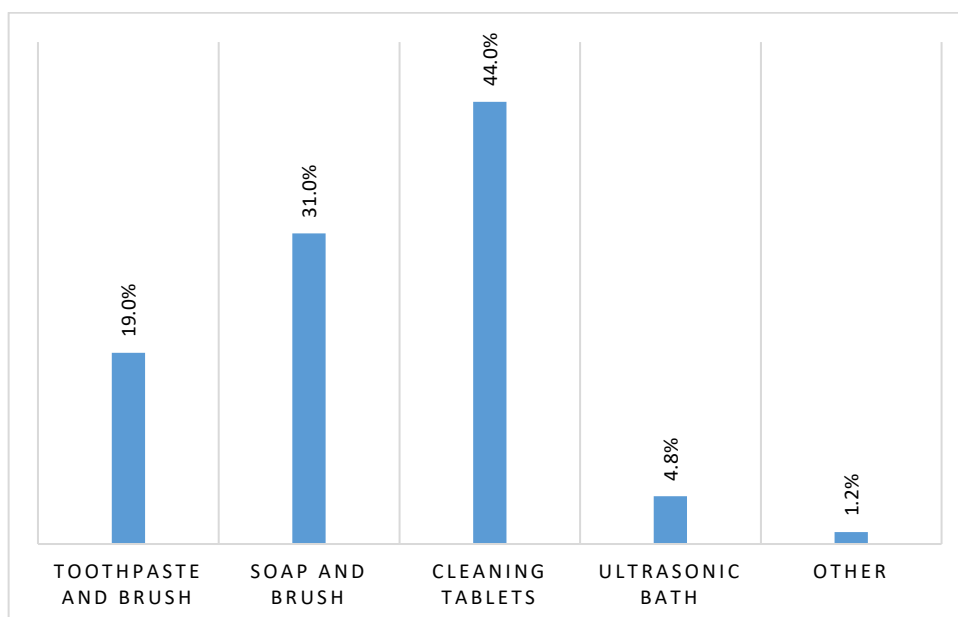


Figure 27. Distribution of responses based on which method of disinfection is most recommended when it comes to flexible “ThermoSens” dentures.

The last question is focused on the sources of information from which the dental practitioners receive the latest theoretical knowledge regarding removable prosthetics. A large number of respondents 140 (44.6%) say they receive the latest information from textbooks, 127 (40.2%) from scientific articles, 38 (12%) from the internet and 10 (3.3%) from other sources (Fig. 14).

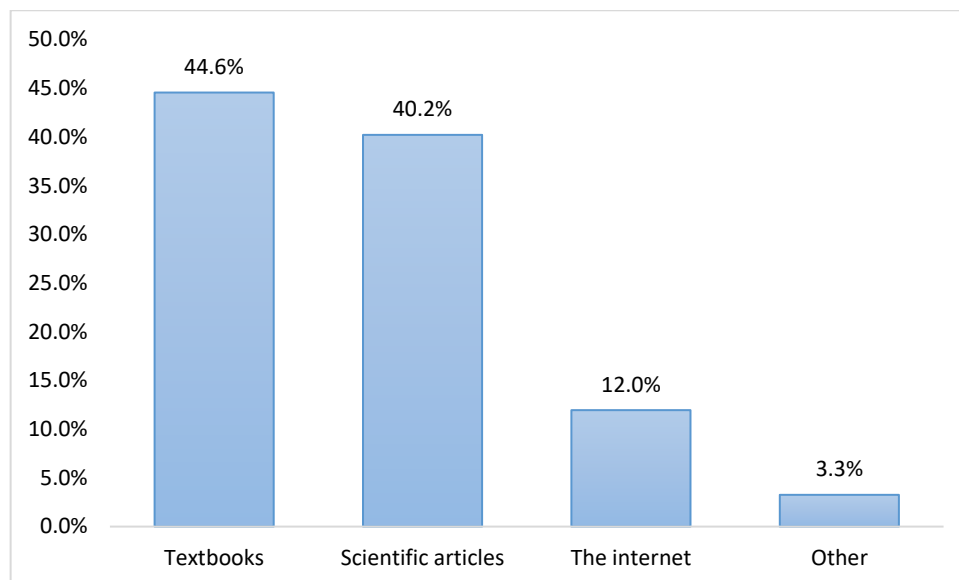


Figure 28. Distribution of respondents by the most commonly used source of information regarding removable prosthetics.

