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REVIEW ARTICLE

Dental biomaterials that cause allergies

Biomateriales dentales que producen alergia

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ABSTRACT

Introduction: in contemporary dental practice, various dental materials with specific aesthetic and mechanical properties are used to restore and replace dental structures. However, their prolonged use may lead to adverse effects, including allergic reactions.
Objective: to describe the allergic response produced by dental biomaterials. Methods: The literature on allergic reactions to dental biomaterials published between 2018 and 2024 was reviewed, following the PRISMA guidelines. Sixteen relevant studies were selected and qualitative analysis was performed on them, which allowed identifying patterns and gaps, providing a comprehensive overview and basis for future research and clinical practice.
Results: materials that can trigger such reactions include composites, latex, local anesthetics, endodontic materials, and metals. Despite the excellent biocompatibility of titanium, hypersensitivity reactions to titanium dental implants have been documented. Furthermore, factors such as poor surgical techniques, bacterial infections, and prosthesis design may contribute to implant failure. The systematic review revealed variable rates of positive reactions to titanium sensitivity testing in patients with a history of intolerance. Furthermore, hydroxyapatite was found to reduce dentin hypersensitivity, while dental hygienists exposed to natural rubber latex developed dermatitis.
Conclusions: it is essential to properly diagnose and manage allergies to dental biomaterials to ensure patient safety and well-being. Safer biomaterials need to be developed and treatment tailored to prevent these allergies in clinical practice.

Keywords: Allergies; Dental Biomaterials; Treatments.

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RESUMEN

Introducción: en la práctica odontológica contemporánea, se emplean diversos materiales dentales con propiedades estéticas y mecánicas específicas para restaurar y reemplazar estructuras dentales. Sin embargo, su uso prolongado puede conllevar a efectos adversos, incluidas las reacciones alérgicas.
Objetivo: describir la respuesta alérgica producida por los biomateriales dentales.
Métodos: se revisó la literatura sobre reacciones alérgicas a biomateriales dentales publicada entre 2018 y 2024, siguiendo las directrices PRISMA. Se seleccionaron 14 estudios relevantes, efectuando análisis cualitativo en los mismos, lo que permitió identificar patrones y brechas, proporcionando una visión integral y base para futuras investigaciones y prácticas clínicas.
Resultados: entre los materiales que pueden desencadenar tales reacciones se encuentran los composites, el látex, los anestésicos locales, los materiales de endodoncia y los metales. A pesar de la excelente biocompatibilidad del titanio, se han documentado reacciones de hipersensibilidad a los implantes dentales de titanio. Además, factores como técnicas quirúrgicas deficientes, infecciones bacterianas y diseño de prótesis pueden contribuir al fracaso del implante. La revisión sistemática reveló tasas variables de reacciones positivas a pruebas de sensibilidad al titanio en pacientes con historial de intolerancia. Además, se observó que la hidroxiapatita puede reducir la hipersensibilidad dentinaria, mientras que los higienistas dentales expuestos al látex de caucho natural presentaron dermatitis.
Conclusiones: es esencial diagnosticar y abordar adecuadamente las alergias a los biomateriales dentales para garantizar la seguridad y el bienestar del paciente. Se necesita desarrollar biomateriales más seguros y personalizar el tratamiento para prevenir estas alergias en la práctica clínica.

Palabras clave: Alergias; Biomateriales Dentales; Tratamientos.

INTRODUCTION

In modern dentistry, a wide range of dental materials are used that meet various requirements, depending on the uses and their aesthetic and mechanical properties. These materials are used to restore lost dental structures or replace teeth, and are designed to remain in the patient's oral cavity for extended periods, even decades. However, prolonged use of these materials can result in the appearance of side effects, with allergic reactions being documented in recent years to have increased. In this regard, throughout the history of this subject, it has been observed that certain dental materials can trigger allergic reactions in some patients, dating back to 1928, the first documented case of allergy dates back to 1928, when stomatitis and dermatitis due to dental amalgam restorations were reported.[1]

These allergic reactions can manifest in a variety of ways, from mild symptoms such as hives, swelling and rash, to life-threatening conditions such as laryngeal edema, anaphylaxis and cardiac arrhythmias. Oral contact allergy is considered a T-cell-mediated delayed hypersensitivity reaction. Clinical symptoms may range from discomfort such as burning, pain and dryness of the mucosa, to more severe manifestations such as non-specific stomatitis and cheilitis.[2]

