Association of Resin With Reinforcement Fiber in Extensive Posterior Restoration

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1 INTRODUCTION

In recent years, restorative techniques aimed at preservation of the dental structure have been garnering significant attention in the clinical practice. With the improvement and greater development of adhesive restorative materials, modern dentistry has provided various clinical options to re-establish the aesthetic and masticatory function for the patient and professional satisfaction for the Dental Surgeon.

Reinforcement with fibers has been discussed in the literature since 1960, but the interest from Dental Surgeons in the use of this material is recent. Reinforcement fibers can be glass, polyethylene, kevlar, carbon, and combinations of fibers.

Resins, especially when associated with reinforcement fibers, present properties which, depending on the clinical indication, approach dental ceramics. In addition to the improvement of its resistance to wear and staining and its good aesthetics, some comparative parameters are interesting in relation to dental ceramics, such as greater practicality, greater facility in adjustment and repairs, greater facility in polishing, minimal or no wear of the antagonist teeth, lower modulus of elasticity (rigidity), fragility, and relatively lower cost[11].

The infrastructure of fiber-reinforced composites (FRCs) is translucent and needs no opaque material, which allows there to be a minimal layer of particulate composite veneering resin and excellent aesthetics. The light-cured FRC infrastructure has an oxygen-inhibited layer, sticky on its outer surface that allows a direct chemical bond with the veneering composite, eliminating the need for mechanical retention that would be required with a metallic structure [1].

The main indications for the use of fibers are: direct filling cores, indirect filling cores, periodontal splinting, orthodontic splinting, direct and indirect adhesive prosthetic, extensive acrylic temporaries, repair of full prosthesis, and removable partial prosthesis, composite resin pure crown, composite resin fixed prosthesis, large composite resin restorations, composite resins with fibers in their composition, various emergency situations of the clinic, bridge structures on implant [3].

The composite resin restoration can be performed directly, indirect or semi-directly. Direct restorations allow for conservative treatments, with minimal removal of healthy dental tissue. In cases where we find small or medium-sized class I or class II cavities, with proximal boxes diverging little to the proximal direction, direct resins are well indicated [1 2].

In situations where large losses of tissue are observed, the indication is to execute indirect restorations to be cemented in an adhesive manner. This treatment involved more than one clinical session and one laboratory step. An alternative technique can be executed, mixing aspects of the direct and indirect techniques, called the semi-direct technique. A composite resin restoration for clinical use can be prepared on a semi-rigid model, in the same clinical session as the preparation and the molding[12].

2 Materials and methods

2.1 Description of the Clinical Case

A 34-year-old male patient appeared at the dentistry service of UFPE seeking treatment for replacement of worn, poorly-fitting, and infiltrated restorations. During the procedures of anamnesis, clinical examinations, and radiography, it was possible to observe extensive restorations with occlusal wear on element 36, and the same situation on element 37 with infiltration and a carious process on the distal face (Figure 1 and Figure 2).

Given the extensiveness of the restorations and all the issues involved in the social situation of the patient, it was decided to prepare a restoration with composite resin with incorporation of reinforcement fiber using the semi-direct technique.

2.2 Clinical Procedures

2.2.1 Removal of the defect

The preparation was started with removal of the defect using the 3131 diamond tip for high rotation from KG SORENSEN on both elements. This bit provides the dental element with a preparation with an expulsive conformation (Figure 3).

2.2.2 Molding and obtaining the working models

For the molding procedures of the lower semi-arch, first the preparations were filled with Angelus 3D fluid addition-cure silicone with the aid of an insertion gun. Then a perforated lower partial tray was filled with dense addition-cure silicone (base paste and catalyst paste of the same brand as the previous one), and subsequently adapted to the corresponding semi-arch in the regions of the preparations. Then the lower mold was obtained (Figure 4).

With a tray for the upper semi-arch filled with Hydrogum alginate from Zhemack, the corresponding mold was obtained (Figure 5). Subsequently, the molds were cast with type IV Durone plaster from DENTSPLY, to obtain the working models (Figure 6 and 7).

