Case report

Applications of fibreglass to reinforce the crown of endodontically-treated molars

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ABSTRACT

The crown reconstruction of an endodontically-treated molar allows different treatment options, from the classic crown of complete onlay cemented directly on the remaining crown closed with composite or on a cast post-core that restores the crown, to the simple reconstruction with composite. Between both options a wide range of treatment options are described, among which we can highlight the inlay with ceramic or prepolymerised resin overlay retainer. All admit the added insertion of the controversial screw or cemented post or even that which is adhered in the interior of one of the canals. It questions what is the best technique to use and how the decision made, which may always be disputed and even controversial, depends on the remaining crown that has been left in the endodontically-treated molar. Is that molar going to be capable of resisting the masticatory forces? Will the molar resist more if we restore its crown with composite to which we add a fibreglass reinforcement? We are going to show various techniques of crown reconstruction on endodontically-treated molars using Dentapreg® fibreglass.

KEYWORDS

Restoration; Molar, Root Canal; Fibreglass.

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INTRODUCTION

Once the decision is made to perform a composite reconstruction on a crown of an endodontically-treated molar, we must first decide what treatment guideline we are going to follow and for this various alternatives are posed:

1. Are we simply going to reconstruct the crown with a composite that substitutes all the lost dentin and enamel?
2. Do we first insert a post in the lumen of the widest root?
3. Will we increase the resistance of the crown remnant if we insert fibreglass as an internal ferrule?
4. In what position do we place the fibreglass within the crown?
5. What fibreglass design options do we have?

The objective of this work is to show the technique with application of fibreglass for the crown reconstruction of an endodontically-treated molar.

CLINICAL APPLICATION

Let's start from the beginning with a clinical case that serves as a model on which we can expand on all the questions that we have posed from the preamble.

Ángel comes to the dentist's office, with pain… of course, in the tooth no. 47, for which reason we take a periapical X-ray where a large caries on the distal aspect of the tooth no. 47 is observed with pulp tissue involvement. We perform the root canal treatment on that molar (Figure 1), we extract the wisdom tooth and we wait for its healing with a temporary filling. Since we have the remaining crown on which we have to act and in this case, rendering unnecessary the discussion of other crown restoration techniques and that which we are going to describe, we go on to shape the matrix that is going to bring back the initial anatomy that the crown of the tooth had (Figure 2). We continue using with very good results the classic Automatrix® (Caulk/Dentsply) matrix since it allows us, thanks to its design, the adaptation and subgingival fixation to the dentinal remnant, which is not easy on many occasions due to the crown des-

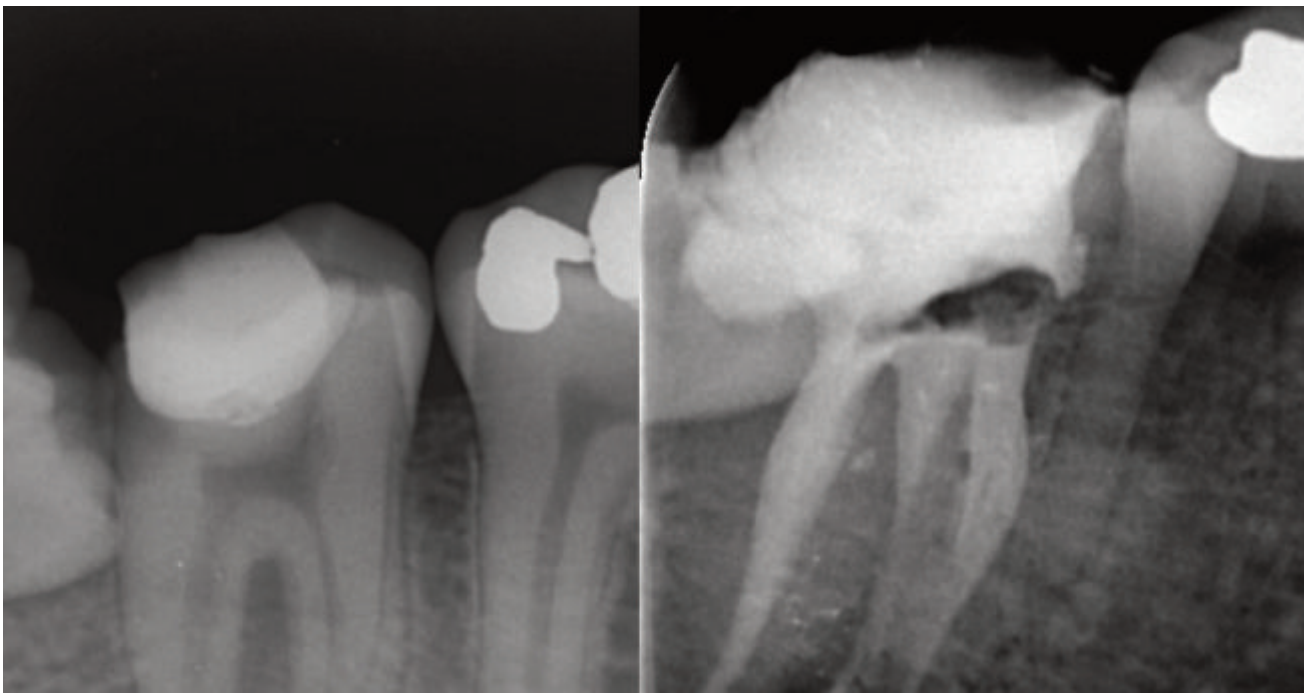

Figure 1. Preoperatory radiograph of the affected molar in ortho-radial direction and the final X-ray of the root canal treatment from mesio-radial direction, before the extraction of the wisdom tooth.

