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Giomer technology for preventive and restorative clinical management of erosive tooth wear: a case report

Tecnologia Giomer para manejo clínico preventivo e restaurador de desgaste dentário erosive: relato de caso

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ABSTRACT

Increasing prevalence of erosive tooth wear (ETW) is notable mainly due to current knowledge and its early diagnosis. Once teeth are functionally and/or esthetically affected, dental restorations may become necessary. Materials capable of interacting with the eroded dental tissue allied to their resistance to subsequent continuous erosive challenges are desirable. Giomer technology based on S-PRG (surface pre-reactive glass) filler has been launching to provide benefits for the dental treatment due to its innovative multi-ionic release system, which involves fluoride. This case report describes the employment of preventive and restorative materials based on this technology for a patient under frequent erosive challenges and complaining about dental sensitivity. Patient reported immediate reduction on this sensitivity and the restorations has been followed up for 2 years, presenting satisfactory performance. S-PRG-based systems seem to be promissory for preventive and therapeutic management of ETW used simultaneously with the patient compliance.

KEYWORDS

Biocompatible materials; Dental restoration; Smart polymer; Tooth erosion.

RESUMO

O aumento da prevalência do desgaste dentário erosivo (DDE) é notável especialmente devido ao conhecimento atual e seu diagnóstico precoce. Uma vez que os dentes são afetados funcional e/ou esteticamente, restaurações dentárias se tornam necessárias. Materiais focados na habilidade de interagir com o tecido dentário erodido associados com sua resistência aos desafios erosivos contínuos subsequentes são desejáveis. A tecnologia Giomer baseada em partículas S-PRG (superfície de vidro pré-reativo) foi lançada no mercado para oferecer benefícios para o tratamento odontológico devido ao seu sistema inovador de liberação multi-iônica, que envolve o flúor. Esse caso clínico descreve o uso de materiais preventivo e restaurador baseados nessa tecnologia em um paciente em desafio erosivo e com queixa de sensibilidade. O paciente relatou redução imediata da sensibilidade e as restaurações foram acompanhadas por 2 anos apresentando desempenho satisfatório. Sistemas baseados em S-PRG se mostram promissores para manejo preventivo e terapêutico do DDE empregados simultaneamente à colaboração do paciente.

PALAVRAS-CHAVE

Materiais biocompatíveis; Restaurações dentárias; Polímeros inteligentes; Erosão dentária.

INTRODUCTION

The prevalence of erosive tooth wear (ETW) is increasing. Therefore, professionals must be aware about the historical data and clinical characteristics regarding this new demand to provide correct diagnosis to support long-term satisfactory restorative approach [1-4].

Caries disbiose and erosion are clinical events determined from different etiologies, and so, their treatments may be sustained distinctly. Erroneously, most professionals still support the approach of ETW based on caries prevention [1]. The former involves a subsurface demineralization, while the latter occurs upon the external surface of the tooth. In this case, it is stated that intrinsic or extrinsic acid with no bacterial involvement contact the external surface on enamel and/or dentin. Based on a chemical process, these substrates are dissolved causing their softening In a second step, the wear is accelerated by mechanical factors as abrasion and attrition [5]. This successive mechanism expose continuously a new sublayer, if not stopped. This comprehension by the practitioners can address for specific clinical approaches based on the clinical signs and patient information [4,6,7].

ETW is a behavior-dependent condition regarding to the life style of the patient, mostly unaware by the patients. After professional instructing in respect to their main factors including diet and hygiene habits, it is also mandatory to determine their commitment level to offer appropriate choices for preventive and/or restorative dental material [1,2,6-8]

Resin composite-based materials are frequently used specially to treat young patients, allowing more conservative management [9]. Additionally, other advantages despite the bonding ability includes the variety of color shade options and their resistance compared to glass-ionomer based materials against acid-attacks, which make them more attractive [10,11].