Discussion

The conducted survey provides an opportunity to objectively analyze and summarize the general opinion of dental practitioners in Bulgaria regarding the use, advantages, and disadvantages regarding the mechanical and physical properties of flexible removable dentures “ThermoSens”, the treatment of the denture surface as well as different recommendations regarding the disinfection of the dentures. The participation of dental practitioners with a varying degree of work experience, as well as clinicians with a specialty in Prosthetic dental medicine brings comprehensive information on the issue included in the survey.

The work experience of the respondents is important for a better understanding and interpretation of the survey results. The use of flexible removable dentures “ThermoSens” as a new method for prosthetic treatment in Bulgaria is more apparent in dental practitioners with less than 15 years of work experience, this trend is confirmed by a study done by Elfaidy et al. in 2022 (17). The average length of clinical practice amongst the respondents is approximately 16 years; with the largest number of respondents, 137 have over 25 years or more of work experience.

In general, 1 out of 4 Bulgarian dentists use flexible dentures in their daily dental practice, compared to 1 in 5 dental practitioners in Romania according to Dragomir G. et al. (18) and 1 in 3 dental practitioners in Wisconsin, U.S.A. (19). These further cements the view of the general practitioners that the flexible dentures will not replace the conventional PMMA dentures in the daily practice.

When it comes to the color stability of the flexible dentures “ThermoSens” the majority of respondents 186 (59%) said that they have observed a change in the color properties of the removable dentures over a prolonged period of use. Similar results can be found when using flexible dentures in a study of Bosînceanu DN et al. and Takabayashi et al. (20, 21) where they associate the change of the color with the bad oral hygiene of the patients as well as the surface characteristics of the denture base material.

Regarding the most commonly observed problems when it comes to using removable dentures, 31.6% of respondents answered with change in the retention and stability of the dentures, 25.7% say that change in the color is the biggest problem. Followed by 17.1% that say it is the change in the surface roughness, 11.8% respond with a change of the volume of the denture and 13.8% say they have no negative observations. These results follow a similar trend that a survey conducted by Polyzois et al. (22) in which the respondents have noted that the most common issue is the discoloration of the base material, followed by problems with the retention and base fracture.

The decision of which type of removable denture to use is strictly individual when approaching different clinical cases. The majority of Bulgarian dental clinicians still rely on the use of conventional acrylic (PMMA) removable dentures in their daily practice (67.4%) compared to other clinicians in the same region. A study conducted by Polyzois G. et al. (22), which includes practitioners from both Greece and Croatia, has shown that the majority of them rank their preferences regarding which denture type to use. Metal-frame dentures; 78% of the Greek respondents and 71.4% of the Croatian respondents, followed by acrylic; 13% compared to 14.4% and flexible dentures; 8.7% compared to 14.2%.

It is important for the patients to be well instructed and educated when it comes to the disinfection of their removable dentures; this means that the dental practitioner must have extensive knowledge regarding which method of disinfection is most suited for the different types of removable dentures (23). When it comes to conventional PMMA dentures, dental practitioners in Bulgaria recommend the use of cleaning tablets (44.4% of respondents), followed by soap and brush (26.9%), toothpaste and brush (22.2%) and ultrasonic bath (5.3%). In a survey conducted by Cinquanta et al. in 2021 (24) among patients regarding their attitude and habits towards hygiene of removable dentures. The majority of the respondents answered that the most commonly used method for cleaning their dentures was using toothpaste and brush (30%), only one fifth of the respondents replied that they were applying the recommended method of both using toothpaste and brushing their denture and using cleaning tablets (21%). Studies conducted by Mylonas P. et al. and Peracini et al. (25,26) also shows that the most commonly used methods for disinfection are the use of a toothpaste and brush and cleaning tablets.

Regarding the disinfection of flexible dentures and more specifically “ThermoSens” removable dentures, Bulgarian clinicians recommend the use of cleaning tablets (44%) followed by soap and brush (31%) and toothpaste and brush (19%). The results show that unlike with the conventional PMMA dentures, when it comes to flexible dentures the clinicians would recommend the use of soap and brush over the use of toothpaste and brush, this can possibly be linked to the presence of abrasive particles in the toothpaste which could damage the dentures surface. Most of

the manufacturers of the base material used in flexible dentures also manufacture their own brand of cleaning agents, which are to be used with the corresponding base material (27, 28).

