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Preheated resin as a cementing agent in fixed prosthesis: Literature review

Trabajo de titulación previo a la obtención del título de Odontólogo

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Resumen

Objetivo: Recopilar información sobre el uso de resina precalentada como agente cementante y comprobar mediante evidencia científica su uso.

Materiales y métodos: Se llevó a cabo una búsqueda bibliográfica en PubMed, Scielo, Refseek y LILACS. Se incluyeron publicaciones en inglés y español, publicados entre el 2018 y 2022, revisiones de la literatura, revisiones sistemáticas, reportes de casos clínicos, estudios in vitro y estudios experimentales. Se excluyeron artículos duplicados, inaccesibles por costo y que no hagan referencia a la resina precalentada como cementante. Se encontraron un total de 346 publicaciones, de las cuales tras aplicar los criterios de inclusión y exclusión se seleccionaron 20 artículos.

Conclusiones: El precalentamiento de la resina compuesta presenta varios beneficios clínicos como: reducción de la viscosidad, mejor adaptabilidad marginal, aumento de la microdureza, rigidez y grado de conversión. El aumento de temperatura pulpar puede ser inocuo cuando la temperatura del material se encuentra hasta los 60°. Se puede considerar apropiada para la implementación clínica.

Palabras clave: Resina precalentada, composite precalentado, cementación, adhesión

Abstract

Objective: Collect information on the use of preheated resin as a cementing agent and verify through scientific evidence if it can be considered an optimal option for its use.
Materials and methods: A bibliographic search was carried out in PubMed, Scielo, Refseek and LILACS. Included are publications in English and Spanish, published between 2018 and 2022, literature reviews, systematic reviews, clinical case reports, in vitro studies, and experimental studies. Duplicate articles, inaccessible due to cost and that do not refer to the preheated resin as a cementing agent were excluded. A total of 346 publications were found, of which, after applying the inclusion and exclusion criteria, 20 articles were selected.
Conclusions: The preheating of the composite resin presents several clinical benefits such as: reduction of viscosity, better marginal conformability, increase of microhardness, rigidity and degree of conversion.The increase in pulp temperature can be harmless when the temperature of the material is up to 60°. It can be considered appropriate for clinical implementation.

Keywords: Preheated resin, preheated composite, cementation, adhesion

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1. Introduction

Currently, composite resins, also known as composites, have been used for the cementation of indirect restorations since, by modifying their temperature, they acquire properties such as: lower viscosity, which results in a thinner cement layer, more optimal mechanical properties, a higher degree of polymeric conversion, ease of polishing and handling, diversity of colors and shorter polymerization time. (1) (2) The purpose of this review is to gather information on the use of preheated resin as a cementing agent for indirect restorations and to prove its use through scientific evidence.

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2. State of the art

Resins are synthetic materials used to restore the lost structure of teeth. Thanks to their physical, mechanical and esthetic properties, they have improved color, translucency and opacity, resembling natural teeth as much as possible, making them the most widely used material for various purposes such as direct and indirect restorations, cementation of orthodontic appliances, etc. (1) (3) Resins are divided into acrylic resins and composite resins. (4) Acrylic resins are multifunctional nanoparticle-based resins filled with glass and/or silica (up to 40%), have good esthetic properties, leaving a smooth and shiny surface that does not require polishing. (5) On the other hand, composite resins, also called composites are a combination of at least two chemically different materials, such as: an organic matrix which in most composites is a combination of the monomer such as Bis-GMA (Bisphenol-glycidyl methacrylate) or UDMA (urethane dimethacrylate); an inorganic filler consisting of glass particles, fused quartz, aluminum silicate, lithium aluminum silicate, ytterbium fluoride, barium, strontium, zirconium and zinc glass; and a bonding agent silane, which is a bifunctional molecule, which allows the union between the organic and inorganic component, the combination of these materials provides better properties that cannot be obtained with materials in isolation. (6)

Composite resins have been classified based on the size of the filler particles as follows: macroparticulate, microparticulate, hybrid, microhybrid, nanofilled and nanohybrid resins. (7)

Adhesive systems are biomaterials that aim to condition and demineralize both enamel and dentin to achieve a good compatibility between the adhesive and the dental substrate achieving a strong bond, avoiding microleakage, marginal pigmentation and secondary caries (8).