Recently, new commercial materials advocating for bioactive potential have been launched for different approaches. Among them, Giomer technology based on S-PRG (surface pre-reactive glass) fillers has driven interesting perspectives [12]. These particular particles are organized in three laminar levels to offer more than fluoride releasing and remineralization abilities [13]. Imazato et al. [14] called it multiple ion-releasing glass filler based on a particle in which the releasing and reaction of these ions do not affect the core content of the filler. These particles can release and recharge F, Sr^{2+}, Na^{+}, $BO_3^{\ 3+}$, Al^{3+} and $SiO_3^{\ 2+}$. Therefore, their ability also seems to provide further possibilities rather than to remineralize the substrate [13,14]. The role of BO_3^{3+}, Al^{3+}, $SiO_3^{\ 2+}$ and Sr^{2+} can favor for antimicrobial potential, relief of dentin hypersensitivy, increase resistance to acid attacks and reinforce the surface, respectively, for instance [14,15].

Materials focusing on the ability to interact with dental tissue, as Giomer technology-based ones could provide benefits as stated by a clinical study over the 13-year period of follow-up, which indicated positive therapeutic effects from this material [15]. Therefore, as ETW causes the exposition of internal surface due to the loss of outer dental layers and the sensitivity if dentin is exposed, Giomer based on S-PRG fillers seems to be an interesting alternative to treat patients affected by different compromising levels of erosive attack. It is possible since S-PRG filler have Al^{3+} can promote dentin tubules obliteration, while SiO_3 is able to promote dentin remineralization in association to fluoride ions leading to remineralization and fluoride apatite formation.

The aim of this case report is to present the preventive/control or restorative approach using Giomer technology-based materials application in a young patient who suffered from ETW.

CASE REPORT

A 21-year-old male patient sought for dental treatment complaining about sensitivity on posterior teeth. He consented for treating planning and its divulgation. During the anamnesis, he reported harmful dietary habits, which clearly referee to high consumption of soft drink. Erosive wear with concavities with aspect of cuppings limited by round margins was detected around preexistent amalgam restorations on the occlusal surface of #36 and #37 (Figure 1A).

According to the treating planning, amalgam restoration would be replaced by resin composite filling, as it could involve the worn surface. Also, patient claimed for esthetics.

For both teeth, the amalgam restoration was removed through an initial access with