With a preheated sheet of 7 wax, the record of the interocclusal contacts was obtained. Then the two models were mounted on the verticulator to obtain the interocclusal relation (Figure 8).

2.2.3 Preparation of the temporary restoration

After removal from the molding, a temporary restoration was prepared using an appropriate photopolymerizable resin with a rubberoid consistency, BIOPLIC - BIODINÂMICA (Figure 9).

2.2.4 Selection and cutting of reinforcement fiber

The reinforcement fiber selected was INTERLIG® from Angelus, an impregnated (braided) fiberglass. The preparations were measured with a cut of lead sheet of periapical radiograph film and then the dimensions were passed on for cutting the fiber (Figures 10, 11, and 12).

2.2.5 Preparation of the restoration

First, the color of the resin was selected, Opallis DA3 and EA2. Then the working model was isolated with petroleum jelly on the area corresponding to the prepared teeth and the first increments of resin were placed with the aid of spatulas for preparation of restoration of composite resin from DUFLEX, incorporating fragments of reinforcement fiber into it (Figure 13).

For the restoration of element 37, two layers of reinforcement fiber were adapted, due to its length and depth, and for element 36, since it was a smaller cavity, only one layer of fiber was needed. After the perfect adaptation of the fibers and photopolymerization for each increment of resin (Figure 14), the occlusal sculpture of each element was prepared with the incremental progressive sculpture technique (Figures 15 and 16). Then, the sheets were put into contact with the antagonist model on the verticulator, still with a fine layer of resin without photopolymerization to obtain the points of interocclusal contact, and they were photopolymerized soon after (Figure 17).

After this step, they underwent a new finishing process with the occlusal finishing kit from KG SORENSEN, specifically tips 4322F and 4323F, for better anatomical adaptation of the surfaces. For the polishing of the restorations, the special finishing kit from TDV was used, where the pieces were subjected to a polishing sequence with rubber tips for polishing of composite resin and the a felt disc and TDV Poligloss general-use polishing paste (Figures 18, 19, and 20).

2.2.6 Treatment of the laminate and Cementation of the piece:

The temporary restoration was removed with the aid of an exploratory probe and the pieces were tested on the patient's teeth for possible adjustments. The laminates were subjected to Condac 37 FGM phosphoric acid etching at 37% for a period of 1 minute (with the objective of degreasing them due to the petroleum jelly applied to the model), washing, drying, and application of a homogeneous layer of adhesive system for enamel and dentin, FGM amber, and subsequent photopolymerization for 20 seconds (Figures 21, 22, and 23). Then, we did absolute isolation of the operating field, acid etching of the elements for 15 seconds, washing, drying, application of adhesive, and polymerizations (Figures 24, 25, and 26).

The resin cement selected was FGM allcem in color A3, then the cement was compounded and inserted in the preparations (each tooth in turn), and the pieces were introduced to the respective prepared cavities where they were contained and stabilized with an instrument. Then, a quick photopolymerization (5 seconds) was done with the purpose of removing the excess, and then, further polymerizations of 40 seconds on both the occlusal surface and the vestibular and lingual faces (Figures 27 and 28).

2.2.7 Ajustes oclusais e acabamento final:

After cementation of the restoration, with a Muller clamp and carbon, it was checked and the posterior and simultaneous bilateral contacts were obtained. Premature contacts were removed and a new finish and polishing of the restoration was done (Figure 29 and 30).

Figure 1. Initial situation of the patient.

Figure 2. Diagnostic periapical radiography: vital teeth

Figure 3. MOD Preparation Using diamond tip 3131.

Figure 4. Lower molding with Angelus 3D dense addition-cure silicone.