The adhesion to the enamel is a simple procedure, since with the use of orthophosphoric acid between 30 to 37 % we manage to obtain a loss of adamantine structure, which translates into a rougher and rougher surface, resulting in a cross-linking of the resin material with the porosities created thanks to the adhesive. On the other hand, in dentin the adhesion process is more complex due to the characteristics of this structure such as porosity and humidity, in dentin the conditioning process generates demineralization and increase of the diameter of the dentinal tubules, exposure of the collagen fibers of the intertubular dentin and elimination of the smear layer, achieving an interweaving of the exposed collagen fibers with the resinous material. (8)

Adhesive systems have been classified in different ways: by the number of clinical steps, by the number of vials to be used and by the modes of action. In terms of classification according to their clinical steps, we find etch-and-rinse and self-etching adhesive systems. In etch and rinse systems, after conditioning both the enamel and dentin using orthophosphoric acid, a profuse rinse is performed and then light-curing is performed, achieving the formation of resin micro tags at the adamantine and dentin level. This system can be performed in 2 or 3 steps, in the first case the acid is used as an individual step and the primer and adhesive in a single step, unlike the following system where the acid, primer and adhesive are applied separately. Finally, self-etching systems do not require a prior acid etching process, since they contain acid monomers that condition and prime the tooth surface. (8)

Eighth generation or universal adhesives are composed of nano-sized fillers, and contain acidic hydrophilic monomer. They are self-etching adhesives, but can also be used in total etching. In addition, they are used for both direct and indirect restorations. (9)

The composite resin can be heated using various dry heating devices which usually have a specific design to adapt to the resin syringe, other instruments that can be used for this purpose are wax heaters, it is also mentioned that the incubator is another device that can be used for preheating the resin and finally the composite resin syringe can be placed in a hermetically sealed bag and immersed in a container with hot water. An important aspect to consider is that the devices must be free of moisture in order to achieve the desired properties. (10)

2.1. Cementation protocol

2.1.1. Preparation of the indirect restoration

- Etching with 9.5% hydrofluoric acid for 60 sec.
- Cleaning with phosphoric acid for 15 sec.
- Washing and drying

- Application of silane
- Adhesive application (11)

2.1.2. Substrate preparation

- Absolute isolation
- Etch the enamel with phosphoric acid for 30 s and apply the same adhesive used previously.
- Preheat the composite resin at 68 °C for 10 min
- Application of preheated composite with a syringe, indirect restorations are placed on the prepared teeth and light pressure is applied for seating
- Removal of excess composite resin - Light cure for 60 sec with an LED unit.
- Finishing is performed with scalpel blades and polishing with diamond polishers.
- Check after 21 days (11)

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3. Methodology

3.1. Search strategy

The present study, literature review, is based on the analysis of the existing literature of the last 5 years, from September 2022 to December 2022, four databases were searched: PUBMED, Scielo, Refseek and LILACS. The keywords used were: "preheated resin", "preheated composite", "cementation" and "adhesion". The Boolean descriptors "and" and "or" were also used.

3.2. Exclusion/inclusion criteria

Publications written in English and Spanish, current articles published between 2018 and 2022, literature reviews, systematic reviews, clinical case reports, in vitro studies, and experimental studies were included in this study. Excluded publications were those that are duplicated, articles inaccessible due to cost, and manuscripts that do not refer to preheated resin or composite as a cementing agent.