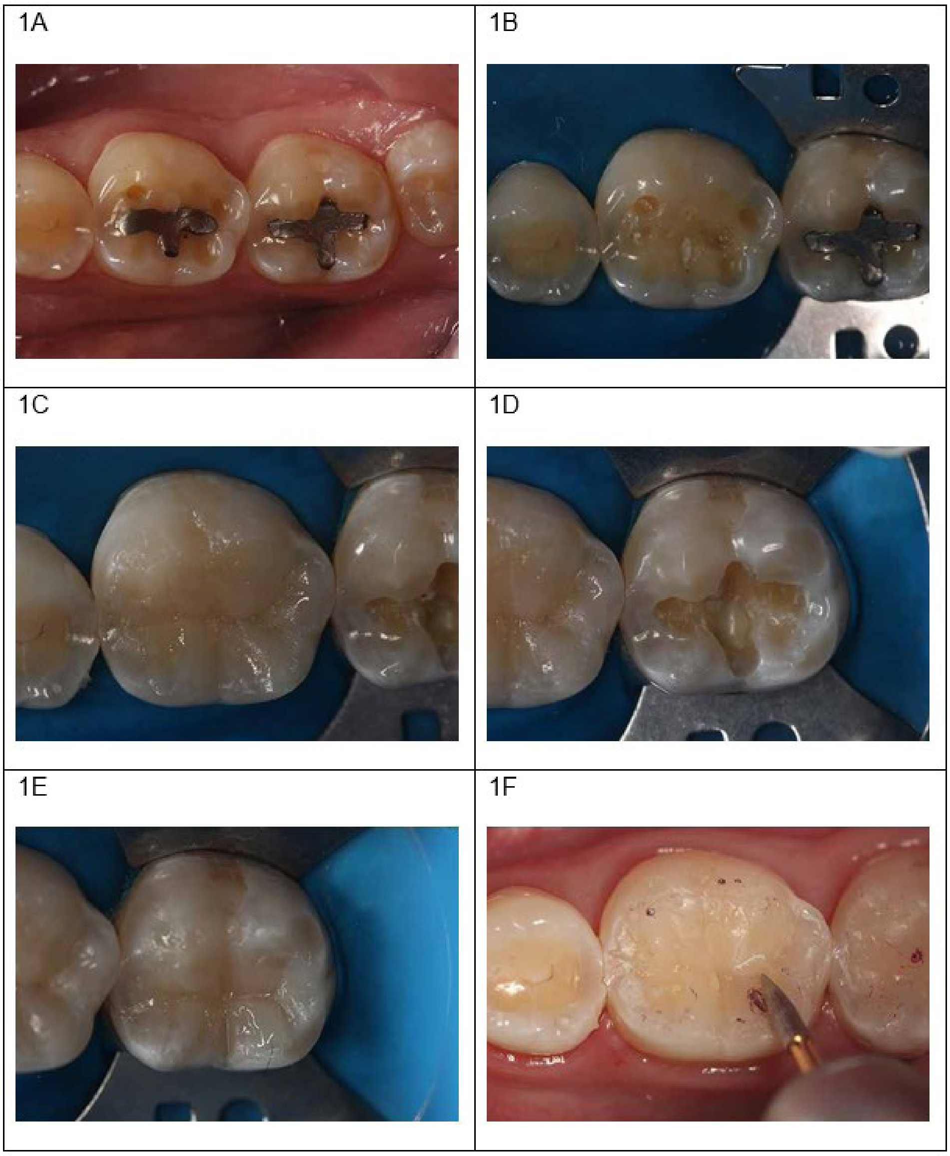

Figure 1. (1A) Initial aspect of amalgam restorations teeth #36 and #37; (1B) Final aspect of prepared cavity; (1C) Final aspect of restoration #36; (1D) Glass Ionomer Cement liner #37; (1E) Final aspect of restoration #37; (1F) Removal of excesses.

nº245 carbide bur (KG Sorensen, Cotia, SP, Brazil) in high rotation. All used materials for treatment are described in Table 1.

After finishing the cavities (Figure 1B), enamel margins were acid-etched for 15s with 37% phosphoric acid (Dentsply, São Paulo, SP, Brazil), followed by application of a self-etching dentin bonding system FL-Bond II (Shofu Inc., Kyoto, Japan). Then, the restorative procedure was conducted with increments of the Beautifil II composite (Shofu Inc., Kyoto, Japan), shade A2O for dentin and A2 for enamel, respectively. All the used materials present S-PRG. Final aspect is observed in Figure 1C. For #47, Vitrebond (3M/ESPE, St Paul, MN, USA) was used as liner (Figure 1D) and the final aspect of tooth 37 is presented in Figure 1E.

The occlusal contacts were checked with AccuFilm Carbon, (Parkell, New York, NY, USA) and the excess was removed with multi-fluted tungsten carbide burs (Figure 1F). After 7 days, fine adjustments were performed and the polishing was conducted.

At the 1-year follow up appointment, the patient reported sensitivity on maxillary anterior teeth. After examination, the presence of minimal surface loss was noted (Figure 2A). These surfaces were not restorable yet, but to refrain the progress of dental loss in advance, a mechanical barrier was applied, choosing the PRG Barrier Coat (Shofu Inc., Kyoto, Japan). Besides reducing dentin sensitivity, this polymeric barrier could function as a temporary strategy to prevent additional wear of the anterior teeth.

Table 1 - Composition of material used

Material	Composition	Category	Manufacturer
Phosphoric Acid[1]	Phosphoric acid 37%, Surfactant, Aerosil 200, Deionized water, Pigments	Etchant	Dentsply, São Paulo, SP, Brazil
Vitrebond[1]	Powder: Ion-leachable fluoroaluminosilicate glass powder Liquid: Polyacrylic acid, HEMA (2-Hydroxy Ethyl Methacrylate), Water, photoinitiator	Glass-Ionomer Liner	3M/ESPE, St. Paul, MN, USA
FL-Bond II[1]	Primer: Ethanol, Methacrylic adhesive monomer, Pure water, Others Adhesive: HEMA (2-Hydroxy Ethyl Methacrylate), SPRG - filler, UDMA (Urethane Dimethacrylate), TEGDMA (Triethylenglycol Dimethacrylate), Others	Self-etching Adhesive System	Shofu Inc., Kyoto, Japan
Beautifil II[1]	Bis-GMA (Bisphenol A Diglycidildimethacrylate), TEGDMA (Triethylenglycol Dimethacrylate), S-PRG filler, Al2O3, Camphorquinone, Others Hazardous ingredients are not included	Resin Composite	Shofu Inc., Kyoto, Japan
PRG Barrier Coat[2]	S-PRG fillers Polymeric fillers Water Carboxylic acid monomer, Phosphoric acid monomer Bis-MPEPP [2,2'bis (4-Methacryloxy Polyethoxy-phenyl) propane], TEGDMA (Triethylenglycol Dimethacrylate), Polymeric monomer and photoinitiator	Varnish	Shofu Inc., Kyoto, Japan

[1]Compositon according to the manufacturer; [2]Composition according to the Hosoya et al. [12].