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Dental materials that have been associated with biocompatibility issues include composites, latex gloves, local anesthetic agents, endodontic materials, impression materials, and metals. As dentistry has become globalized and modernized, instances of the use of various dental materials have become more common around the world. However, it is important to note that there are variations in individual and population sensitivity to these materials, reflected in the underreporting of cases in some regions such as India. Therefore, it is essential to consider both individual and population sensitivity when selecting and using dental materials globally.[3]

Allergy to dental metals, including mercury, nickel and recently titanium, is a problem in dentistry. Although titanium is highly biocompatible and safe, it can cause hypersensitivity. Dental implants have a low risk of causing adverse reactions compared to artificial joints, but failure can be due to multiple factors, such as poor surgical techniques and inadequate planning.[4,5]

It is important to note that while these are common factors associated with implant failure, not all cases of failure can be attributed to them. In some cases, unexplained implant failures may occur despite the absence of these identified problems. Furthermore, rejection reactions or allergic responses to the implant, although uncommon, may also contribute to implant failure and should be considered as a possible idiopathic cause of poor implant prognosis. [6,7,8,9]

It is of great interest to dentists to know the adverse effects reported in the literature in relation to dental materials, especially those that cause allergic reactions that can trigger risk to the patient's life,[10,11,12,13] which is why the present review was carried out, which aimed to describe the allergic response produced by dental biomaterials.

METHODS

A systematic literature review was conducted to investigate both the incidence and factors associated with allergic reactions to dental biomaterials. To ensure transparency and excellence in the review process, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were rigorously followed. Meticulous inclusion criteria were used for the selection of relevant studies, encompassing original research, systematic reviews, and meta-analyses addressing the incidence, mechanisms, and risk factors associated with allergic reactions to dental biomaterials, published between 2018 and 2024. Studies that did not meet predefined methodological quality criteria or lacked full-text access were excluded.

In addition to this selection and exclusion process, a thorough qualitative analysis of the collected data was conducted. The aim of this analysis was to identify patterns, emerging trends and gaps in knowledge related to allergic reactions to dental biomaterials. To achieve this, a detailed descriptive approach was applied, thus allowing a comprehensive and detailed synthesis of the findings derived from the studies incorporated in the review. This comprehensive methodological approach not only provides a deep and broad insight into the topic at hand, but also serves as a fundamental starting point for future research and informed clinical practice.

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DEVELOPMENT

The results obtained from this study provide a detailed insight into the potential allergic reactions associated with the use of dental biomaterials. A considerable number of patients were found to have clinical manifestations of allergies after undergoing dental implant therapies, such as swelling, pain, redness, and mucosal lesions. Furthermore, a significant association was identified between the use of clindamycin as an alternative to penicillin and an increased likelihood of experiencing dental implant failure. The analyses also revealed variable rates of positive reactions in tests for titanium sensitivity in patients with a history of intolerance to this material.

Furthermore, it was observed that the application of hydroxyapatite closed the dentinal tubules, thus reducing dentinal permeability and dentinal hypersensitivity. Finally, a significant prevalence of allergic reactions was recorded among dental hygienists exposed to natural rubber latex (NRL), manifesting in the form of dermatitis and chemical dermatosis on the hands and fingers. These findings highlight the importance of appropriately identifying and addressing allergies related to dental biomaterials to ensure patient safety and well-being in the dental setting.

Table 1. Results obtained.

No.	Author	Methodology and procedure	Reaction
1	(Carlos Miguel Marto, et al., 2019)[14]	Review of 74 randomized clinical trials, where the evaporative stimulation method and the visual analogue scale were used. The role of potassium nitrate, arginine, glutaraldehyde and nicotinamide in the treatment of inflammatory bowel disease was evaluated.	They demonstrated efficacy in reducing dentin hypersensitivity (DH) at different follow-up times.
2	(Pier Paolo Poli, et al., 2021)[15]	A systematic search was performed including patients with dental rehabilitations with implants, evaluating peri-implant soft tissue reactions attributed to implants and evidencing allergy to titanium, diagnostic methods and forms of resolution.	25 patients presented clinical manifestations of allergic reactions after implant therapy, with symptoms such as swelling, pain, hyperemia and mucosal lesions.
3	(Naushad R. Ediba, et al., 2023)[16]	A systematic review, meta-analysis and delabeling protocol was performed, selecting four studies that investigated the relationship between the use of clindamycin as a substitute for penicillin in allergic patients and dental implant failure.	Patients receiving clindamycin were estimated to be 3.30 times more likely to experience implant failure compared with those receiving penicillin.
4	(Lena Katharina Müller-Heupt, et al, 2022)[17]	A systematic review was conducted in which several studies used titanium salts in epicutaneous testing. Research such as those by Müller et al. and Jacobi-Gresser et al. evaluated the sensitivity and specificity of ECT, LTT and MELISA testing in patients with titanium intolerance.	Patch testing showed positive reaction rates ranging from 0.9% to 25.7% in patients with suspected titanium intolerance. LTT and MELISA results were also inconsistent, with some positive and others negative reactions in patients allergic to titanium.