3.3. Data analysis

The search in the four databases used resulted in a total of 346 articles, of which by excluding publications whose publication date was not between 2018 and 2022 232 articles were selected, by excluding manuscripts whose language was other than English and Spanish the result was 225 articles, by excluding publications that were duplicated the number of articles decreased to 197, by discarding publications that were inaccessible due to cost the selected articles were 174 and finally by excluding publications which do not deal with resin or preheated composite as a cementitious agent the number of articles collected for the review was 21 scientific publications. FIG 1 In the first phase, the reviewers selected the publications whose titles refer to the topic to be investigated; in a second phase, the researchers read the abstract of the selected articles and discarded those that did not meet the inclusion criteria; finally, the reviewers read the full text of the previously selected articles and excluded those that did not meet the aforementioned inclusion criteria.

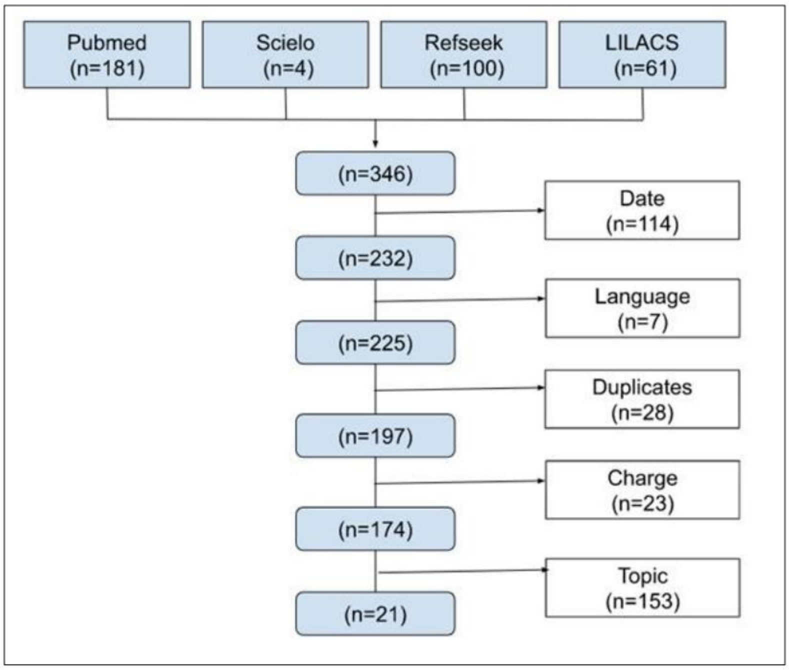

Figure 1 Item Selection Flowchart

4. Results

This review article included a total of 21 scientific publications which met the established inclusion criteria. A summary of the authors, article title, year of publication and conclusions is included in Table 1.

Table 1 Summary of publications included in this review

Authors	Investigation	Year of publication	Conclusions
Danica Scepanovic, Matej Par, Thomas Attin, Tobias T. Taubock	Marginal adaptation of flowable versus sonically activated or preheated resin composites in	2022	"Restorative approaches using flowable composites initially showed slightly better marginal integrity compared to preheated resin, thermomechanical loading led to similar marginal integrity for all restorative approaches investigated. However, it can be considered appropriate or clinically applicable."