The use of the different disinfection methods and techniques can lead to an increase of the surface roughness observed on both conventional PMMA dentures and flexible dentures (29, 30). Several studies have concluded that the surface of flexible dentures can be damaged more easily (31) which can lead to more retention of microorganisms and eventually lead to denture stomatitis (32, 33). The majority of dental practitioners in Bulgaria have pointed that it is less likely to observe (77.2%) denture stomatitis when using flexible dentures compared to conventional PMMA dentures (22.8%).

When it comes to the surface finishing of the denture base material the majority of respondents have answered that there is a specific for the material surface-treating agent (78.3%). The finishing of the "ThermoSens" denture surface is done using the Vertex "ThermoGloss" finishing agent (34).

Conclusion

The analysis of the responses shows that the dental practitioners with less work experience are more inclined to use flexible dentures in their dental practice, however the majority of practitioners still rely on the conventional acrylic dentures. The knowledge of Bulgarian dental practitioners regarding the mechanical and physical properties of the flexible dentures "ThermoSens" could be improved. Regarding the disinfection of the dentures, irrelevant of work experience the majority of respondents have answered adequately. It is advisable to increase the theoretical and practical knowledge of dental practitioners to have more confidence in using flexible dentures as an alternative to conventional PMMA removable dentures in daily dental practice.

1. Bonev B. DENTAL HEALTH AND QUALITY OF LIFE OF PEOPLE OVER 20 YEARS OF AGE IN THE REPUBLIC OF BULGARIA [Internet] [Dissertation]. [Sofia]: MEDICAL UNIVERSITY - SOFIA FACULTY OF DENTAL MEDICINE 2013 [In Bulgarian] [cited 2023 Jun 12]. Available from: http://cml3.mu-sofia.bg:8080/xmlui/bitstream/handle/10861/540/Boyko_Bonev-ref.pdf?sequence=2&isAllowed=y

2. Prabhu N, Kumar S, D'souza M, Hegde V. Partial edentulousness in a rural population based on Kennedy's classification: An epidemiological study. *The Journal of Indian Prosthodontic Society*. 2009;9(1):18.

3. Akinboboye¹ B, Azodo² C, Soroye³ M. Odonto-Stomatologie Tropicale Partial edentulism and unmet prosthetic needs amongst young adult Nigeria. Vol. 37, *Tropical Dental Journal*. 2014.

4. Khalid Abdel-Rahman H, Dhahir Tahir C, Mahmud Saleh M. Incidence of Partial Incidence of partial edentulism and its relation with age and gender. Vol. 17, *Zanco J. Med. Sci*. 2012.

5. Khan BChD S, Dentistry P. Aesthetic Clasp Design for Removable Partial Dentures: A Literature Review Aesthetic clasp design for Removable partial dentures: A literature review *SADJ* June. Vol. 60. 2005.

6. Thakral GK, Aeran H, Yadav B, Thakral R. Flexible Partial Dentures-A hope for the Challenged Mouth. Vol. 5, *People's Journal of Scientific Research*. 2012.