Cleaning of surface was performed with water and pumice mixture. This PRG barrier coat system consists on separate parts (base and active) that were mixed according to the manufacturer's instructions, which was immediately applied on dental surfaces (Figure 2B). Proximal excess was removed with dental floss (Figure 2C) and light-cured for 10s. The patient reported an immediate hypersensitivity reduction and the final aspect of both faces is shown in figure 2D.

A follow up of the restorations was performed after 6 months (Figure 2E), 1 year (Figure 2F) and 2 years (Figure 2G). These restorations performed satisfactorily regarding marginal adaptation, secondary caries, anatomical form and postoperative sensitivity. It was observed a slight color alteration without compromising long-term performance, which did not bother the patient, who reported that had not noticed it. However, regarding the PRG Barrier coat, it is important to state that after 15 days, patient reported that this material layer was detached spontaneously after few weeks, which may be related to toothbrushing. However, no sensitivity was reported. After 2 months (Figure 2H), patient still declared not to have any discomfort. Also, patient reported to be aware on his dietary habits in this process and he was willing to control and reduce the ingestion of these erosive beverages. Periodical appointments still will be set to control.

DISCUSSION

For dental approaches, diagnosis and control of the disease of event is primary mandatory. Meanwhile, as a great variety of materials and strategies are available, they turn their selection a hard task for professionals. They may carefully consider the cost-benefit to the patients and drive for strategical uses, looking for more promissory performance overtime. In this scenario, giomer-based materials seem to be an interesting option. Previous laboratory and clinical studies have been supported their use as this multi-ionic technology acting as targeting properly according to the particular clinical challenge [12,15-17]. Therefore, this system can be effective in mostly circumstances.