	cervical lesions		
Bruna L. Porto, Fabíola J. Barbón, Cristina P. Isolan, Alexandre L. Borges, Aloísio O. Spazzin, Rafael R. Moraes and Noeli Boscato	Effect of ultrasound on preheated composite resins used as ceramic luting agents	2022	"It was shown that restorative composites that reacted differently to preheating to 69°C were clearly affected by the application of ultrasound to the ceramic during the cementation procedure. Preheated restorative composites produced greater immediate bond strength to ceramic compared to resin cement, but ultrasound application was unable to reduce film thickness.
Jay Bhopatkar, Anuja Ikhar, Manoj Chandak, Nikhil Mankar, and Shweta Sedani	Composites preheating: a novel approach in restorative dentistry	2022	"Preheating of composite resins improves the degree of conversion, stiffness, marginal conformability and microhardness. Flexural strength is unaffected, polymerization shrinkage is hampered, and microleakage results are unknown."
Edina Lempel, Dóra Kincses, Donát Szebeni, Dóra Jordáki, Bálint Viktor Lovász, József Szalma	Intrapulpal temperature changes during the cementation of ceramic veneers	2022	"The intrapulpal temperature can increase above 8.12 °C during the cementation of the veneers, using different combinations of resin-based materials and ceramic thicknesses. The temperature values were predominantly influenced by the composition of the resin-based materials, followed by the thickness of the ceramic veneer. Furthermore, the application of preheated restorative resins as luting agents resulted in a significantly higher temperature rise compared to that measured for adhesive resin cements."
Prudence-Felix Teyagirwa, Claire Aquin, Naji Kharou, Tatiana Roman, Bernard Senger, François Reitzer, Olivier Etienne	Operator versus material influence on film thickness using adhesive resin cement or pre-heated resin composite	2022	"Similar film thickness can be achieved with preheated light-curing composites or dual-cure adhesive resin cements. However, this achievement depends on the experience level of the operator. In fact, compared to the expert, the novice obtains thicker films with preheated composites and, above all, more disperse values, sometimes reaching inadequate clinical thicknesses. Interestingly, the thinnest films were obtained using a dual-cure cement, regardless of operator experience level. Therefore, novice clinicians should carefully consider the use of preheated composites as luting

			agents for indirect restorations until they are well trained. ”
De´borah Lousan do Nascimento Poubel, Ana Elisa Ghanem Zanon, Julio Cesar Franco Almeida, Liliana Vicente Melo de Lucas Rezende, Fernanda Cristina Pimentel Garcia	Composite Resin Preheating Techniques for Cementation of Indirect Restorations	2022	“All heating devices demonstrated effectiveness in heating composite resins used for cementation of indirect restorations. The ideal heating device should be free of moisture and calibrated to reach a preset temperature (between 54 and 68°C) and should maintain stability at the preset temperature after heating. The preheated material should be used as soon as possible after removing it from the device, as the temperature of the composite will drop rapidly. Preheating the material directly on the prosthetic restoration or dispensing syringe reduces clinical time. The indirect restoration should be less than 2 mm thick if a light-cure luting cement or composite resins are to be used. The composition of composite resins directly affects the viscosity achieved after preheating, therefore, materials indicated for this purpose or that show greater fluidity when heated should be used.”
Fabíola Jardim Barbon, Cristina Pereira Isolan, Leonardo Dias Soares, Alvaro Della Bona, Wellington Luiz de Oliveira da Rosa, Noéli Boscato	A systematic review and meta-analysis on using preheated resin composites as luting agents for indirect restorations.	2022	“The use of preheated resin compounds as luting agents offers minor improvements in the mechanical properties of indirect restorations and similar to poorer physicochemical properties than resin cements, including clinically unacceptable film thickness.
Rogério L. Marcondes, Verónica P. Lima, Cristina P. Isolán, Giana S.Lima, and Rafael Moraes	Ceramic laminate veneers bonded with preheated resin composite: a 10-year clinical report	2021	“Clinical treatment was performed in which laminated ceramic veneers were cemented to maxillary anterior teeth with preheated composite resin showing excellent clinical service and remarkable marginal integrity after 123 months of follow-up. Exceptional biological, esthetic and mechanical results were observed, in particular with regard to the absence of any marginal deterioration and the maintenance of a smooth ceramic-tooth transition.”