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Figure 2. The crown remnant before and once the matrix is placed. Observe the grinding down that was made in the vestibular enamel of the dental wall in order to be able to accommodate the fibreglass and the gingival adaptation of the matrix on the distal aspect.

truction. We miss these matrices not being contoured which would save us having to subsequently carve the restoration, giving convexity to the walls of the crown.

It is important to determine clearly the gingival margin of the restoration, not leaving areas of carious dentin or defects in the isolation that impedes us from using the adhesion technique such as that which we are describing. Given that on occasions and in this one in particular in which the crown of the tooth on the distal aspect has been destroyed very subgingivally, it can be used in an alternative manner, given that the thickness does not interfere with the area of contact due to the absence of the distal tooth, the even more classic copper ring that allows us to place it in a more subgingival position (Figure 3). It is true that this is archaic, but when we have made the decision to restore this type of clinical situation we are facing with composite, we can cut it, deform it, and adapt it until we can get a certain marginal adjustment of the matrix, managing to isolate the compromised gingival margin.

In the case that we are describing as the basis of the presentation, it was decided to use fibreglass as a circular reinforcement of the crown and for this reason, in addition to bevelling the crown margins of the dentinal remnant so that the composite may embrace it, we just make a slight quadrangular carving on the vestibular face, in order to give space to the fibreglass thickness and thus be able to place it out-

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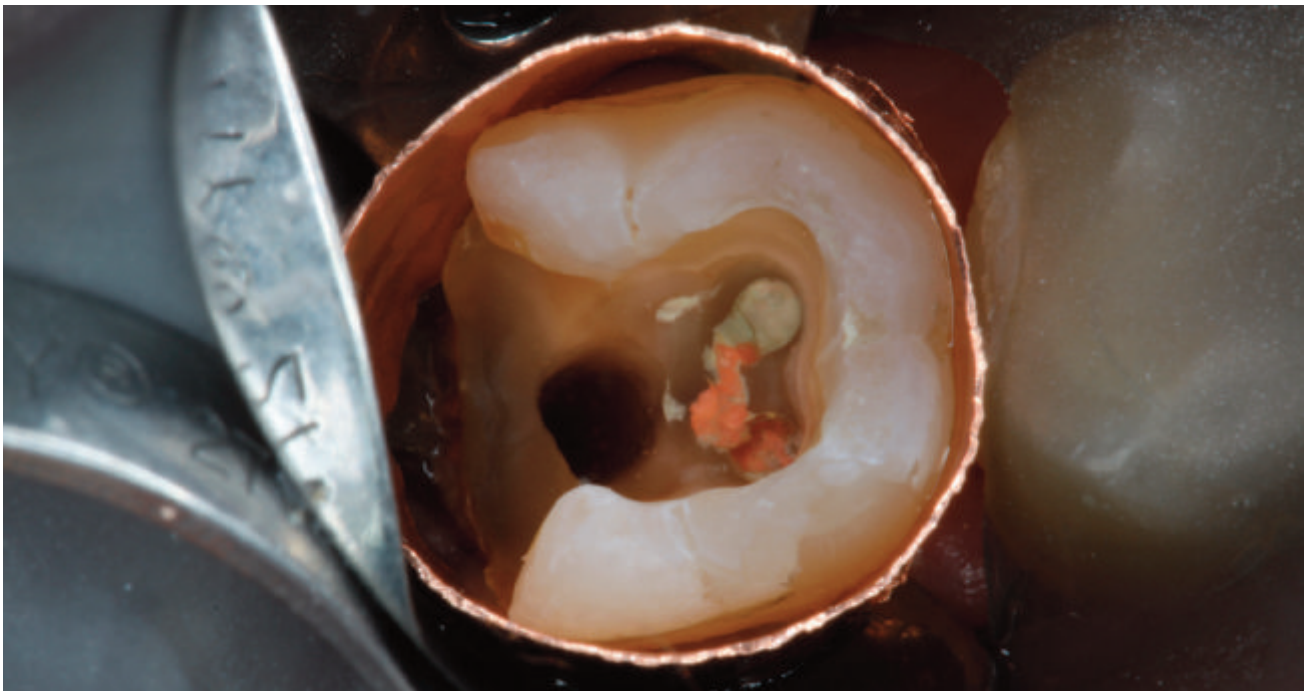

Figure 3. The archaic ring of copper allows shaping when the caries is very subgingival, a profile for the restoration that allows us to isolate relatively the cavity. The placement of the post is always done in the widest and straightest canal.

side the dental wall without increasing the diameter of the original crown of the tooth. In a schematic drawing, one can see what we are trying to explain (Figure 4).

Of course, if we also wanted to insert a post, we should empty the canal and leave it ready to be accommodated before placing the matrix. We leave for now the subject of the post and we are going to focus on the case that concerns us.

Once the matrix is put into position and the complete isolation of the gingival margin is verified, we can begin the systematic adhesion processes, such as the placement of phosphoric acid for 30 to 60 seconds, washing, drying and placement of the adhesion system and its photopolymerisation.

