Research, Society and Development, v. 11, n. 9, e52011932054, 2022
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v11i9.32054

The benefits of semi-direct technique and bioactive materials for dental restorative treatment of irradiated oral oncology patient

Os benefícios da técnica semi-direta e dos materiais bioativos para o tratamento restaurador odontológico de paciente oncológico oral irradiado

Los beneficios de la técnica semidirecta y de los materiales bioactivos para el tratamiento restaurador dental del paciente oncológico oral irradiado

Received: 06/22/2022 | Reviewed: 07/02/2022 | Accept: 07/08/2022 | Published: 07/17/2022

Giovanna Speranza Zabeu
ORCID: https://orcid.org/0000-0001-5044-6690
University of São Paulo, Brazil
E-mail: giovanna.zabeu@gmail.com
Letícia Ferreira Freitas Brianezzi
ORCID: https://orcid.org/0000-0002-9488-9140
University of São Paulo, Brazil
E-mail: leticia.brianezzi@hotmail.com
Marina Ciccone Giacomini
ORCID: https://orcid.org/0000-0002-9886-7264
University of São Paulo, Brazil
E-mail: mary_giacomini@hotmail.com
Marilia Mattar de Amoedo Campos Velo
ORCID: https://orcid.org/0000-0001-7841-9459
University of São Paulo, Brazil
E-mail: mariliavelo@yahoo.com.br
Paulo Sérgio da Silva Santos
ORCID: https://orcid.org/0000-0002-0674-3759
University of São Paulo, Brazil
E-mail: paulosss@fob.usp.br
Linda Wang
ORCID: https://orcid.org/0000-0001-6308-2769
University of São Paulo, Brazil
E-mail: wang.linda@usp.br

Abstract
Patients who undergo radiotherapy for head-and-neck cancer usually present oral complications that impair their quality of life. This clinical case presents the advantage of using a semi-direct technique with bioactive materials to restore compromised posterior teeth by dental professionals who participate as members of the oncology network support team to provide long-lasting treatment in a shorter time. Post-radiotherapy patients presented several oral challenges, including the presence of radiation-induced caries. In addition, the left maxillary second premolar showed unsatisfactory class II restoration. For radiation caries lesions, glass-ionomer cement restorations were performed. For the unsatisfactory class II restorations, semi-direct technique using resin composite was used. Glass ionomer-based restorations offer appropriate marginal adaptation and reduced sensitivity. For the semi-direct restorations, adequate anatomical contour, contact point, and occlusal contact were achieved using relevant clinical parameters. For patients who have had head-and-neck radiotherapy, restoration of affected teeth is relevant for improving their dental function to avoid malnutrition and to recover their quality of life, including esthetics and self-esteem. This semi-direct procedure reduced chairside time, which is beneficial also for the professionals. Using bioactive materials and person-centered care concept, technical and long-term benefits can be achieved.
Keywords: Dental caries; Head and neck neoplasms; Radiotherapy; Dental restoration permanent; Case management.

Resumo
Pacientes submetidos à radioterapia para câncer de cabeça e pescoço geralmente apresentam complicações bucais que prejudicam sua qualidade de vida. Este caso clínico apresenta a vantagem de utilizar uma técnica semi-direta com materiais bioativos para restaurar dentes posteriores comprometidos por profissionais de odontologia que participam como membros da equipe de apoio da rede oncológica para proporcionar um tratamento duradouro em menor tempo. Os pacientes pós-radioterapia apresentaram vários desafios orais, incluindo a presença de cárie induzida por radiação. Além disso, o segundo pré-molar superior esquerdo apresentava restauração classe II insatisfatória. Para lesões de