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5	(Brigitte Grosgogeat, et al, 2022)[18]	The PRISMA statement methodology was followed for the selection of studies. Data were collected from the selected studies, including general details, study type, sample size, methods, and results. The quality of the studies was assessed and conclusions were drawn based on the findings.	It was found that cobalt and chromium could cause type IV hypersensitivity reactions, irritation and allergic reactions in rare cases.
6	(Fabiana Allevi, et al, 2022)[19]	The study, following the PRISMA framework, focused on endoscopic sinus surgery with intraoral access. Evaluation was endoscopic. In cases of failure, antibiotic therapies were used in seven cases and surgical revision in seven others. One patient was lost to follow-up.	The PICO strategy was used to formulate the research question and in vitro studies in human teeth were included to evaluate the bond strength of dentin agents after the application of desensitizers. Of 146 studies identified, 23 met the inclusion criteria and were included.
7	(Hashmat Gul, et al., 2021)[20]	A literature search on hydroxyapatite and dentin hypersensitivity was performed, including 16 studies. In vitro results showed that hydroxyapatite occludes dentinal tubules, reducing permeability and decreasing dentin hypersensitivity over a 10-year study period.	There is no reaction because hydroxyapatite has the potential to reduce dentin hypersensitivity by occluding the dentinal tubules over a period of 2 to 8 weeks.
8	(C Lajolo, et al., 2019)[21]	A systematic review was conducted following PRISMA guidelines, selecting 10 studies on exposure to natural rubber latex (NRL) as a chemical risk for dental hygienists. Hypersensitivity reactions to NRL and exposure to acrylic resins and mercury were discussed.	US: Of 34 oral health professionals, 1 hygienist had an allergic reaction to latex gloves. Of 390, 5 reported dermatitis, with no patch test reactions. Sweden: Of 114 hygienists, 13 reported occupational allergies; 4 tested positive to latex. Norway: 37% of 189 hygienists had chemical dermatitis, one-third from latex gloves.
9	(Mohammed E Sayed, 2023)[22]	A systematic search of four databases was conducted to study the effect of desensitizing agents on retention of fixed dental prostheses. Key information was extracted on study design, sample size, materials, desensitizing agents, cement types, and retention strength.	Most of the reviewed studies reported variable findings due to differences in the composition of the dentin desensitizing agents tested and the types of luting cements used.
10	(Jong Seung Kim, et al., 2019)[23]	A data search was carried out in the PRISMA databases Twenty-seven studies were included in the meta-analysis. The proportion of cases of postoperative sinusitis, sinus membrane perforation and implant failure were analyzed.	The proportions of cases of postoperative sinusitis (0.05), sinus membrane perforation (0.17) and implant failure (0.05) were reported.
11	(Jiarui Li, et al., 2021)[24]	A search was conducted in four databases The review followed PRISMA guidelines	The results revealed significant differences between several desensitizers, with high heterogeneity between subgroups. CPP-ACP and arginine-CaCO3 did not negatively affect immediate adhesive strength, whereas other desensitizers did show some influence.

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12	(W Lu, et al., 2020)[25]	A search of four electronic databases and a manual search were performed up to March 2019. The results of using acellular dermal matrix (ADM) with connective tissue grafts (CTG) and free gingival grafts (FGG), as well as with the combination of ADM with coronally advanced/laterally positioned flap, were compared.	ADM showed comparable clinical efficacy to autogenous tissue procedures for root coverage and good long-term stability. However, in soft tissue augmentation, ADM was less effective than FGG and had lower long-term stability than CTG. Patients reported good esthetics, relief of dentin hypersensitivity, and less surgical morbidity with ADM.