It is a "sine qua non" condition that the fibreglass, regardless of its location, is included completely in the centre of the composite since if it is exposed to the surface, it does not have resistance to wear. For this reason a thin layer of composite is placed over the matrix and it is compacted on it in increments, to avoid contraction of the curing, with a steel ball or spatula (Figure 5). It is now when the fibreglass is placed in the position that we had planned and it remains as shown in the schematic drawing of Figure 6.

The fibre that we are using is permeated in composite so that it is maintained until it is used, in a container opaque to the light, however, it is not an impediment for when we place it as long as it is permeated with a composite that generally is fluid, in order to adapt it well and avoid empty spaces remaining between it and the composite placed previously. One must stress that the fluid composite cannot be placed on the exterior of the tooth, since it resistance to wear is much less due to its composition than that of the restoration composite. And it is now when we must go into depth in the types of fibreglass we can use.

They range from the classic Ribbond® or Connect® (Sybron/Kerr), which can continue being used, per-

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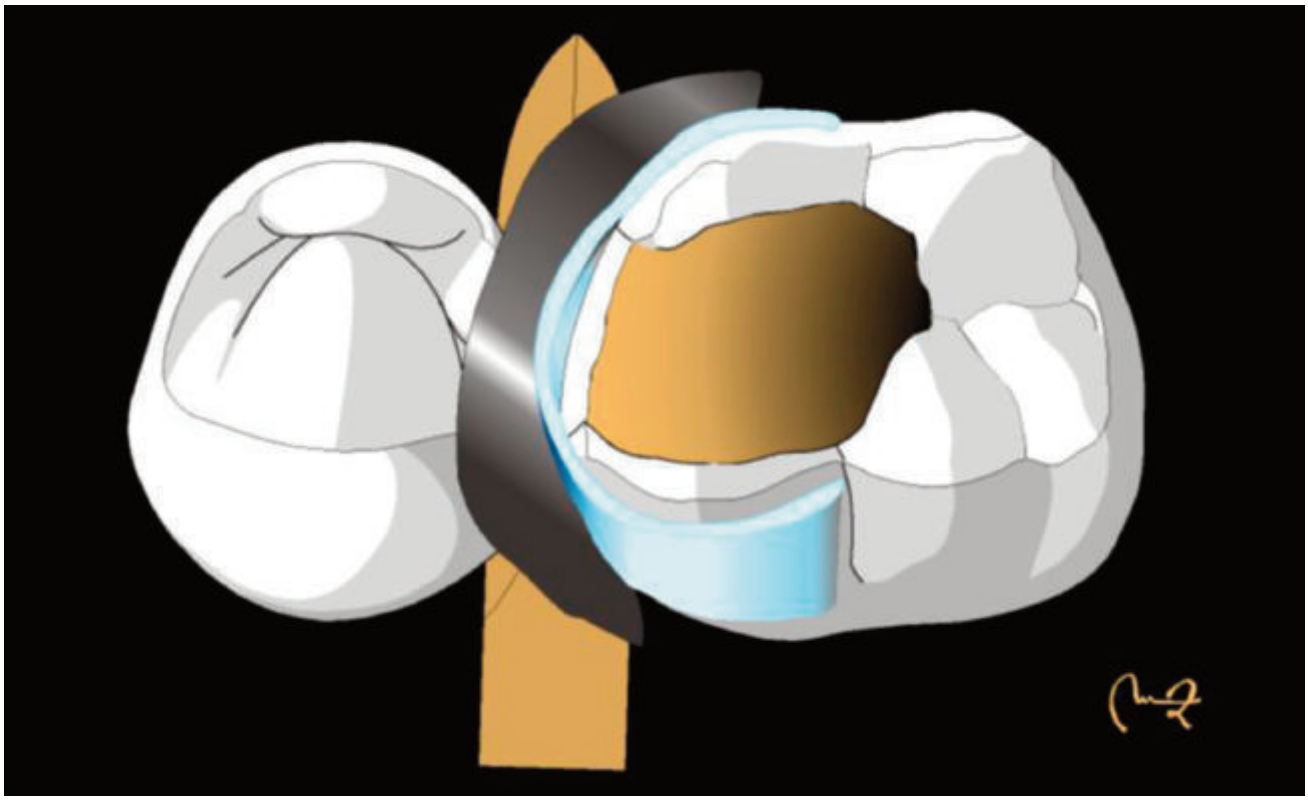

Figure 4. The fibreglass can be placed in this position or in that which is shown in figure no. 6. In both cases, the fibre girths the vestibular and lingual wall of the crown of the endodontically-treated molar.