cárie de radiação, restaurações de cimento de ionômero de vidro foram realizadas. Para as restaurações classe II insatisfatórias, foi utilizada a técnica semi-direta com resina composta. As restaurações à base de ionômero de vidro oferecem adaptação marginal adequada e sensibilidade reduzida. Para as restaurações semi-diretas, o contorno anatômico adequado, ponto de contato e contato oclusal foram alcançados usando parâmetros clínicos relevantes. Para pacientes que fizeram radioterapia de cabeça e pescoço, a restauração dos dentes afetados é relevante para melhorar sua função dentária, evitar a desnutrição e recuperar sua qualidade de vida, incluindo estética e auto-estima. Esse procedimento semi-direto reduziu o tempo de consultório, o que também é benéfico para os profissionais. Usando materiais bioativos e conceito de cuidado centrado na pessoa, benefícios técnicos e de longo prazo podem ser alcançados.
Palavras-chave: Cárie dentária; Neoplasias de cabeça e pescoço; Radioterapia; Restauração dentária permanente; Administração do caso.

Resumen

Los pacientes que se someten a radioterapia por cáncer de cabeza y cuello suelen presentar complicaciones orales que deterioran su calidad de vida. Este caso clínico presenta la ventaja de utilizar una técnica semidirecta con materiales bioactivos para restaurar dientes posteriores comprometidos por profesionales de la odontología que participan como miembros del equipo de apoyo de la red de oncología para brindar un tratamiento duradero en un menor tiempo. Los pacientes posradioterapia presentaron varios desafíos orales, incluida la presencia de caries inducida por la radiación. Además, lo segundo premolar superior izquierdo mostraba restauracion de clase II insatisfactoria. Para las lesiones de caries por radiación, se realizaron restauraciones con cemento de ionómero de vidrio. Para las restauraciones de clase II insatisfactorias, se utilizó una técnica semidirecta con resina compuesta. Las restauraciones a base de ionómero de vidrio ofrecen una adaptación marginal adecuada y una sensibilidad reducida. Para las restauraciones semidirectas, se lograron un contorno anatómico, un punto de contacto y un contacto oclusal adecuados utilizando parámetros clínicos relevantes. Para los pacientes que han recibido radioterapia de cabeza y cuello, la restauración de los dientes afectados es relevante para mejorar su función dental para evitar la desnutrición y recuperar su calidad de vida, incluida la estética y la autoestima. Este procedimiento semidirecto redujo el tiempo de consulta, lo que también es beneficioso para los profesionales. Utilizando materiales bioactivos y un concepto de cuidado centrado en la persona, se pueden lograr beneficios técnicos y a largo plazo.
Palabras clave: Caries dental; Neoplasias de cabeza y cuello; Radioterapia; Restauración dental permanente; Manejo de caso.

1. Introduction

Oral cancer patients who undergo radiotherapy frequently experience significantly compromised oral health as a consequence once the radiation used for cancer treatment modifies the biological tissues. The severity depends on the dose and frequency of the radiotherapy (Madrid Troconis et al., 2017; Velo et al., 2018). Mucositis, hyposalivation, and dysfunctions such as dysphagia, are the most common adverse effects that compromise the patient's quality of life. One of the more severe consequences relies on the significant impact on eating and swallowing, resulting in malnutrition (Samim et al., 2016; de Melo et al., 2018; Tanaka, Kellesarian, 2018). Malnutrition affects the overall systemic condition of patients who undergo oncologic treatment (Lee et al., 2016).

Dentally, the literature has provided consistent evidence that radiotherapy, directly and indirectly, affects the patient's oral condition. In particular, radiation promotes important alterations to the arrangement and content of the mineral crystals (Madrid Troconis et al., 2017; Madrid et al., 2017; Campos Velo et al., 2017; Velo et al., 2018). These modifications are further exacerbated by changes in the organic components (Madrid Troconis et al., 2017; Madrid et al., 2017; Lopes et al., 2021).

As patients with radiated-caries lesions are generally less tolerant to prolonged appointments owing to local and systemic issues, short clinical sessions are more appropriate. To achieve successful results, dental professionals should consider not only the long-term adequate performance of the treatment provided, but also the chairside time. For patients who have undergone head-and-neck radiotherapy, short chairside time is necessary. This treatment option fits well with the concept of person-centered care that focuses on specific patient relevance, thereby motivating patients to comply and collaborate in the recovery process. This, in turn, contributes to overall long-lasting treatment (Lee et al., 2018).