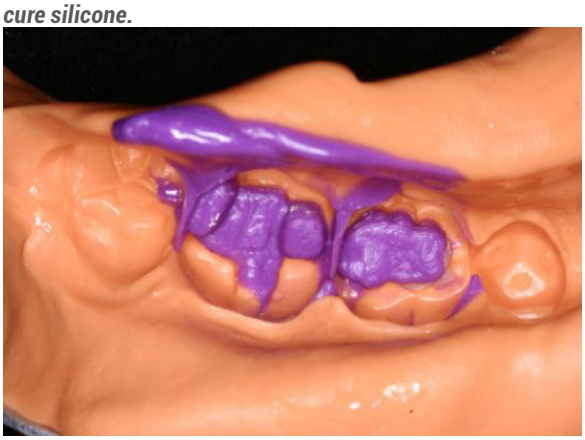

Figure 5. Upper molding of alginate

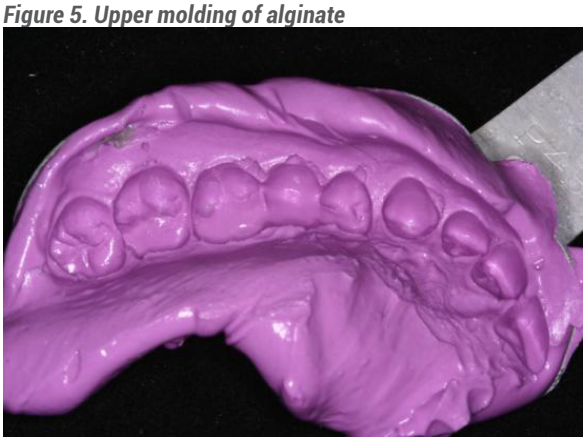

Figure 6. Lower working model in type IV plaster.

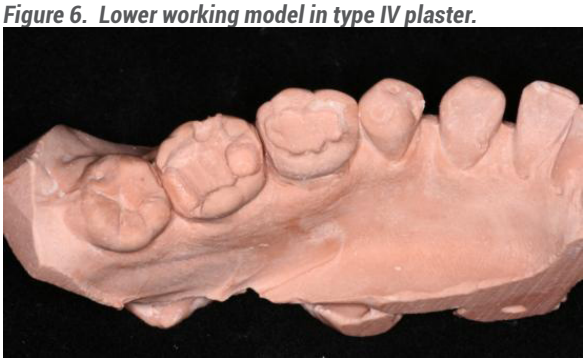

Figure 7. Upper working model in type IV plaster.

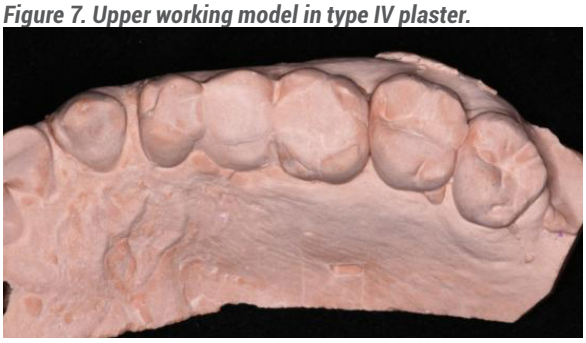

Figure 8. Mounting the models in a verticulator.

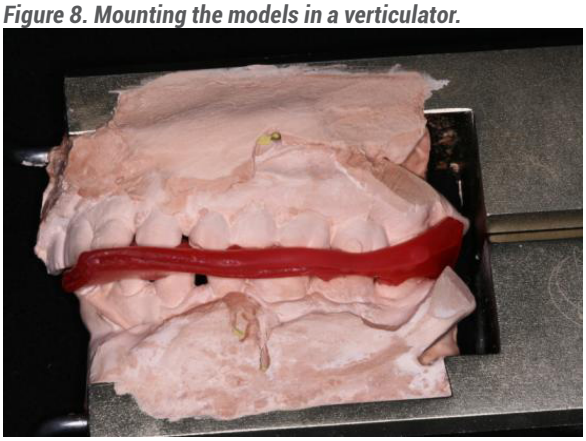

Figure 9. Temporary restoration with Bioplic.