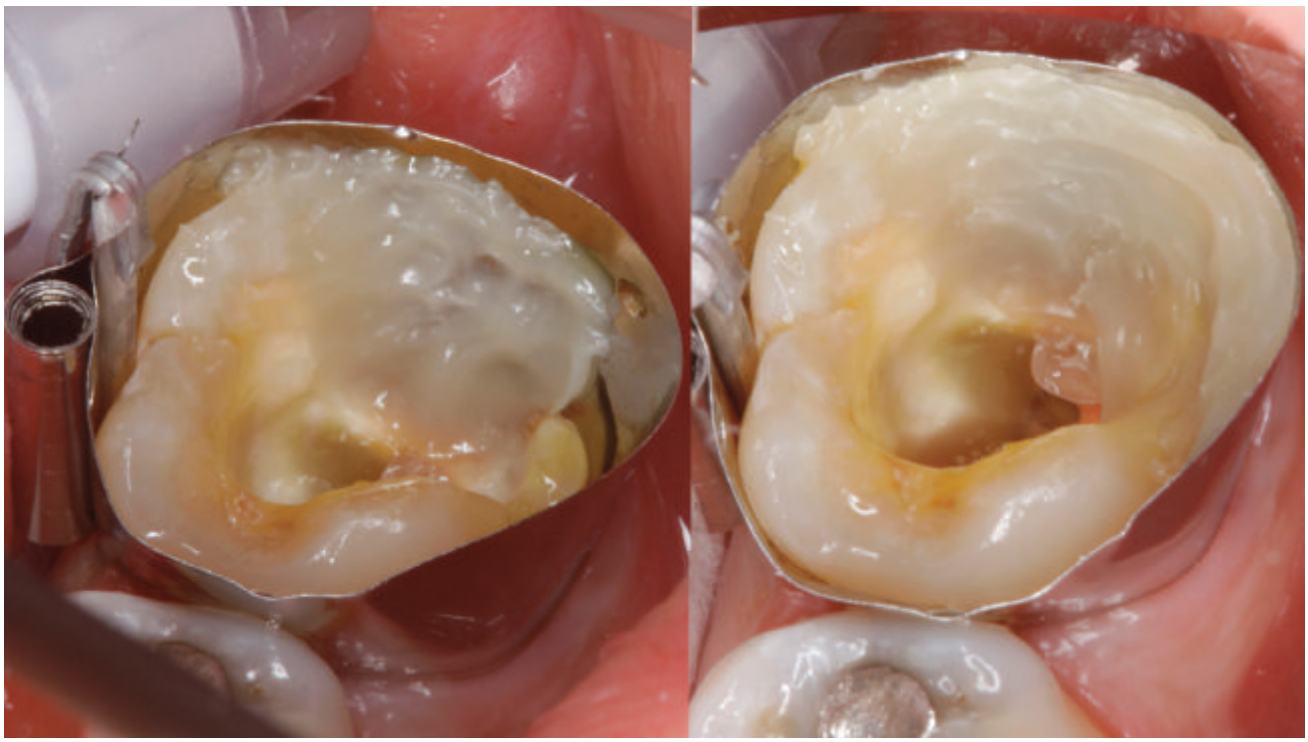

Figure 5. First, place a thin layer of composite adapted to the matrix that remains covering and isolating the fibreglass in the interior of the restoration.

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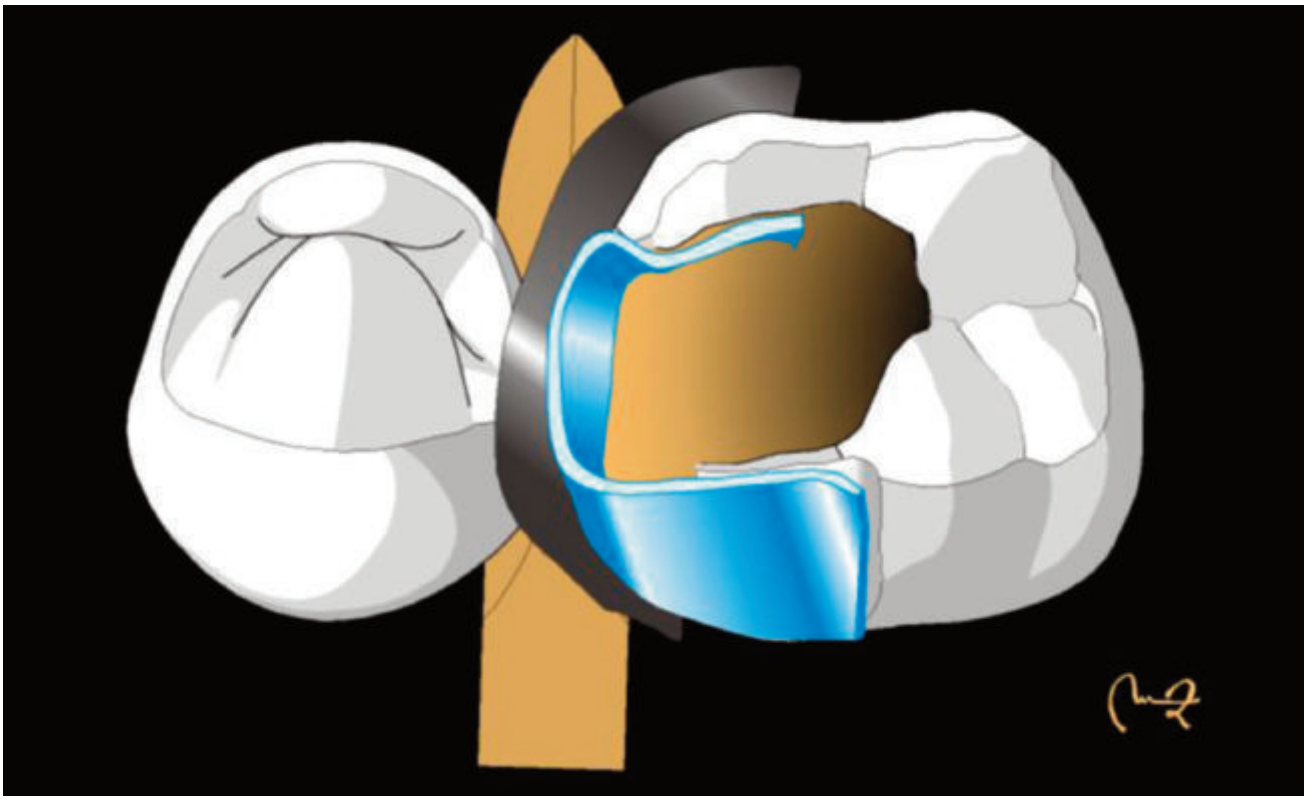