Therefore, oral rehabilitation including the restoration of the affected areas is of utmost importance because teeth are involved in the processes of mastication, speech, and the patient's self-esteem. Evidence suggests that the restorative material of choice depends on the affected dental region and the severity of the condition. For the cervical area, glass-ionomer-based materials are the material of choice (Celik et al., 2019; de Lima Navarro e al., 2021). For the posterior teeth, more resistant materials are preferable because of the load applied during jaw movements (Lynch et al., 2014).

Resin composites are most effective for the dental treatment of posterior teeth (Spreafico et al., 2005). Currently, there are numerous categories of resin composites and techniques available, which cater to different clinical situations. More recently, the development of bioactive materials for different dental indications is promissory of more effective dental treatment options (Fujimoto et al., 2010; Kitagawa et al., 2018).

The semi-direct resin composite technique is performed outside the patient's mouth and therefore reduces clinical time and patient discomfort. In this technique, the tooth preparation is performed, and the resin restoration is made on a semi-rigid, fast setting impression. The resin composite is polymerized extra-orally. The prefabricated resin restoration is then cementation in the patient's mouth (Alharbi et al., 2014; Nandini, 2010). This method has the advantage of reducing the clinical time and pre-polymerization increases the mechanical properties of the resin composite (Nandi, 2010; Wendt Jr, 1991). Clinical studies using this technique for anterior and posterior teeth showed improvements in marginal adaptation, greater control over moisture, and reducing stress generated by polymerization shrinkage of the resin composite (Spreafico, 1996; Caneppele et al., 2020).

Direct techniques are simple and effective. However, the operative steps usually require a longer time than what can be tolerated by these patients, despite the technical advantages of the semi-direct techniques, even this strategy likely will be completed over two shorter appointments. Herein, we discuss the dental treatment approach used for a patient who had radiation treatment for head-and-neck cancer and presented with severe dental problems, which led to other limitations.

2. Methodology

This article is a clinical case report with descriptive purposes. In addition to this description, this work presents and discusses the general aspects about the importance, indication, applicability, and clinical conduction of a semi-direct restoration in a patient undergoing radiotherapy due to head-and-neck cancer. The patient signed the Free and Informed Consent Term for photography and dissemination of clinical steps.

3. Case Presentation

A 58-year-old man was referred to the Clinical Research Center of Bauru School of Dentistry (University of São Paulo, Bauru, SP, Brazil) for oral health management during head-and-neck cancer treatment. Anamnesis and examinations revealed no surgical intervention required for oropharyngeal squamous cell carcinoma treatment (CEC T3N2M). Radiotherapy and chemotherapy were administered. Regarding the radiotherapy, the patient underwent 35 sessions, totalizing 70 Gy, as well as a boost dose of 50 Gy to the surrounding area. The patient also had 3 cycles of chemotherapy. Moreover, the patient reported being addicted to alcoholic drinks and smoking and continued to consume two tins of beer and one pack of cigarettes daily.

A dental examination was performed during the patient's six-month post-radiotherapy review. Clinically, dry oral mucosa, hyposalivation, and missing teeth were noted. The anterior teeth presented cavitated lesions of darkened brown color, affecting the incisal and cervical regions, and extending mainly to the buccal surfaces (Figures 1A and 1B). In the cervical area, these lesions had a soft consistency. In the incisal areas, the lesions were dark and had a harder consistency.

An unsatisfactory Class II MOD resin composite restoration of the left maxillary second premolar was detected (Figure 1C). In addition, the dental tissues showed exogenous pigmentation induced by smoking. A thick mature biofilm was also noted (Figures 1A and 1B).

Figure 1. Initial oral health condition. A- General clinical overview of the dental situation showing gingival inflammation, exogenous pigmentation by cigarettes, and biofilm accumulation. Also, cervical carious lesions are especially notable in the mandibular teeth. B- Incisal areas show a dark brown color and hard dental tissue. C- The failed resin composite Class II MOD restoration at #25.