DISCUSSION

The descriptive study conducted by Marto et al.,[14] involved a large group of 5366 participants. They used the evaporative stimulation method together with the visual analog scale to evaluate the efficacy of several agents, including potassium nitrate, arginine, and glutaraldehyde, in reducing dentin hypersensitivity (DH). Through the comprehensive review of 74 randomized clinical trials, they demonstrated that these agents were effective in reducing DH at different follow-up times. This finding highlights the importance of developing and using effective methods for the treatment of DH, which can have a significant impact on the quality of life of patients.[16]

On the other hand, Poli et al.,[15] conducted a systematic review that included 401 participants undergoing implant-supported dental rehabilitation. They observed that 25 patients presented clinical manifestations of allergic reactions after implant therapy, such as swelling, pain, hyperemia, and mucosal lesions. These results highlight the importance of considering the possibility of titanium allergies in patients with dental implants and the need for proper diagnosis and management of these adverse reactions.

In another study, Edibam and his team,[16] conducted a systematic review that included a large number of 10,853 dental implants. Four relevant studies were selected that investigated the relationship between the administration of clindamycin as a substitute for penicillin in patients with penicillin allergy and dental implant failure. Patients receiving clindamycin were estimated to be 3.30 times more likely to experience implant failure compared to those receiving penicillin. This finding underlines the importance of considering drug allergies when planning dental implant treatments and the need for safe alternatives for patients with known allergies.

In the study by Müller-Heupt et al.,[17] a systematic review and meta-analysis was conducted involving 270 participants. Various tests, such as Epicutaneous Testing (ECT), Lymphocyte Transformation Test (LTT) and Memory Lymphocyte Immunostimulation Assay (MELISA), were examined in patients with a history of titanium intolerance. Variations in the positive reaction rates in the tests were observed, underlining the need for more accurate diagnostic methods to identify titanium intolerance and prevent complications associated with dental implant placement.

On the other hand, in the study by Grosgogeat et al.,[18] a systematic review was carried out that included in vitro studies and in vivo studies in human patients. It was found that cobalt (Co) and chromium (Cr) could trigger type IV hypersensitivity reactions in rare cases, especially in individuals allergic to Co or Cr. These results highlight the importance of considering the materials used in dental rehabilitations and assessing the risk of allergic reactions in susceptible patients.

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Regarding the study by Allevi et al.,[19] they conducted a systematic review and meta-analysis that included 181 participants. The efficacy of endoscopic sinus surgery in the treatment of sinusitis after dental implantation was evaluated. A treatment success rate of 94.7% was observed, supporting the efficacy of this therapeutic approach. However, the need to standardize diagnoses and definitions was highlighted to facilitate comparisons between the results of different studies.

Furthermore, Gul et al.,[20] conducted a systematic review covering 16 studies on the effect of hydroxyapatite on dentin hypersensitivity. The results indicated that hydroxyapatite could reduce dentin hypersensitivity by occluding dentinal tubules within a period of two to eight weeks. This highlights the potential of hydroxyapatite as an effective treatment option for dentin hypersensitivity.

CONCLUSIONS

In summary, awareness and accurate diagnosis of dental biomaterial allergies are essential for patient oral health and well-being. It is crucial for dentists to assess the risks and carefully select the materials used, encouraging the development of safer and less allergenic biomaterials. Personalization of treatment and prevention are vital, requiring a thorough assessment of medical history. Continued efforts are needed to improve the diagnosis, treatment and prevention of these allergies, ensuring safe and effective dental care.

BIBLIOGRAPHIC REFERENCES

1. Syed M, Chopra R, Sachdev V. Allergic Reactions to Dental MaterialsA Systematic Review. Journal of Clinical & Diagnostic Research [Internet]. 2015 [Citado 20/04/2024]; 9(10): ZE04–ZE09. Disponible en: https://pmc.ncbi.nlm.nih.gov/articles/PMC4625353/

2. Di Spirito F, Lo Giudice R, Amato M, Di Palo MP, D'Ambrosio F, Amato A, et al. Inflammatory, Reactive, and Hypersensitivity Lesions Potentially Due to Metal Nanoparticles from Dental Implants and Supported Restorations: An Umbrella Review. Applied Sciences [Internet]. 2022 [Citado 20/04/2024]; 12(21): 11208. Disponible en: https://www.mdpi.com/2076-3417/12/21/11208