Figure 6. Schematic drawing that shows how we have placed the fibreglass in the clinical case we are describing.

meated as always with a fluid composite, to the now defunct Vectris® (Ivoclar/Vivadent) and the recently presented Dentapreg® which is what we have used (Figure 7). Dentapreg has a great variety in fibreglass design (braided PFM of 3 mm, braided UFM of 6 mm, braided SFM of 2 mm and braided SFU of 2 mm) with specific indications that we are going to omit except in those that we are going to use in the case presented which is going to be the PFU of 2 mm in width with parallel fibres that can be expanded to 3 mm if pressed.

Once the fibre is placed in position, which we adapt to the surface with a steel spatula or with a ball also of thick steel, curing it with light to fixate it in the position and now we observe that the external walls of the crown have been reconstructed but the entire centre of the crown is left empty, for which we must begin the filling of this entire cavity with a composite that can be placed in small increments so that the light is effective throughout its thickness. This requires time since we have to put many layers of composite; it is for this reason that at present composites have been designed that can be cured in thicker layers with the curing light reaching the depths. They are the fluid composites Filtek™ Bulk Fill (3M ESPE) and the SDR™, Smart Dentin Replacement (Dentsply). These are injected in the base of the cavity, removing the needle as they are being inserted and they are placed in a thicker layer and always deep, that is to say, they cannot be exposed to the surface since their resistance to abrasion is less than that of the composite. A short time ago a new composite came out on the market from the firm Ivoclar/Vivadent named Tetric EvoCeram® Bulk which is of a thick consistency, low contraction in curing, good resistance to wear and capable of being polymerised in thick layers of approximately 4 mm. This product can be left on the surface, but one must stress that it is of a thick consistency and not fluid like those described previously.

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Figure 7. Dentapreg® PFM fibreglass of 3 mm is a good option for girthing the crown. Braided fibreglass can also be used.

In this case that we are describing, first the base of the cavity was filled with the composite Filtek™ Bulk Fill (3M ESPE) and then the fibreglass was placed in the crown wall (Figure 8).

We have now restored the crown wall and reinforced with fibreglass which we have placed in a circular form and filled the deepest hollow of the cavity which remained in the centre of the crown. This in itself reinforces the crown of the tooth since we are girthing it, but we can also have additional reinforcement by again adding fibreglass but now placed in the vestibular-lingual sense (Figure 9). This placement of the fibreglass from the buccal wall to the lingual is that which is normally used in clinical practice.

The fibre that we have now used is the PFM of 3 mm in width (Figure 10) which we take to the cavity that we have made before, covered with a composite fluid to achieve a good adaptation to the walls and to avoid empty spaces remaining. We adapt it perfectly in the shape of a U to the vestibular wall, to the base of the cavity and to the lingual wall, applying pressure with a thick steel ball to adapt it perfectly to the walls. Once in position, it is polymerised. Now an important point must be made: taking into account that the fibreglass cannot be exposed to the exterior, we have a first option, which is that of being meticulous in the measurement of the length of the fibreglass so that it does not surpass the crown margin of the vestibular and lingual wall. This is hard to achieve since frequently it each remains buried or surpasses the margin. To avoid making the clinical work difficult, we can first surpass the margin, without going too far, of course, we use the photopolymerisation light to harden it and then we have two options: either eliminate the excess with a diamond bur, making at the same time a bevel as observed schematically in the drawing of Figure 11, or else after filling the remaining cavity and having carved the occlusal anatomy of the molar, we see whether or not part of the fibre has remained exposed. If it has been, a cavity is made with the diamond bur and it is filled with composite leaving the fibre at a depth. With both options one has to make a new acid etching and placement of the adhesive before placing the composite, since it is possible that we may leave the enamel exposed.

Once the fibre is in place, the rest of the cavity is filled with a nanofilled composite which in this case has been the Filtek™ Supreme XTE (3M ESPE) which is placed as always in various triangulated layers to avoid the contraction in curing and to achieve a good hardening in the depth. It can be inserted in small increments of material until the crown anatomy is reconstructed or place an excess and then eliminate the excess with the diamond bur until achieving an appropriate occlusal anatomy (Figure 12).

The matrix is removed and the carving is begun of the crown profile (diamond fissure bur from the firm Komet® Ref. 806 314 250 524 012) as well as the occlusal anatomy (diamond bur with the shape of a rugby ball from the firm Komet® Ref. 806 314 257 524 023) although for this you can use a multitude