Font: Authors.

Restorative treatment

The treatment plan included preventive measures, selective removal of radiation carious tissues, and definitive restoration of the affected teeth (Schwendicke et al., 2016). Since patients undergoing radiotherapy are susceptible to osteoradionecrosis, the use of rubber dam must be avoided to minimize trauma to the hard and soft tissues. As mentioned, the patient's inability to tolerate lengthy dental appointments should be considered.

In our patient, the restorative material of choice for the cervical radiation caries was the resin-modified glass-ionomer cement (RMGIC- Vitremer, 3M/ESPE, St. Paul, MN, USA).

For the left maxillary second premolar (#25), which was more severely compromised, a semi-direct technique using resin composite was planned.

After periodontal treatment, shade selection was performed. For the treatment of the carious lesions in the right maxillary first molar (#14), right maxillary second molar (#15), left mandibular lateral incisor (#32), left mandibular canine (#33), right mandibular lateral incisor (#42), right mandibular canine (#43), and right mandibular first molar (#44), carious tissues were selectively removed with compatible-sized steel drills and finished with manual instruments (Figure 2A). After cavity cleaning, the RMGIC primer was applied using a microbrush following the manufacturer's instructions and light-cured for 20 s (DBD 686 D700 – Dabi Atlante, Ribeirão Preto, SP, Brazil).

During the restorative procedure, a polyester strip was used to avoid cervical and proximal excess (Figure 2B). RMGIC was placed into the cavity using a commercial delivery system (Centrix, Shelton, CT, USA) to minimize air incorporation (Figure 2B). The strip was carefully removed. The restoration design was adjusted and then, the RMGIC was polymerized with a light-curing unit for 40s.

The excess restorative material was removed with a flame-shaped carbide finishing bur (KG Sorensen Ind. e Com. Ltda., Barueri, SP, Brazil), and the restoration was contoured using Pop-on Contouring Flex discs (3M/ESPE, St. Paul, MN, USA). After one week, the restoration was polished with silicon cups impregnated with aluminum oxide (Enhance, Dentsply/Sirona, York, PA, USA), followed by a silicon carbide brush (Occlubrush, Kerr, Joinville, SC, Brazil). The final

restoration is shown in Figure 2C.

Figure 2. Restorative procedures for the cervical buccal areas are exemplified in the tooth 33. A- Selective carious tissue removal with a steel drill at slow speed rotations. B- Polyester strip positioned to avoid cervical and proximal excess, and RMGIC placed with the Centrix delivery system. C- The final restoration.

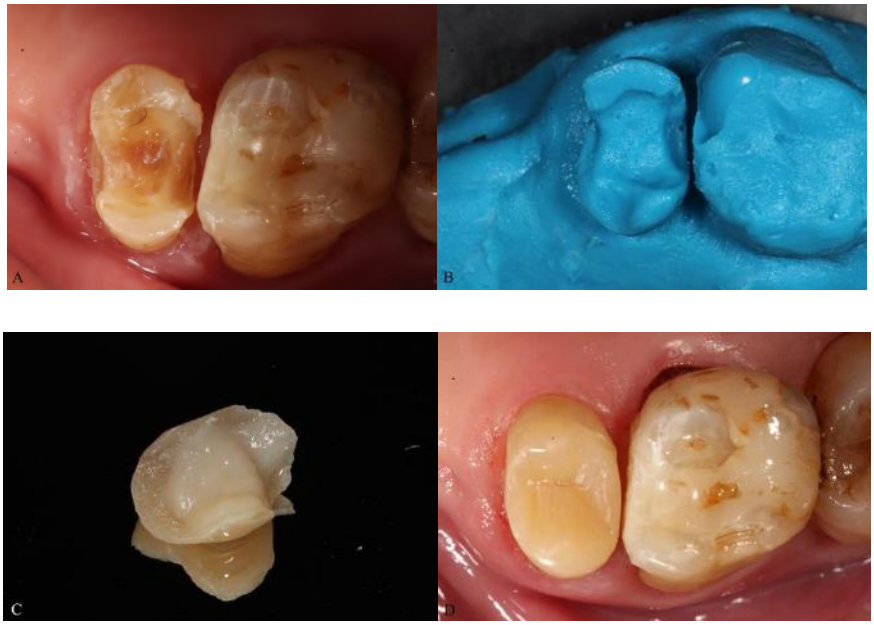
Font: Authors.