3. Oviedo Quirós J, Madriz Montero L, Lorz UlloaP. Characterization of Allergic Manifestations in Dental Professionals. Odovtos [Internet]. 2022 [Citado 20/04/2024]; 24(2): 100-117. Disponible en: https://www.scielo.sa.cr/scielo.php?script=sci_arttext&pid=S2215-34112022000200100

4. Hosoki M, Nishigawa K, Tajima T, Ueda M, Matsuk Y. Cross-sectional observational study exploring clinical risk of titanium allergy caused by dental implants. Journal of Prosthodontic Research [Internet]. 2018 [Citado 20 de abril de 2024]; 62(4): 426-431. Disponible en: https://pubmed.ncbi.nlm.nih.gov/29673741/

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2024; 28(S2): e6605

5. Cieplik F, Hiller AK, Scholz K, Schmalz G, Buchalla W, Mittermüller P. General diseases and medications in 687 patients reporting. Clinical Oral Investigations [Internet]. 2023 March [Citado 20/04/2024]; 27(8): 4447-4457. Disponible en: https://pubmed.ncbi.nlm.nih.gov/37212840/

6. Poli P, de Miranda F, Braga Polo T, Ferreira Júnior J, Lima Neto J, Ribeiro Rios B, et al. Titanium Allergy Caused by Dental Implants: A Systematic Literature Review and Case Report. Materials [Internet]. 2021 March [Citado 20/04/2024]; 14(18): 5239. Disponible en: https://pubmed.ncbi.nlm.nih.gov/34576463/

7. Watanabe M, Liu L, Ichikawa. Are Allergy-Induced Implant Failures Actually Hypersensitivity Reactions to Titanium? A Literature Review. Dentistry Journal [Internet]. 2023 [Citado 20/04/2024]; 11(11): 263. Disponible en: https://pubmed.ncbi.nlm.nih.gov/37999027/

8. Shen C, Rawls H, Esquivel-Upshaw J F. LA CIENCIA DE MATERIALES DENTALES DE PHILLIPS [Internet]. 13ed. ELSEVIER; 2022 [Citado 20/04/2024]. Disponible en: https://www.scribd.com/document/702958891/Ciencia-de-los-materiales-dentales-13va-Phillips

9. Martinez Camus DC, Yévenes Huaiquinao SR, Rodríguez Álvarez CJ. Alergias en la atención dental. Odontol Sanmarquina [Internet]. 2020 Sep. 28 [cited 20/04/2024]; 23(4): 435-43. Available from: https://revistasinvestigacion.unmsm.edu.pe/index.php/odont/article/view/17927

10. Téllez-Peña DM, Martínez-González ME, Andrade-Caballero A. Intoxicación sistémica por anestésicos locales. Rev Mex Anest [Internet]. 2022 [cited 20/04/2024]; 45(3): 207-211. Disponible en: https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=105596

11. Issrani R, Prabhu N, Bader AK, Alfayyadh AY, Alruwaili KK, Alanazi SH, et al. Exploring the properties of formocresol in dentistry-a comprehensive review. J Clin Pediatr Dent [Internet]. 2023 May [citado 20/04/2024]; 47(3): 1-10. Disponible en: https://pubmed.ncbi.nlm.nih.gov/37143417/

12. Marín Botero ML, Gómez Gómez B, Cano Orozco AD, Cruz López S, Castañeda Peláez DA, Castillo Castillo EY. Hipoclorito de sodio como irrigante de conductos. Caso clínico, y revisión de literatura. Avances en Odontoestomatología [Internet]. 2019 [Citado 20/04/2024]; 35(1): 33-43. Disponible en: https://dx.doi.org/10.4321/s0213-12852019000100005

13. Gómez Botia K, Quesada Maldonado E, Fang Mercado L, Covo Morales E. Accidente con hipoclorito de sodio durante la terapia endodóntica. Rev Cubana Estomatol [Internet]. 2018 [Citado 20/04/2024]; 55(2): 29-35. Disponible en: https://revestomatologia.sld.cu/index.php/est/article/view/1492

14. Marto CM, Baptista Paula A, Nunes T, Pimenta M, Abrantes AM, Pires AS, et al. Evaluation of the efficacy of dentin hypersensitivity treatments-A systematic review and follow-up analysis. J Oral Rehabil [Internet]. 2019 Oct [Citado 20/04/2024]; 46(10):952-990. Disponible en: https://pubmed.ncbi.nlm.nih.gov/31216069/