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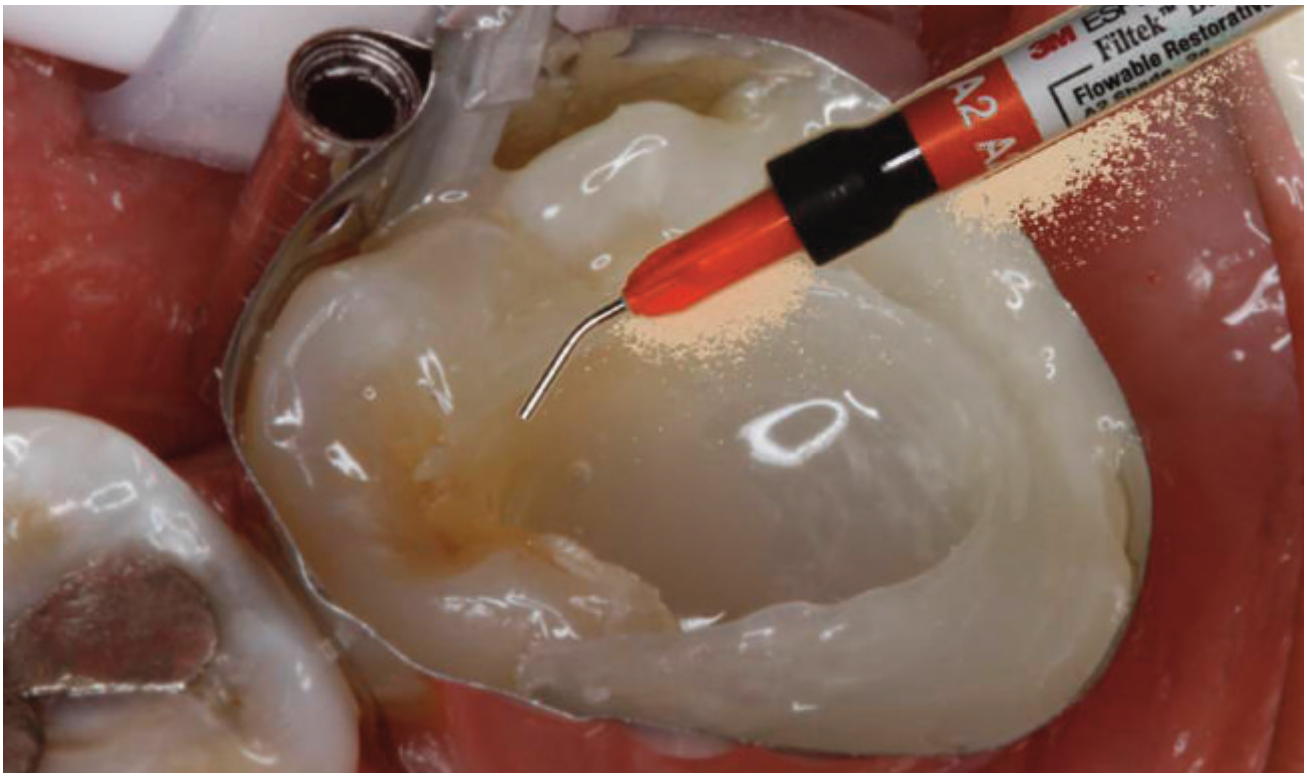

Figure 8. Through the interior of the preliminary wall of the composite adapted to the matrix, the fibreglass is placed, embedded in the classic composite fluid or in the new Bulk Fill (Filtek™ 3M ESPE). We also use this to fill the base of the cavity, avoiding with its injection leaving air bubbles and polymerisation problems in the deepest area.