For the semi-direct technique, the failed restoration was first removed, and the remaining tooth structure was prepared using a spherical diamond bur (FG 1014, KG Sorensen Ind. e Com. Ltda., Barueri, SP, Brazil). An onlay preparation was performed using conical diamond tips (FG 4138 and FG 3131, KG Sorensen Ind. e Com. Ltda., Barueri, SP, Brazil). The tooth preparation featured a slightly divergent shape and sufficient space for the restorative material (Figure 3A). An impression of the tooth preparation was made using condensation silicone (Zetalabor, Zhermack, São Paulo, SP, Brazil). A mold was created with the same material to obtain a semi-rigid model (Figure 3B). The restoration was prepared over this model with resin composites (Beautifil A3 and A3O, for enamel and dentin, respectively; Shofu, Kyoto, Japan), as shown in Figure 3C.

During the subsequent appointment, the semi-direct restoration was cemented with a self-adhesive resin cement (BeautiCEM SA, Shofu, Kyoto, Japan- Ivory shade). The resin composite restoration was prepared for cementation using aluminum oxide sandblasting. A pumice stone slurry was used for cleaning the tooth. Initially, the semi-direct restoration was positioned in the prepared tooth to assess the marginal adaptation and occlusal surface. As the patient had several teeth missing, which changed in the positions of his teeth, it was not possible to create interdental contact with the first molar. We had planned to restore the interdental contact by restoring the first molar, but the patient did not attend his follow-up visits.

Excesses of resin composites were removed from the restoration using a flame-shaped carbide finishing bur (KG Sorensen Ind. e Com. Ltda., Barueri, SP, Brazil), and Pop-on Contouring Flex discs (3M/ESPE, St. Paul, MN, USA). Polishing procedures were performed using silicon cups impregnated with aluminum oxide (Enhance, Dentsply/Sirona, York, PA, USA) followed by a silicon carbide brush (Occlubrush, Kerr, Joinville, SC, Brazil). The occlusion was tested with articulating paper, and proximal contact with dental floss. The final resin composite restoration is shown in figure 3D.

Figure 3. Operative sequence of the semi-direct resin composite restoration. A- Final appearance of the tooth after onlay preparation. B- Flexible model made with condensation silicone. C- The final restoration. D- The final restoration after adhesive cementation, and occlusal and proximal adjustments.



Font: Authors.

4. Discussion

The holistic care approach aims to offer the patient a complete and integrated management plan. As such, oral health must not be overlooked, especially for vulnerable patients (Lee et al., 2016; Lee et al., 2018). To guarantee satisfactory nutritional conditions, preserving dental structures and maintaining healthy mucosa conditions are both essential. For patients who have undergone head-and-neck cancer treatment, efforts to rehabilitate compromised dental and oral tissues are relevant and important (Samim et al., 2016; de Melo et al., 2018; Sroussi et al., 2018).

These patients experience more discomfort during appointments due to difficulties in maintaining in position and keeping the mouth open for a long time (Sroussi et al., 2018). Dental professionals must be aware of all the possible protocols that can be applied, but at the same time respect the patient's limitations. The semi-direct technique is a feasible and reliable dental treatment for these patients (Spreafico, 1996; Alharbi et al., 2014). The restoration is constructed outside of the mouth; therefore, a shorter chairside time is possible. This is advantageous for the patient.