Figure 10. Cutting the Lead sheet of periapical radiography film.

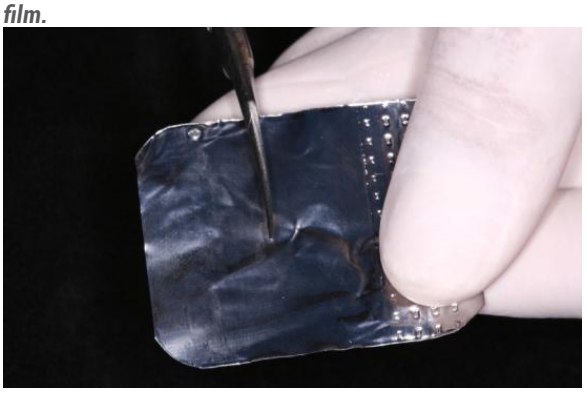

Figure 11. Measurements of the preparation for the cut of the reinforcement fiber.

Figure 12. Cutting the fiberglass.

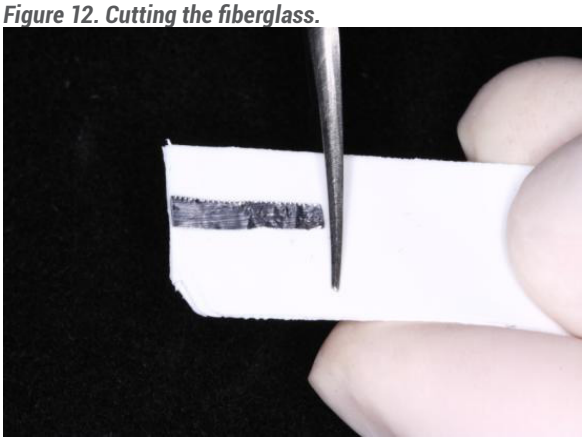

Figure 13. Incorporation of the fiberglass in the composite resin in the first increment.

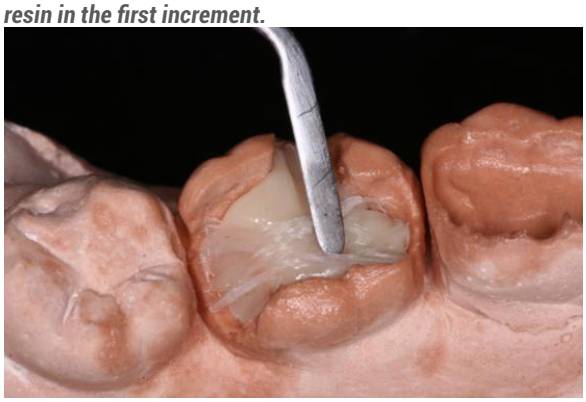

Figure 14. Photopolymerization of the adapted fiber in the increment of Composite Resin.

Figure 15. Photopolymerization of the first cuspid.

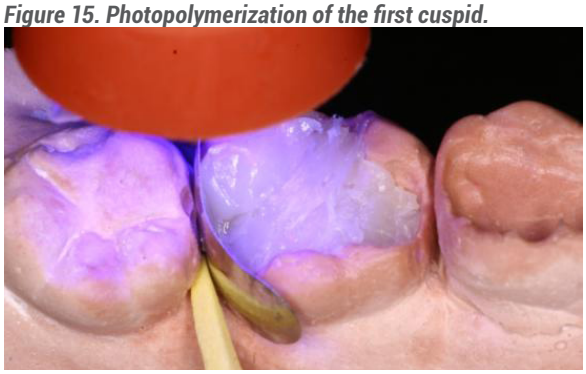

Figure 16. Finalization of the coronary anatomy of element 37.

Figure 17. Obtaining the interocclusal contacts photopolymerizing the last increment of resin.

Figure 18. Finishing with the KG SORENSEN 4323F occlusal finishing tip.