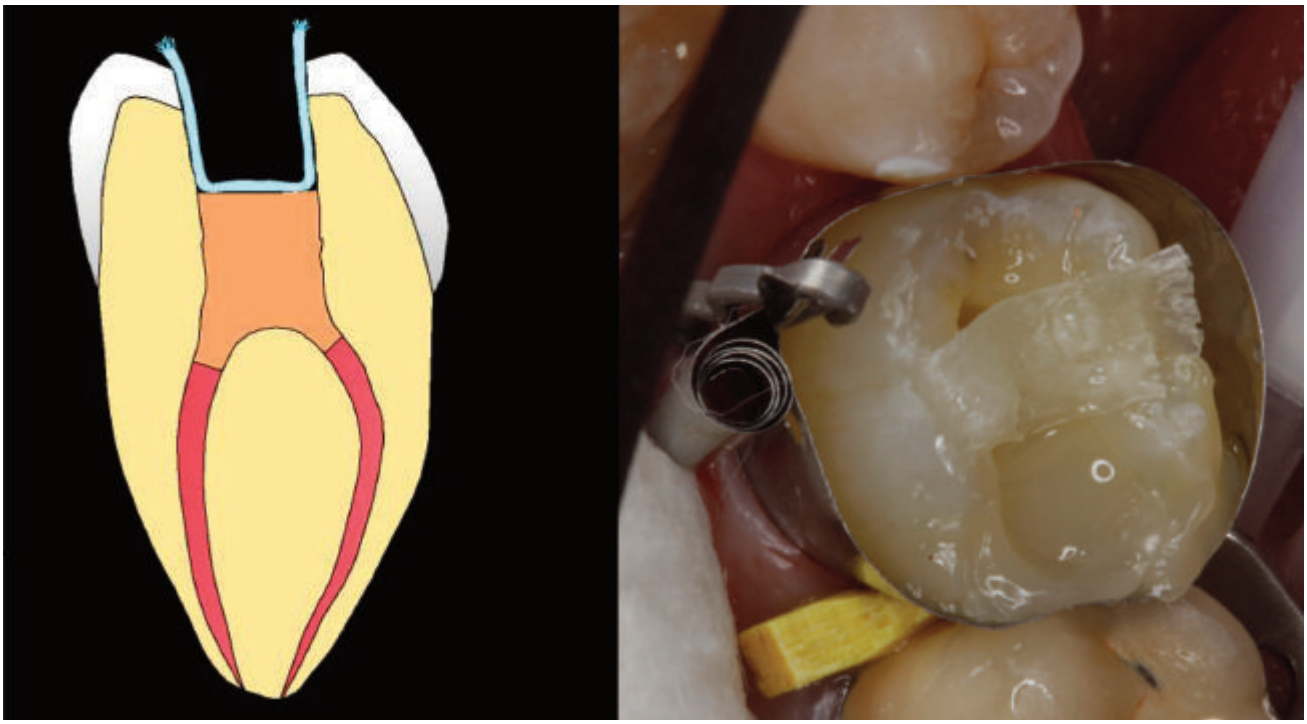

Figure 9. Schematic drawing of the position of the fibreglass placed making a loop from the vestibular wall to the lingual or palatal wall and a clinical case "in vivo" of its placement before being adapted to the walls and to the base of the cavity.

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Figure 10. Dentapreg® braided fibreglass of 3 mm PFM3 and of 2 mm SFM.

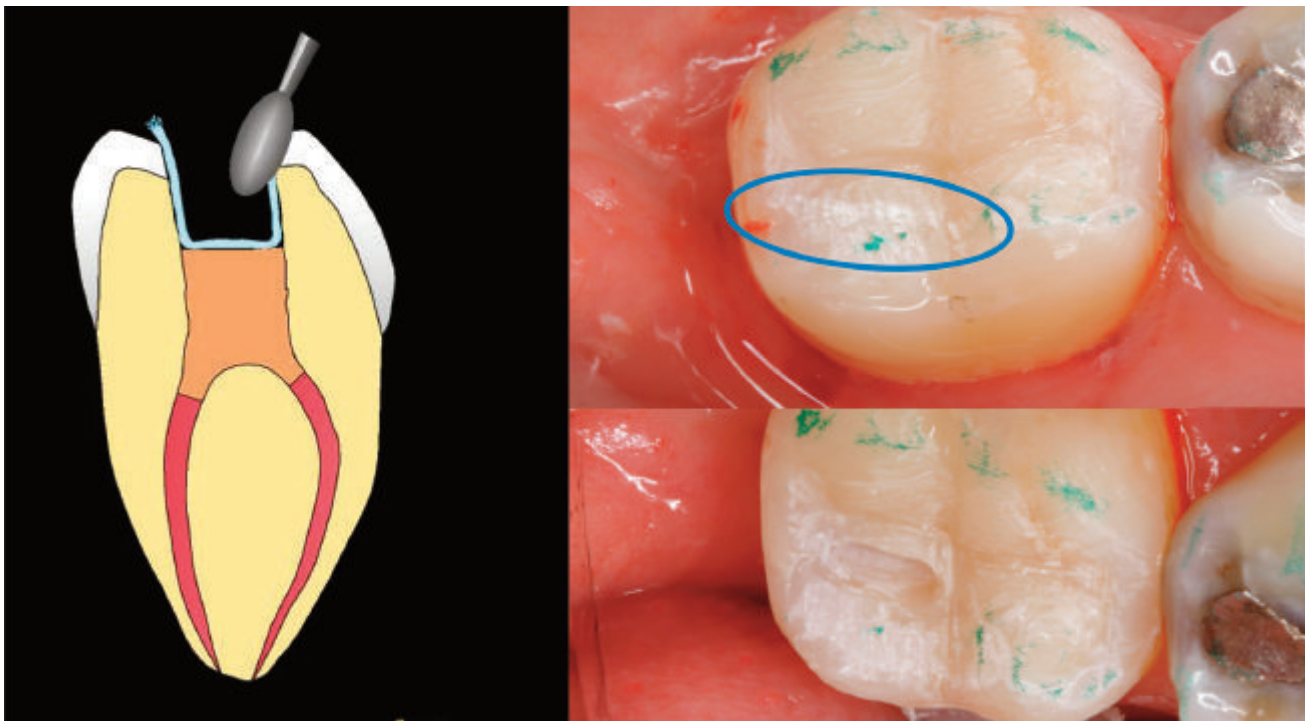

Figure 11. One of the ways of getting the fibreglass to remain included in the restoration is to eliminate the excess with a diamond bur once it is polymerised in its position as described in the drawing and another way is, after carving the occlusal anatomy of the crown and we detect its exposure, to make a micro cavity, eliminating it from the surface and then burying it with a new application of the composite.

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Figure 12. The filling of the cavity is done by layers with a composite of the nanofiller Filtek™ Supreme XTE (3M ESPE) waiting for the final carving.

of bur designs that are available for all the consumers' tastes (Figure 13). We control the occlusion, of course, in centric occlusion and lateralities and afterwards we perform the final polishing which in the molars we usually do with Enhance™ cup-shaped finishers (Caulk/Dentsply) even when the polish can be improved with Prisma Gloss™ (Caulk/Dentsply) polishing paste with felt cups. A polishing system Sof-Lex™ has just been presented by 3M which is ideal for the occlusal faces of the molars which cannot be polished with the classic discs. They are spiral finishing and polishing wheels.

The final radiograph taken from the ortho-radial position shows us the contour of the restoration and the adaptation to the gingival margin. The composite is radiopaque so it is easily distinguished from the dental structure (Figure 14).

DISCUSSION

Once the technique has been described and followed step by step, we still have a series of questions that we had indicated at the beginning of the explanation.

Do we previously insert a post in the lumen of the widest root?

Will we increase the resistance of the crown remnant if we insert fibreglass as an internal ferrule?