Another possible complication in patients undergoing cancer treatment is the risk of osteoradionecrosis of the jaw. Osteoradionecrosis is radiation-induced necrotic bone ischemia associated with soft tissues (Rice et al., 2015). The change may occur spontaneously and may be exacerbated after trauma in the region (Rice et al., 2015). Despite few studies, there are reports in the literature on the use of staples during rubber dam placement associated with the appearance of ulcerative lesions in patients undergoing oncologic treatment (Gallego et al., 2011). Thus, the semi-direct technique is preferable as it only requires the restoration to be cemented, thus alleviating the need for a rubber dam.

The literature also states that the properties of the restorative material are enhanced by this semi-direct technique which facilitates improved marginal and proximal contacts. Better adaptation is a clinical advantage (Llena Puy et al., 1993; Aggarwal et al., 2008). In addition to the advantage of optimizing the anatomical features of the restoration using the semi-direct technique, other benefits include better control over polymerization shrinkage. To achieve satisfactory clinical outcomes,

protocols that can minimize polymerization shrinkage and optimize the thinness of the cement layer are important. (Wendt Jr., 1991; Spreafico et al., 2005; Nandini, 2010; Alharbi et al., 2014)

The use of bioactive materials such as glass-ionomer cements for general cervical lesions and the use of materials such as the giomer technology developed by Shofu can enhance the quality of dental restorations (Fujimoto et al., 2010; Kitagawa et al., 2018). In particular, giomers were developed with S-PRG (surface pre-reactive glass) particles (Fujimoto et al., 2010; Kaga et al., 2014; Kitagawa et al., 2018). These fillers can release multiple ions, especially under acidic and unfavorable conditions (Kaga et al., 2014; Bergantin et al., 2022). As patients undergoing head-and-neck radiation suffer from hyposalivation, the correct management combined with the use of ideal bioactive materials can improve patient outcomes and provide long-lasting performance. Among these ions, strontium and fluoride can reinforce the tooth structure by creating strontium-apatite and fluorapatite.

Contemporary dental approaches can benefit from new materials and techniques. There are many available techniques, including intraoral (tooth to be restored is isolated and used as a die) and extraoral (alginate impression is combined with a fast-setting silicon model) modes, in addition to the technique applied in the present case.

This case report was limited by the patient being lost to follow-up. He did not return our calls. It is not uncommon, particularly when patients have financial difficulties, making it difficult to manage post-radiotherapy treatment needs (Nayak et al., 2017). Symptoms of depression among cancer patients have also been reported in the literature (Nayak et al., 2017), which may have reduced the patient's interest in dental procedures. In our case, it was not possible to follow-up on the long-term outcomes. It seems reasonable to report these situations so that professionals can be aware of these additional challenges. Our case report may be helpful to practitioners by suggesting reliable materials and techniques to increase the chances of successful patient management.

Despite the limitations, this case highlights the person-centered care approach combined with the use of bioactive materials and appropriate techniques for improving the patient’s quality of life. We strongly recommend the semi-direct technique as a relevant restorative strategy for oncology patients. The shorter chairside time is of particular benefit to patients suffering from mucositis and dry mouth (Lee et al., 2018; Sroussi et al., 2018). The limitation of the case was the loss of contact with the patient for follow-ups. New clinical studies will be of great relevance to the knowledge of the longevity of restorative treatment.

5. Conclusion

Dental treatment is commonly neglected by unaware professionals. To enhance overall health and achieve excellence in patient care, it is extremely relevant to look for strategies that enable distinctive management. The impact on quality of life must not be ignored, even when considering chair time. Taken together, complete health can be reached. For patients who have undergone head-and-neck radiotherapy, dental care requires more specific actions during appointments, to achieve a satisfactory long-term outcome.

Acknowledgments

This work was supported by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

References

Aggarwal, V., Logani, A., Jain, V., & Shah, N. (2008). Effect of cyclic loading on marginal adaptation and bond strength in direct vs indirect class II MO composite restorations. Oper Dent, 33(5), 587-592.