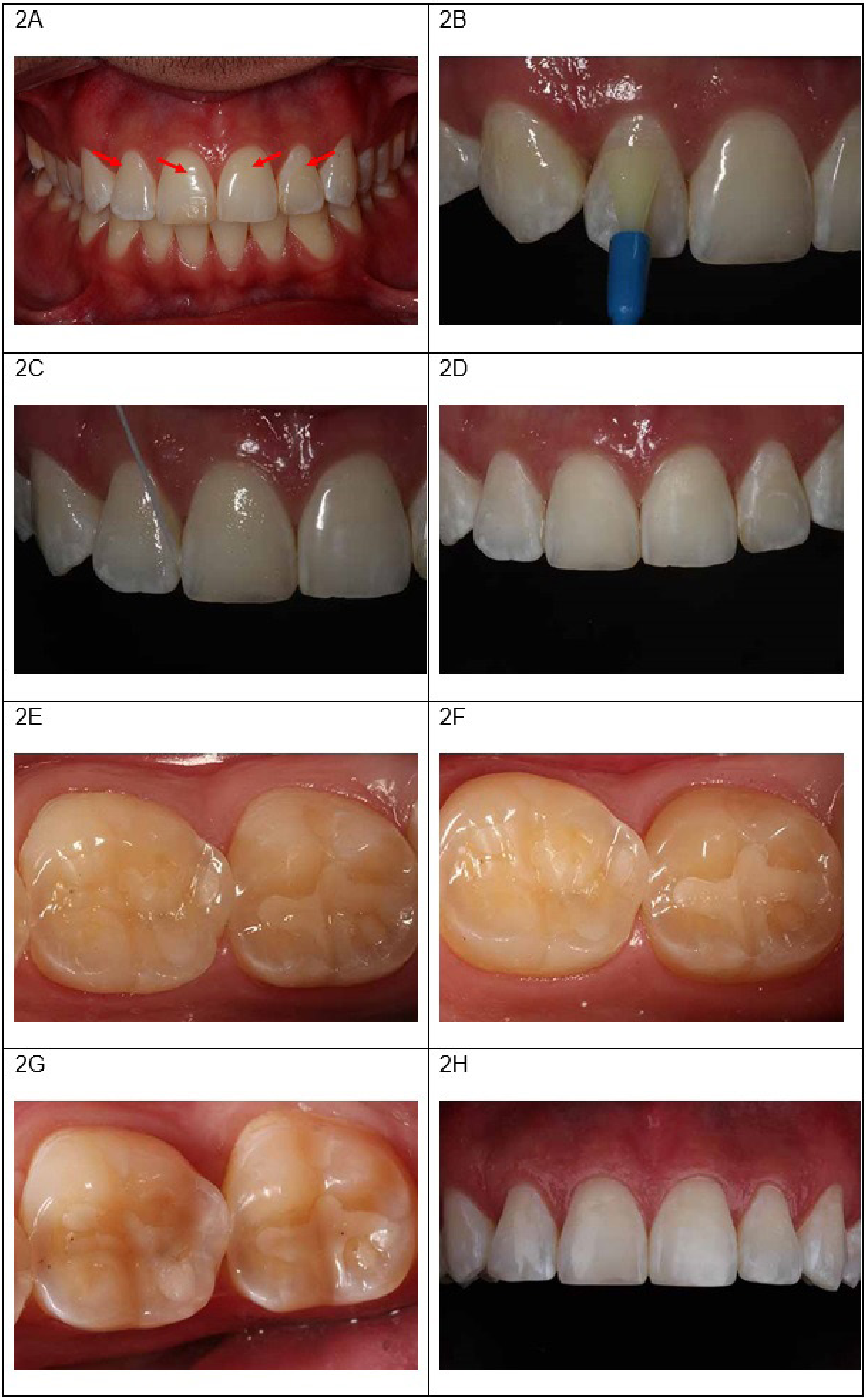

Figure 2. (2A) Erosive tooth wear evidence on buccal surface of the anterior teeth; (2B) PRG Barrier Coat application; (2C) Proximal excess removal; (2D) Final aspect; (2E/F/G) 6 months, 1-year and, 2-years, respectively, of restoration of teeth #36 and #37; (2H) 2-years follow-up of PRG Barrier Coat application.

Under erosive challenges, if it is not intercepted in early stages, the management will be more complex. In the severe cases, extensive mineral losses promote functional and esthetic issues causing dentin exposure, dental sensitivity, pulpal inflammation and decrease of the vertical dimension of occlusion [1,9].

Continuing exposure to acids causes physical properties changes of dental structure decreasing the enamel resistance [18,19]. Therefore, as patients do not refrain from their habits or disorders easily, the use of a bioactive material seems to be able to aid the dental properties and capable of protecting against new episodes of acid attack.

Among the current strategies, the S-PRG-based materials seem to provide conditions for preventive and restorative dental managements due to the benefits or their ion-rich resource [12,13]. In particular to erosive scenario, ts ability may favor the decrease acid production and neutralize acid on contact. The S-PRG filler also presents capacity to recover neutral pH in contact with acidic salivary fluids and stablish a buffer potential. Also, the release of certain ions, especially strontium and fluoride contribute to convert hydroxyapatite to fluoride apatite, improving the acid resistance of the teeth [14,15].

This case presents classical clinical signs of erosive lesions. Also, usually the concavities with round limits are noted close to the cusps of posterior teeth. Studies showed that the physical properties change in eroded enamel may affect enamel/restoration and dentin bonding interface. Hybrid layer on these substrates is superficial and irregular resulting in lower bond strength values [2,3]. Thus, as the dental surface is partially devoid of minerals, the organic content becomes more evident, which impairs in more complex challenge in terms of restoration durability. Previous investigations were effective to introduce new effective formulations for dental bonding as the use of functional monomers from self-etching dental systems [20]. These monomers chemically react with hydroxyapatite crystals. Giacomini et al. [3] showed through in situ study, that self-etching systems is not necessarily more effective than total-etching systems if enamel were also selectively conditioned. On the other hand, Giacomini et al. [7] demonstrated that erosive-affected dentin was quite vulnerable regarding the longevity on eroded dentin. Up to now, it is relevant to be aware of the possibility of more fragile interaction of these systems with the altered dental substrates. This is a reason to invest in solutions based on “smart systems” as S-PRG based-systems for instance; meanwhile the control of etiologic factors is always mandatory. The improvement of dentin bonding might be considered over time and the ions release should be taken into account. The Giomer technology must improve and reinforce collagen [21] leading to an adhesive interface more resistant through acid challenges. Fluoride ions role has been successfully proven, such as incorporated in glass-ionomer based materials. In resin composite-based materials it is still controversial since it depends on the mechanism of the involved technology. Therefore, the long-term evaluations of these categories of materials are welcome to sustain their use [15,22].