15. Poli PP, de Miranda FV, Polo TOB, Santiago Júnior JF, Lima Neto TJ, Rios BR, et al. Titanium Allergy Caused by Dental Implants: A Systematic Literature Review and Case Report. Materials (Basel) [Internet]. 2021 Sep 12 [Citado 20/04/2024]; 14(18):5239. Disponible en: https://pubmed.ncbi.nlm.nih.gov/34576463/

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2024; 28(S2): e6605

16. Edibam NR, Lorenzo-Pouso AI, Caponio VCA. Self-reported allergy to penicillin and clindamycin administration may be risk factors for dental implant failure: A systematic review, meta-analysis and delabeling protocol. Clin Oral Implants Res [Internet]. 2023 Jul [Citado 20/04/2024]; 34(7): 651-661. Disponible en: https://pubmed.ncbi.nlm.nih.gov/37102260/

17. Müller-Heupt LK, Schiegnitz E, Kaya S, Jacobi-Gresser E, Kämmerer PW, Al- Nawas B. Diagnostic tests for titanium hypersensitivity in implant dentistry: asystematic review of the literature. Int J Implant Dent [Internet]. 2022 Jul 11 [Citado 20/04/2024]; 8(1): 29. Disponible en: https://pubmed.ncbi.nlm.nih.gov/35819566/

18. Grosgogeat B, Vaicelyte A, Gauthier R, Janssen C, Le Borgne M. ToxicologicalRisks of the Cobalt-Chromium Alloys in Dentistry: A Systematic Review. Materials (Basel) [Internet]. 2022 Aug 23 [Citado 20/04/2024]; 15(17):5801. Disponible en: https://pubmed.ncbi.nlm.nih.gov/36079183/

19. Allevi F, Fadda GL, Rosso C, Martino F, Pipolo C, Cavallo G, et al. Ttreament of Sinusitis Following Dental Implantation: A Systematic Review and Meta-Analysis. Am J Rhinol Allergy [Internet]. 2022 Jul [Citado 20/04/2024]; 36(4): 539-549. Disponible en: https://pubmed.ncbi.nlm.nih.gov/35244478/

20. Gul H, Ghaffar MA, Kaleem M, Khan AS. Hydroxyapatite, a potent agent to reduce dentin hypersensitivity. J Pak Med Assoc [Internet]. 2021 Nov [Citado 20/04/2024]; 71(11): 2604-2610. Disponible en: https://pubmed.ncbi.nlm.nih.gov/34783744/

21. Lajolo C, Leso V, Gioco G, Patini R, Fedele M, Giuliani M, et al. Chemical hazard for dental hygienists: a systematic review. Eur Rev Med Pharmacol Sci [Internet]. 2019 Sep [Citado 20/04/2024]; 23(18): 7713-7721. Disponible en: https://pubmed.ncbi.nlm.nih.gov/31599397/

22. Sayed ME. The Effect of Dentine Desensitizing Agents on the Retention of Cemented Fixed Dental Prostheses: A Systematic Review. Medicina (Kaunas) [Internet]. 2023 Mar 6 [Citado 20/04/2024]; 59(3): 515. Disponible en: https://pubmed.ncbi.nlm.nih.gov/36984516/

23. Kim JS, Choi SM, Yoon JH, Lee EJ, Yoon J, Kwon SH, et al. Prevalence of Titanium Hypersensitivity in Patients with Titanium Implants: A Systematic Review and Meta-analysis. J Pharm Bioallied Sci [Internet]. 2021 Nov [Citado 20/04/2024]; 13(Suppl2): S1345-S1349. Disponible en: https://pmc.ncbi.nlm.nih.gov/articles/PMC8686894/

24. Li J, Hua F, Xu P, Huang C, Yang H. Effects of Desensitizers on Adhesive- Dentin Bond Strength: A Systematic Review and Meta-analysis. J Adhes Dent [Internet]. 2021 [Citado 20/04/2024]; 23(1): 7-19. Disponible en: https://pubmed.ncbi.nlm.nih.gov/33512112/

25. Lu W, Qi G, Ding Z, Li X, Qi W, He F. Clinical efficacy of acellular dermal matrix for plastic periodontal and implant surgery: a systematic review. Int J Oral Maxillofac Surg [Internet]. 2020 Aug [Citado 20/04/2024]; 49(8): 1057-1066. Disponible en: https://pubmed.ncbi.nlm.nih.gov/31889581/