Alharbi, A., Rocca, G. T., Dietschi, D., & Krejci, I. (2014). Semidirect composite onlay with cavity sealing: a review of clinical procedures. J Esthet Restor Dent, 26(2), 97-106.

Bergantin, B. T. P., Di Leone, C. C. L., Cruvinel, T., Wang, L., Buzalaf, M. A. R., Borges, A. B., Honório, H. M., & Rios, D. (2022). S-PRG-based composites erosive wear resistance and the effect on surrounding enamel. Sci Rep, 17(1), 12:833.

Campos Velo, M. M. A., Farha, A. L. H., da Silva Santos, P. S., Shiota, A., Sansavino, S. Z., Souza, A. T. F., Honório, H. M., & Wang, L. (2017). Gamma radiation increases the risk of radiation-related root dental caries. Oral Oncol, 71, 184-185.

Caneppele, T. M. F., Meirelles, L. C. F., Rocha, R. S., Gonçalves, L. L., Ávila, D. M. S., Gonçalves, S. E. P., & Bresciani, E. (2020). A 2-year clinical evaluation of direct and semi-direct resin composite restorations in non-carious cervical lesions: a randomized clinical study. Clin Oral Investig, 24(3), 1321-1331.

Celik, E. U., Tunac, A. T., & Yilmaz, F. (2019). Three-year clinical evaluation of high-viscosity glass ionomer restorations in non-carious cervical lesions: a randomised controlled split-mouth clinical trial. Clin Oral Investig, 23(3), 1473-1480.

de Lima Navarro, M. F., Pascotto, R. C., Borges, A. F. S., Soares, C. J., Raggio, D. P., Rios, D., Bresciani, E., Molina, G. F., Ngo, H. C., Miletić, I., Frencken, J., Wang, L., Menezes-Silva, R., Puppin-Rontani, R. M., de Carvalho, R. M., Gurgan, S., Leal, S. C., Tüzüner, T., Fagundes, T. C., Nicholson, J. W. & Sidhu, S. K. (2021). Consensus on glass-ionomer cement thresholds for restorative indications. J Dent, 107, 103609.

de Melo, N. B., Bernardino, I. M., de Melo, D. P., Gomes, D. Q. C., & Bento, P. M. (2018). Head and neck cancer, quality of life, and determinant factors: a novel approach using decision tree analysis. Oral Surg Oral Med Oral Pathol Oral Radiol, 126(6), 486-493.

Fujimoto, Y., Iwasa, M., Murayama, R., Miyazaki, M., Nagafuji, A., & Nakatsuka, T. (2010). Detection of ions released from S-PRG fillers and their modulation effect. Dent Mater, 29(4), 393-397.

Gallego, L., Junquera, L., Pelaz, A., & Díaz-Bobes, C. (2011). Rubber dam clamp trauma during endodontic treatment: a risk factor of bisphosphonate-related osteonecrosis of the jaw? J Oral Maxillofac Surg, 69(6), e93-95.

Kaga, M., Kakuda, S., Ida, Y., Toshima, H., Hashimoto, M., Endo, K., & Sano, H. (2014). Inhibition of enamel demineralization by buffering effect of S-PRG filler-containing dental sealant. Eur J Oral Sci, 122(1), 78–83.

Kitagawa, H., Miki-Oka, S., Mayanagi, G., Abiko, Y., Takahashi, N., & Imazato, S. (2018). Inhibitory effect of resin composite containg S-PRG filler on Streptococcus mutans glucose metabolism. J Dent, 70, 92-96.

Lee, H., Chalmers, N. I., Brow, A., Boynes, S., Monopoli, M., Doherty, M., Croom, O., & Engineer, L. (2018). Person-centered care model in dentistry. BMC Oral Health, 18(1), 198

Lee, J. L. C., Leong, L. P., & Lim, S. L. (2016). Nutrition intervention approaches to reduce malnutrition in oncology patients: a systematic review. Support Care Cancer, 24(1), 469-480.