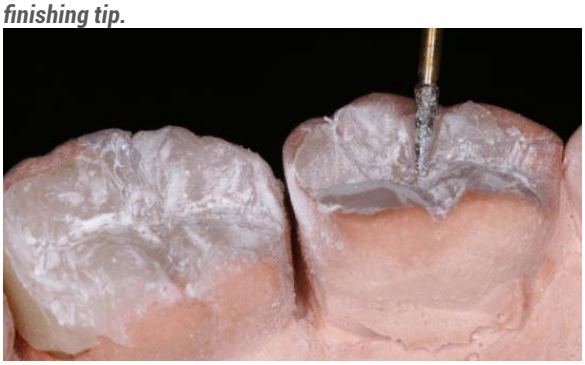

Figure 19. Finishing with the TDV rubber tip for finishing the composite resin.

Figure 20. Laminates after being removed from the models.

Figure 21. Acid etching of the laminate.

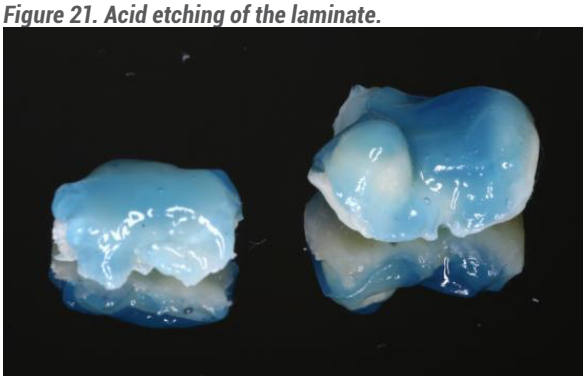

Figure 22. FGM amber adhesive in restoration.

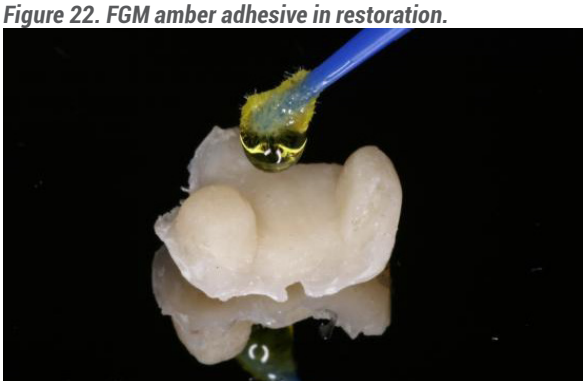

Figure 23. Photopolymerization of the adhesive on the laminate.

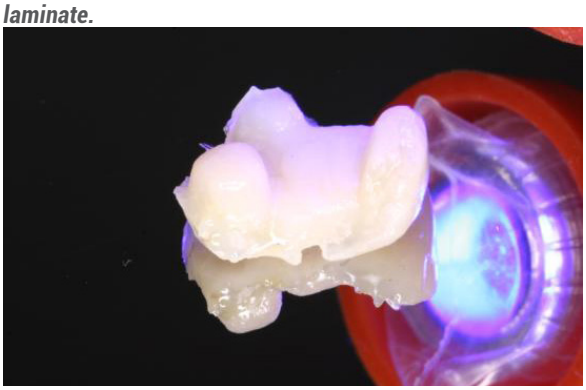

Figure 24. Acid etching of the preparation.

Figure 25.Insertion of the adhesive in the preparation.

Figure 26. Photopolymerization of the adhesive.

Figure 27. Stabilization of the restoration in the preparation.

Figure 28. Photopolymerization of the resin cement.

Figure 29. Pieces properly cemented with occlusal adjustments.

Figure 30. Finalization of the restorations.

3 RESULTS

As a result, we can report that we obtained well-adapted extensive restorations with satisfactory aesthetic and masticatory function, as well as a greater resistance to bending and fracture due to the incorporation of the reinforcement fiber.