Guillermo Hector Alvarado-Santillan, Gustavo Augusto Huertas-Mogollon	Preheated resin as a cementing agent: a topic review	2021	“The temperature of the resin preheated to 60°C does not put pulp vitality at risk. The heating of the resin should be limited to a maximum of 4 hours and its repetitive heating does not significantly alter its properties. The preheating of the resin improves the kinetics of polymerization, reduces the photopolymerization time, decreases the viscosity, increases the degree of conversion, improving its mechanical properties, giving a potential benefit in its use. Compared to resin cements, preheated resin improves marginal sealing, bond strength is similar, but film thickness and shrinkage stress is lower in resin cements. The preheated resin is a technique that potentiates the mechanical properties and increases the fluidity of the resin, but like any other technique, it should not be applied in an absolute way, that is, use it for all kinds of situations, since it has indications, limitations. , advantages and disadvantages for each clinical situation.”
Freyshi Ugarte-Mamani, Marco Antonio Sánchez-Tito	Filtek Z250 XT resin preheated as a luting agent for indirect restorations.	2021	"Preheating a conventional resin may be a valid strategy for the use of these resins as a luting agent for indirect restorations, since it does not show differences in tensile strength, when compared with an adhesive resin cement."
Brenda Procopiak Gugelmin, Luiz Carlos Machado Miguel, Bengalas Baratto Filho, Leonardo Fernández da Cunha, Gisele María Correr and Carla Castilla Gonzaga	Color stability of ceramic veneers cemented with resin cements and preheated composites: 12-month follow-up	2020	“The preheating of composite resins has been used as a clinical alternative to decrease the viscosity and improve the use of composite resins both in restorative procedures and in the cementation of ceramic veneers. In the present study, preheating the resins did not increase DC and did not influence the color stability of cemented veneers. From a clinical perspective, the results obtained are favorable.”
Larissa Coelho Pires Lopes, Raquel Sano Suga Terada, Fernanda Midori Tsuzuki, Marcelo Gianini and Ronaldo Hirata	Heating and preheating of dental restorative materials: a systematic review	2020	“Preheating procedures for dental restorative materials are a simple, safe and relatively successful technique. For resinous materials, heating promotes an increase in microhardness and degree of conversion, a reduction in viscosity and better adaptation to the cavity walls. For ionomeric materials, it promotes a reduction in setting time, working time,

			porosity, and an increase in microhardness.”
Luis Felipe J. Schneider, Robson Barroso Ribeiro, Walleska Feijó Liberato, Vinícius Esteves Salgado, Rafael R. Moraes, Larisa María Cavalcante	Cure potential and color stability of different resin-based luting materials	2020	“All the materials tested presented a high curing potential for cementation purposes. The preheated composite presented the highest color stability.”
Manuel Salvador Urcuyo Alvarado, Diana María Escobar García, Amaury de Jesús Pozos Guillén, Juan Carlos Flores Arriaga, Gabriel Fernando Romo Ramírez, Marine Ortiz Magdaleno	Evaluation of the Bond Strength and Marginal Sealing of Indirect Restorations of Bonded Composites with Preheating Resin	2020	“Preheated resins are a luting agent option for indirect resin restorations in Class II cavities in premolars. A better sealing and adaptation of the restorations was observed using PR than using CR. The microtensile bond strength between dentin and resin restoration is increased when cemented with a CR.”
Rogério L. Marconde, Verónica P. Lima, Fabíola J. Barbón, Cristina P. Isolán, Marco A. Carvalho, Marcos V. Salvador, Adriano F. Lima, Rafael R. Moraes	Viscosity and thermal kinetics of 10 preheated restorative composites and effect of ultrasound energy on film thickness	2020	“Resin restorative compounds with different formulations react differently to preheat, which affects viscosity and film build; the optimal working time of the preheated composite is short and clinicians must tailor the cementation sequence to take advantage of the higher temperatures encountered in the first 15 sec; the application of ultrasonic energy is effective in reducing the thickness of the film”
Manar M. Alajrash, Mohamed Kasim	Effect of Different Resin Luting Materials on the Marginal Fit of Lithium Disilicate CAD/CAM Crowns	2020	“Preheated composite resin had produced significantly higher marginal discrepancies than flowable composite resin or resin cement.”