Llena Puy, M. C., Navarro, L. F., Faus Llacer, V. J., & Ferrandez, A. (1993). Composite resin inlays: a study of marginal adaptation. Quintessence Int, 24(6), 429–433.

Lopes, C. C. A., Rodrigues, R. B., Cenci, M. S., Uehara, J. L. S., Maske, T. T., Limirio, P. H. J. O., Soares, P. B. F., & Novais, V. R. (2021). Effect of ionizing radiation and cariogenic biofilm challenge on root-dentin caries. Clin Oral Investig, 25(6), 4059-4068.

Lynch, C. D., Opdam, N. J., Hickel, R., Brunton, P. A., Gurgan, S., & Kakaboura, A. (2014). Academy of Operative Dentistry European Section: guidance on the use of resin composites for direct restoration of posterior teeth. J Dent, 42(4), 377-383.

Madrid, C. C., de Pauli Paglioni, M., Line, S. R., Vasconcelos, K. G., Brandão, T. B., Lopes, M. A., Santos-Silva, A. R., & De Goes, M. F. (2017). Structural analysis of enamel in teeth from head-and-neck cancer patients who underwent radiotherapy. Caries Res, 51(2), 119-128.

Madrid Troconis, C. C., Santos-Silva, A. R., Brandão, T. B., Lopes, M. A., & de Goes, M. F. (2017). Impact of head and neck radiotherapy on the mechanical behavior of composite resins and adhesive systems: A systematic review. Dent Mater, 33(11), 1229-1243.

Nandini, S. Indirect resin composites. (2010). J Conserv Dent, 13, 184-194.

Nayak, M. G., George, A., Vidyasagar, M. S., Mathew, S., Nayak, S., Nayak, B. S., Shashidhara, Y. N., & Kamath, A. (2017). Quality of Life among Cancer Patients. Indian J Palliat Care, 23, 445-450.

Rice, N., Polyzois, I., Ekanayake, K., Omer, O. & Stassen, L. F. (2015). The management of osteoradionecrosis of the jaws--a review. Surgeon, 13(2), 101-109.

Samim, F., Epstein, J. B., Zumsteg, Z. S., Ho, A. S., & Barasch, A. (2016). Oral and dental health in head and neck cancer survivors. Cancers Head Neck, 19, 1-14.

Schwendicke, F., Frencken, J. E., Bjørndal, L., Maltz, M., Manton, D. J., Ricketts, D., Van Landuyt, K., Banerjee, A., Campus, G., Doméjean, S., Fontana, M., Leal, S., Lo, E., Machiulskiene, V., Schulte, A., Splieth, C., Zandona, A. F., & Innes, N. P. (2016). Managing carious lesions: consensus recommendations on carious tissue removal. Adv Dent Res, 28(2), 58-67.

Spreafico, R. Direct and semi-direct posterior composite restorations. (1996). Pract Periodontics Aesthet Dent, 8(7), 703-712.

Spreafico, R. C., Krejci, I., & Dietschi, D. (2005). Clinical performance and marginal adaptation of class II direct and semidirect composite restorations over 3.5 years in vivo. J Dent, 33(6), 499-507.

Sroussi, H. Y., Jessri, M., & Epstein, J. (2018). Oral Assessment and Management of the Patient with Head and Neck Cancer. Oral Maxillofac Surg Clin North Am, 30(4), 445-458.

Tanaka, A., & Kellesarian, S.V. (2021). Xerostomia and patients' satisfaction with removable denture performance: systematic review. Quintessence Int, 52(1), 46–55.

Velo, M. M. A. C., Farha, A. L. H., da Silva Santos, P. S., Shiota, A., Sansavino, S. Z., Souza, A. T., Honório, H. M., & Wang, L. (2018). Radiotherapy alters the composition, structural and mechanical properties of root dentin in vitro. Clin Oral Investig, 22(8), 2871-2878.

Wendt Jr, S. L. (1991). Microleakage and cusp fracture resistance of heat-treated composite resin inlays. Am J Dent, 4(1), 10–12.