PRG Barrier coat, FL Bond II and Beautifill II resin composite (Shofu Inc., Kyoto, Japan) are Giomer materials. According to the manufacturer, S-PRG filler consists of a trilaminar structure (multifunctional fluoroboroaluminosilicate glass, a layer of pre-reacted glass-ionomer phase and a modified surface layer) [10]. This technology combined to composite resin allows conciliating the benefits of resin composites as physical and optical properties associated with fluoride release and recharge, biocompatibility. These properties favor the formation of an acid-resistant layer and reduction of tooth mineral solubility [10].

PRG Barrier Coat is a light-cured Giomer varnish originally indicated for remineralization and hypersensitivity relief [12]. As it forms a polymeric mechanical barrier, we indicated its use for patients with early loss of enamel, which makes it in an effective alternative to avoid ETW progression [23]. By the time, PRG barrier coat was detached, the most important discomfort was eliminated, since the patient did not report sensitivity anymore.

Regarding the use of FL Bond II, besides its a self-etching dentin bonding system, the most advantageous features seems to rely on its ability of be multiple ion-releasing system. The other ions might promote its reinforcement. Associated with a resin composite with the same technology, Beautifill II, they form a unique system. Condò et al. [24], investigated morphological and structural characteristics of Giomer-based products in which Beautfill II showed very similar behavior compared to the other restorative materials investigated that are considered materials as reliable parameters (Tetric, Dyract an Ketac). The restorations carried out using this material performed satisfactorily on posterior teeth over 3 years clinical follow-ups [21].

Further different studies targeting to investigate the possibilities of the applications of this bioactive system have been driven. Almeida Ayres et al. [22] suggested that the fluoride-releasing restorative materials were unable to overcome the dentin demineralization process. Authors highlighted that the results might have been different if a fluoride recharge protocol had been used. Conversely, Shiiya et al. [25] showed that resin-based temporary filling materials containing over 10% S-PRG filler have been able to prevent demineralization of dentin. Furthermore, a greater amount of fluoride release and recharge in acid medium was observed using Beautifill II. The aliquot of ions released might be responsible for buffering capacity of Giomer technology and its preventive effect on enamel demineralization [17].

Thus, this system seems to be able to offer benefits as the formation of an acid-resistant layer, reduction of tooth mineral solubility and subsequent buffering capacity associated with a good clinical performance in posterior teeth enable it's using to restore erosion lesion. Beautifill II performed properly up one-year follow-up restoration. Also, no new erosive lesion around restoration and post-operative sensitivity was observed.

Basically, the key to a successful approach of ETW depends on the balance among the control of the combination of early diagnosis, management of the etiological factors and the determination of a treatment plan based on the use of adequate material selection. The association with bioactive systems as Giomer materials can open a new direction to aid provide long-term adequate therapeutic procedures for ETW.

CONCLUSION

The effective involvement of patient to control the etiologic factors is always mandatory to the final success regardless the material characteristics. The development of bioactive materials is clinically relevant in this process. In this context, Giomer-based materials presenting S-PRG fillers might be a promissory alternative for prevention, control and/or restoration of ETW.

Authors' Contributions

Maria Angélica Silvério Agulhari performed the clinical attendance and wrote the manuscript. Marina Ciccone Giacomini performed the clinical attendance and wrote the manuscript. Daniela Rios discussed aided to plan the case, raised the literature support and revised the manuscript. Juliana Fraga Soares Bombonatti discussed aided to plan the case, raised the literature support and revised the manuscript. Linda Wang supervised the attendance, wrote the manuscript.

Conflict of interest

No conflicts of interest declared concerning the publication of this article.

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Regulatory Statement

Not applicable.

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