Vincenzo Tosco, Riccardo Monterubbianesi, Giulia Orilisi, Simona Sabbatini, Carla Conti, Mutlu Özcan, Angelo Putignano, Giovanna Orsini	Comparison of two curing protocols during adhesive cementation: can the step luting technique supersede the traditional one?	2020	"All the materials tested did not reach the same degree of conversion, the two different curing protocols do not seem to influence the values of the degree of conversion. The clinician can safely use the proven "step cementation" protocol to cement the indirect restoration, simplifying the removal of excess cement, particularly in the interdental space"
Farideh Darabi, Ali Seyed-Monir, Sanaz Mihandoust, and Dina Maleki	The effect of preheating composite resin on its color stability after immersion in tea and coffee solutions: an in vitro study	2019	"Preheating the composite resin is effective in reducing color change after prolonged immersion in a coffee solution."
Natalia F. Coelho, Fabíola J. Barbón, Renata G. Machado, Noeli Boscato, Rafael R. Moraes	Response of composite resins to preheating and the resulting strengthening of cemented feldspar ceramics	2019	"Different composite resins respond differently to preheating, leading to differences in viscosity and flow. The film thickness and the amount of ceramic cure depend on the selection of the preheated composite resin used."
Lucas de Oliveira Tomaselli, Dayane Carvalho Ramos Salles de Oliveira, Jamille Favarão, Ariel Farias da Silva, Fernanda de Carvalho Panzeri Pires-de-Souza, Saulo Geraldeli, Mário Alexandre Coelho Sinhoreti	Influence of Pre-Heating Regular Resin Composites and Flowable Composites on Luting Ceramic Veneers with Different Thicknesses.	2019	"Conventional preheated composites seem to be a potential alternative to ceramic veneers like flowable composites."
Ali A. Elkaffas, Radwa I. Eltoukhy, Salwa A. Elnegoly, Salah H. Mahmoud	The effect of preheating resin Composites on surface hardness: a	2019	"Preheating the Z250 microhybrid resin compound produced notable improvements in hardness compared to no preheat mode. Therefore, sufficient scientific evidence was found to support the hypothesis that preheating can

	systematic review and meta-analysis		improve the hardness of resin composites."

5. Discussion

Marcondes R. et al (2020), mention that "preheating of the material is necessary to reduce viscosity and film thickness. Restorative composites has the advantage of higher filler loading, wear and mechanical resistance, higher color availability, lower polymerization shrinkage" In the clinical case presented they stated "exceptional long-term biological, esthetic and mechanical results, after clinical and SEM imaging the restoration margins had no gaps and no signs of deterioration, marginal ditching, wear or staining [...]" They further concluded that "the restorative resin composite was able to withstand the abrasive and surface challenges imposed by the long-term oral environment" (11) So too, Elkaffas A et al (2019), state that "[...] preheating can improve the hardness of resin composites." (12) Likewise, Bhopatkar J et al (2022), demonstrate that "preheating of composite resins improves the degree of conversion, stiffness, marginal adaptability, microhardness, higher monomer conversion, higher mechanical characteristics, increased longevity of the restoration, stress reduction and faster curing time. "(13) Likewise, Ugarte F et al (2021) concluded that "Preheating a conventional resin may be a valid strategy for the use of these resins as a cementing agent for indirect restorations, because it shows no difference in tensile strength, when compared to an adhesive resin cement."(2)