7. Shen C., Rawls H., Esquivel-Upshaw J. Phillips' Science of Dental Materials. 13th ed. Evolve Elsevier; 2022.
8. Zafar MS. Prosthodontic Applications of Polymethyl Methacrylate (PMMA): An Update. *Polymers (Basel)*. 2020 Oct 8;12(10):2299.
9. Arutyunov S, Kirakosyan L, Dubova L, Kharakh Y, Malginov N, Akhmedov G, et al. Microbial Adhesion to Dental Polymers for Conventional, Computer-Aided Subtractive and Additive Manufacturing: A Comparative In Vitro Study. *J Funct Biomater*. 2022 Apr 11;13(2):42.
10. Takeuchi Y, Nakajo K, Sato T, Koyama S, Sasaki K, Takahashi N. Quantification, and identification of bacteria in acrylic resin dentures and dento-maxillary obturator-prostheses. *Am J Dent*. 2012 Jun;25(3):171–5.
11. Hamanaka I, Takahashi Y, Shimizu H. Mechanical properties of injection-molded thermoplastic denture base resins. *Acta Odontol Scand*. 2011 Mar 27;69(2):75–9.
12. Дражев Т., Иванов Ст. Гъвкави Пластмаси. 2015.
13. Ghee Seong L. The development of flexible denture materials and concept: a narrative review. Vol. 2021, JUMMEC. 2021.
14. Nandal S, Ghalaut P, Shekhawat H, Singh Gulati M. New era in denture base resins: a review [Internet]. Vol. 1, DJAS. 2013. Available from: www.djas.co.in
15. Bana K., Shadab S., Hakeem S., Ilyas F. Comparing Oral Health-related Quality of Life (OHIP-14) and Masticatory Efficiency with Complete Denture Treatment. *Journal of the College of Physicians and Surgeons Pakistan*. 2021 Jun 1;31(6):694–8.
16. Hundal M, Madan R. Comparative clinical evaluation of removable partial dentures made of two different materials in Kennedy Applegate class II partially edentulous situation. *Med J Armed Forces India*. 2015 Dec;71:S306–12.
17. Elfaidy YM, Elnaihoun W. Attitude of Dental Clinicians Towards Flexible Dentures: A Questionnaire Survey in Libya [Internet]. 2022. Available from: www.ljd.com.ly
18. Dragomir G, Farcasiu AT, Pascal I. Romanian dentists' perception of flexible removable partial dentures. *Romanian Journal of Stomatology*. 2021;67(1):53–6.
19. Pun DK, Waliszewski MP, Waliszewski KJ, Berzins D. Survey of partial removable dental prosthesis (partial RDP) types in a distinct patient population. *J Prosthet Dent*. 2011 Jul;106(1):48–56.
20. Bosînceanu DN, Bosînceanu DG, Forna NC. Acrilatul flexibil-soluție terapeutică viabilă în protezarea amovibilă. Vol. 4, *Romanian Journal of Medical and Dental Education*. 2015.
21. TAKABAYASHI Y. Characteristics of denture thermoplastic resins for non-metal clasp dentures. *Dent Mater J*. 2010;29(4):353–61.
22. Polyzois G, Lagouvardos P, Kranjčić J, Vojvodić D. Flexible Removable Partial Denture Prosthesis: A Survey of Dentists' Attitudes and Knowledge in Greece and Croatia. *Acta Stomatol Croat*. 2015 Dec 15;49(4):316–24.
23. Papadiochou S, Polyzois G. Hygiene practices in removable prosthodontics: A systematic review. *Int J Dent Hyg*. 2018 May;16(2):179–201.
24. Cinquanta L, Varoni EM, Barbieri C, Sardella A. Patient attitude and habits regarding removable denture home hygiene and correlation with prosthesis cleanliness: A cross-sectional study of elderly Italians. *J Prosthet Dent*. 2021 May;125(5):772.e1-772.e7.

25. Mylonas P, Milward P, McAndrew R. Denture cleanliness and hygiene: an overview. *Br Dent J.* 2022 Jul 8;233(1):20–6.
26. Peracini A, Andrade IM de, Paranhos H de FO, Silva CHL da, Souza RF de. Behaviors and hygiene habits of complete denture wearers. *Braz Dent J.* 2010;21(3):247–52.
27. Vojdani M, Giti R. Polyamide as a Denture Base Material: A Literature Review. *J Dent (Shiraz).* 2015 Mar;16(1 Suppl):1–9.
28. Valplast International Corporation Limited Warranty [Internet]. Available from: www.valplast.com
29. Tripathi P, Phukela S, Yadav B, Malhotra P. An in vitro study to evaluate and compare the surface roughness in heat-cured denture-based resin and injection-molded resin system as affected by two commercially available denture cleansers. *The Journal of Indian Prosthodontic Society.* 2018;18(4):291.
30. Kawara M, Iwata Y, Iwasaki M, Komoda Y, Iida T, Asano T, et al. Scratch test of thermoplastic denture base resins for non-metal clasp dentures. *J Prosthodont Res.* 2014 Jan;58(1):35–40.
31. Abuzar MA, Bellur S, Duong N, Kim BB, Lu P, Palfreyman N, et al. Evaluating surface roughness of a polyamide denture base material in comparison with poly (methyl methacrylate). *J Oral Sci.* 2010;52(4):577–81.
32. Radford DR, Challacombe S, Walter JD. Denture Plaque and Adherence of *Candida Albicans* to Denture-Base Materials in Vivo and in Vitro. *Critical Reviews in Oral Biology & Medicine.* 1999 Jan 1;10(1):99–116.
33. Bollen CML, Lambrechts P, Quirynen M. Comparison of surface roughness of oral hard materials to the threshold surface roughness for bacterial plaque retention: A review of the literature. *Dental Materials.* 1997 Jul;13(4):258–69.
34. VertexThermoGlossEmulsion. [cited 2023 Aug 21]; Available from: [https://www.flava.cz/download/\[311\]_Vertex_Thermo_Gloss_Emulsion___bezpecnostni_karta.pdf](https://www.flava.cz/download/[311]_Vertex_Thermo_Gloss_Emulsion___bezpecnostni_karta.pdf)