4 DISCUSSION

Currently, there are numerous methods and materials used in Cosmetic Dentistry in the pursuit of partial or total reconstruction of the crown of the posterior teeth with the objective of rehabilitating the aesthetic and function lost through the carious process which damaged the structure of the dental element. It is of the utmost important for the Dental Surgeon to evaluate the aspects related to the patient and the elements to be restored. The socio-economic condition of the patient is also a factor of relevance in the choice of the therapeutic alternative. In the case presented, ceramic laminates would be the better option, had there been no financial limitation.

4.1 Extent of the restoration

Restorations with very divergent proximal boxes make it difficult or impossible to correct adaptation of the matrix and interproximal wedge, which can result in failure in the marginal adaptation of the composite resin and an incorrect for of marginal crest. In addition, restorations with a subgingival margin also make correct isolation and moisture control difficult, and can result in failures in the marginal adaptation of the restoration[12].

It must be remembered that a slightly expulsive or even retentive preparation will at some point make the testing, adjustment, and cementation of the piece difficult. On the other hand, if the expulsivity is very high, a loss of the piece's retention can be expected, even with adhesive cementation[4].

4.2 Preparation of the temporary restoration

The purpose of the temporary restoration is to stability the tooth that was molded in position, protect the prepared cavity, give comfort to the patient in the post-operative period, and preserve phonetics between the sessions[13].

4.3 Mounting the models in a verticulator.

The verticulator is a non-adjustable device where the upper and lower hemi-arch models are connected by guide rods and flat surfaces maintaining the vertical dimension of occlusion of the patient, within the vertical axis of the device. When used together with the simultaneous molding technique of the arches, it provides some advantages: it reduces the quantity of material used both in molding and in preparation of the plaster models, the mounting is less labor-intensive, and the clinical time is shorter[14].

4.4 Importância do isolamento absoluto

Absolute isolation can be done after the cavity preparation, provided that radiographically, the restoration has no proximity with the dental pulp. Although on anterior teeth it can usually be done without, on posterior teeth, it is required due to the excess moisture present.

4.5 Insertion of the composite resin

The use of composite resins for the preparation of semi-direct restorations in posterior teeth with extensive loss of dental tissue represents a viable clinical alternative. The use of the technique of extraoral restoration allows for the optimization of the properties of the material, which can be reflected in a better final clinical performance of the restoration.

In extensive restorations, when carried out directly, it is necessary for the professional to perform the insertion of the resin and its photopolymerization in layers, to compensate for the polymerization contraction. This ends up generating an increase in clinical time, failures in the marginal sealing, and post-operative sensitivity. In the semi-direct technique, the only polymerization contraction is generated by the resin cement, since the restoration is fully prepared outside the oral medium[12].

4.6 Association of the reinforcement fibers

The study of the properties of the reinforcement fibers showed that its incorporation with composite resin increased its elastic modulus. It was demonstrated that the use of fibers to reinforce the resins generates high tensile strength and low shear strength, since they are materials with an elastic modulus similar to dentin, a factor which improves the distribution of tensions during chewing and proximal wear on the natural teeth[2].

The association of composite resin with the fiberglass for reinforcement has been shown to be effective in increasing flexural strength.

Materials consisting of fibers present excellent mechanical properties, and when compared with metals, they offer advantages, because they are not corrosive, they present satisfactory translucency, excellent adhesion, and ease in preparation in clinical or laboratory procedures[2].

4.7 Cementation of the piece

Resin cements have indications and advantages that no other cement has with the capacity to secure pieces in very expulsive preparation or where the clinical crown is too short. The advance preparation, both of the prepared tooth and the piece that will be cemented, is of the utmost important since the adhesive strength of the cemented restoration is not related only to the properties of the resin cement[1].

5. CONCLUSION

Given all the consideration outlined above, we conclude that reproducing and maintaining the characteristics of naturalness of the dentition of the patient, combined with functionality, has been one of the current big challenges facing Dental Surgeons. It was possible, through the restorative technique used, to combine the aesthetics, functionality and resistance, thus ensuring greater longevity of the restoration and patient satisfaction.

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