Pires L et al (2020) mentioned that "some advantages reported in the literature with the technique of preheating resinous materials include a higher degree of conversion, better marginal adaptation of the restorations due to viscosity reduction, and decreased polymerization shrinkage." They further state that "material heating, minimum and maximum times encountered were from 40 s to 24 h, i.e., there is a very wide variation. However, a reasonable clinical time is approximately 15 min" [...]. On the other hand, the most common device for heating is Calset (AdDent Inc, Danbury, CT, USA) concluding that "preheating procedures for dental restorative materials are a simple, safe and relatively successful technique". (14) Also, Alvarado G et al (2021) indicate that "Preheating resin temperature to 60°C does not jeopardize pulp vitality. Resin heating should be limited to a maximum of 4 hours and its repetitive heating does not significantly alter its properties [...] improves polymerization kinetics, reduces light-curing time, decreases viscosity, increases the degree of conversion [...] improves marginal sealing, bond strength is similar, but film thickness and shrinkage stress is lower in resinous cements [...]." (1)

Schneider L. et al (2020) noted that "preheated or thermally modified composite resins. Their filler content is usually higher than that of resin cements and, therefore, they exhibit improved mechanical properties. The use of preheated composite resin had significantly less color change than all other resin luting agents [...]." (15) Similarly, Porto B. et al (2022), add that "Preheated resin composite has been increasingly used for the same purpose with potential advantages such as wear resistance, improved mechanical performance, reducing the viscosity and increasing the flowability of the composite, and minimizing the film thickness." In addition, they inform us that "the application of ultrasound on ceramics may be an effective method of film thinning, as the increased fluidity of the unpolymerized preheated composite may improve its extrusion at the margins of the restoration and ultimately reduce film thickness. However, whether the application of ultrasound could affect the mechanical performance of the bonded ceramic or its bond strength to resin composites has not yet been addressed." (16) On the other hand, Procopiak B. et al (2020), mention that "preheating of different composite resins used for the cementation of ceramic veneers could help in the clinical decision of the luting agent, aiming for long-term esthetic and functional results." He agrees with the aforementioned authors that "preheating improves material adaptation to cavity walls, provides less potential for defect formation at the margins, increased DC and, consequently, better physical and mechanical properties." (17) Likewise, Darabi et al (2019), concluded in their experimental study that "preheating of composite resin is effective in reducing color change after prolonged immersion in a coffee solution because it reduces the absorption and penetration of the dye solution through increasing the degree of polymerization, but this reduction was not significant in the tea solution." (18)

Urcuyo M et al (2020) mentioned "preheated resin is an alternative luting material since, by increasing its temperature between 55° and 60°C, its viscosity is reduced. In addition, its flowability is reduced due to the increased mobility of free radicals, which facilitates better adaptation to the cavity walls compared to conventional luting materials." (19) Similarly, Coelho N et al (2019), indicate that "lithium disilicate laminate veneers cemented with preheated composite resin had less chipping and higher fracture toughness than those cemented with resin cement." Also, "when heated to 69◦C the resin cement had an average viscosity reduction of 42.4 %, while the viscosity was reduced to 93.9 % for the composite resins," of all the resin types tested in the study it was concluded that the microhybrid resin had the lowest viscosity at the end of the test. (20)

Lucas de Oliveira et al (2019), in their study deduced that both preheated composite resins and flowable resin provided benefits such as lower film thickness, similar shear strength, lower degree of conversion and lower color change when used as luting materials and compared to non-preheated composite resin. Therefore, they state that "Conventional preheated composites appear to be a potential alternative to veneers. a potential alternative to ceramic veneers such as flowable composites." (21) Similarly, Scepanovic D et al (2022), mention that "all investigated restorative approaches using sculptable, castable, preheated or socially activated composite resins behaved similarly with respect to the marginal integrity of Class V composite restorations and can be considered appropriate or clinically implementable.". (22)

Tosco V et al (2020), compared the traditional one-time curing method and the stepwise method for flowable resin, preheated composite resin and light-curing and dual-curing resin cements, stating "All the materials tested did not achieve the same degree of conversion, the two different curing protocols do not seem to influence the values of the degree of conversion. The clinician can safely use the proven "step cementation" protocol [...], simplifying the removal of excess cement, particularly in the interdental space." (23)

Teyagirwa P et al (2022), with their study demonstrated that "Similar film thickness can be obtained with preheated light-curing composites or dual-curing adhesive resin cements. However, this achievement depends on the level of operator experience [...]". (24)

Nascimento D et al (2022), compiled information about the preheating techniques of composite resins for the cementation of indirect restorations, where among the most relevant aspects they infer that "All heating devices demonstrated effectiveness. The ideal heating device should be free of moisture and calibrated to reach a predetermined temperature (between 54 and 68°C) [...] The preheated material should be used as soon as possible [...]. The indirect restoration should be less than 2 mm thick if a light-curing luting cement or composite resins are to be used [...]". (10)

Marcondes R et al (2020) reported that "potential advantages of preheated restorative composite resins may include higher color availability, lower cost, lower polymerization shrinkage and marginal degradation, and improved mechanical performance due to their higher filler content. Preheating is intended to reduce viscosity and increase flowability, but thicker films are commonly observed compared to resin cements, which most authors suggest that films should be thinner than 120 m in clinics." However, it should be noted "Restorative resin composites with different formulations react differently to preheating, which affects viscosity and film thickness; the optimal working time of the preheated composite is short, and clinicians should tailor the cementation sequence to take advantage of the higher temperatures found in the first 15 s; the application of ultrasonic energy is effective in reducing film thickness". (25)

Finally, within the review authors such as Jardim F et al (2022), pointed out disadvantages of preheated composite resins such as "[...]physicochemical properties similar to poorer than resin cements, including clinically unacceptable film thickness." (26)

On the other hand, Alajrash et al (2020) express that "Preheated composite resin had produced significantly higher marginal discrepancies than flowable composite resin or resin cement." (27)

In relation to temperature rise authors such as Lempel E et al (2022) state that "Intrapulpal temperature can increase above 8.12 °C during veneer cementation [...]. Furthermore, the application of preheated restorative resins as luting agents resulted in a significantly higher temperature increase compared to that measured for adhesive resin cements." (28) Similarly, Alvarado G et al (2020) stated that pulp temperature rise may even cause pulp damage, however, they indicate that when the preheated resin temperature is at 60° there is no danger of pulp damage. (1) Similarly, Bhopatkar J et al (2022) reported that "placing a composite resin heated to 60°C increases the pulp temperature by 0.8°C, while 15 seconds of light curing increases the pulp temperature by 4.5-5°C", [...] recommending that resin preheating should not exceed 60°C to avoid being harmful. In addition, they point out certain additional disadvantages: "composite preheating reduces shelf life, requires fast operations, repeated preheating cycles have a detrimental effect on the color stability of the composite resin" [...]. (13)

6. Conclusions

The findings of the present study showed that preheating of composite resin as a luting mechanism:

- Reduces viscosity providing better marginal adaptability.
- Increases microhardness, stiffness and degree of conversion.
- The different types of resins and their different compositions react differently to this technique.
- It produces an increase in pulp temperature that can be innocuous for the pulp tissue when the preheated resin obtains a temperature up to 60°.
- This technique is simple, safe, fast and can be considered suitable for clinical implementation.
- Color stability and polymerization shrinkage are controversial and further research is recommended.

7. Dedicatory

In the following section we want to express our gratitude to Dr. Pablo Tamariz for his help and patience in preparing this work. Also, me Odalis, thank God for all his blessings, my parents Alfonso and Elvia, my grandparents Vicente and Elvia, my sisters Fatima and Adriana, my niece Keyla and my partner Jean, for being my unconditional support and my pillar. during my university career, this achievement is for you. Finally, me Paola wants to thank God, for always giving me his blessing, wisdom and strength at all times. To my parents, Cecilia and Pablo, who have been the fundamental pillars in my life, in my education and in the strength to never give up and achieve all my goals.

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Anexos