If the post does not reinforce the tooth and only serves to retain a core or crown restoration, why do we make an effort to insert it? Is it to be more satisfied, to justify our work or even for reminiscences of past times? The truth is that it is difficult to justify the placement of a metallic post, but it is no less difficult to justify the insertion of one of fibre in those cases of

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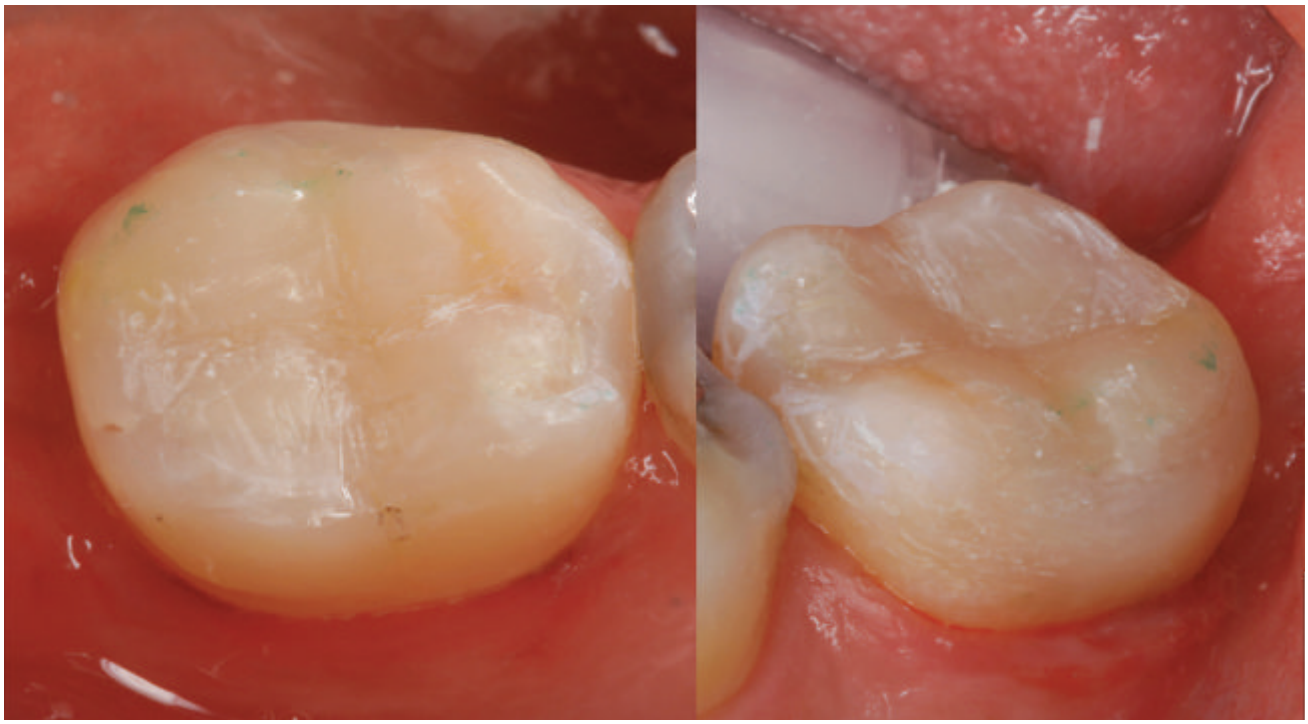

Figure 13. Carved crown.

Figure 14. Final ortho-radial radiograph of the finished crown restoration where we can see its gingival adaptation, thanks to the radiopacity of the composite.

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molar restoration, even when some research papers[1] conclude that the devitalised teeth restored with composite combined with fibre post resist the fatigue trials better.

The indication that makes us be able to decide on the crown restoration with composite instead of other alternatives such as the restoration with a cast post-core and a crown with total onlay is generally established based on two parameters: is there sufficient dentinal structure remaining so that the adhesion of a composite is sufficient? and, can we control the gingival margins of the restoration?

If we want to increase the quantity of dentin exposed, we can rely on that which is in the floor of the pulp chamber, eliminating in this area the gutta-percha that we use to fill the canals. We eliminate then the gutta-percha from the floor of the pulp chamber and we leave then only the gutta-percha filling in the entrance of the canals, freeing all the dentin from the base of the cavity (Figure 15). If we want still more retention it is now when we can place a cemented post inside the canal that is usually the thickest, that is, the distal in the inferior molars and the palatal in the superior molars.

We empty -but do not widen- the canal of the gutta-percha that fills it, using for this the classic Gattes burs (No. 4, 5 or 6) depending on the initial calibre of the canal and we cement the post, whether the current fibre ones or the classic metal ones (Figure 16). It must be stressed as cemented material that this must be dual cured since the light does not reach the apical area of the canal.

The most interesting subject for entering into discussion is the approach made initially. Will we increase the resistance of the crown remnant if we insert fibreglass as an internal ferrule? If we review the published bibliography, as always there are papers in favour[2-7] and against[8], all based on research papers in which their resistance to fracture of our thermal cycled samples are tested and subjected to compressive forces. We lack the long-term monitoring in our experience to verify whether, in fact, the premolar or devitalised molar restored with fibreglass placed in a U shape from the buccal to the lingual wall is clinically more resistant, compared to the classic restoration with only composite. We indeed can certify that over time the classic restoration with only with composite is effective (Figure 17).

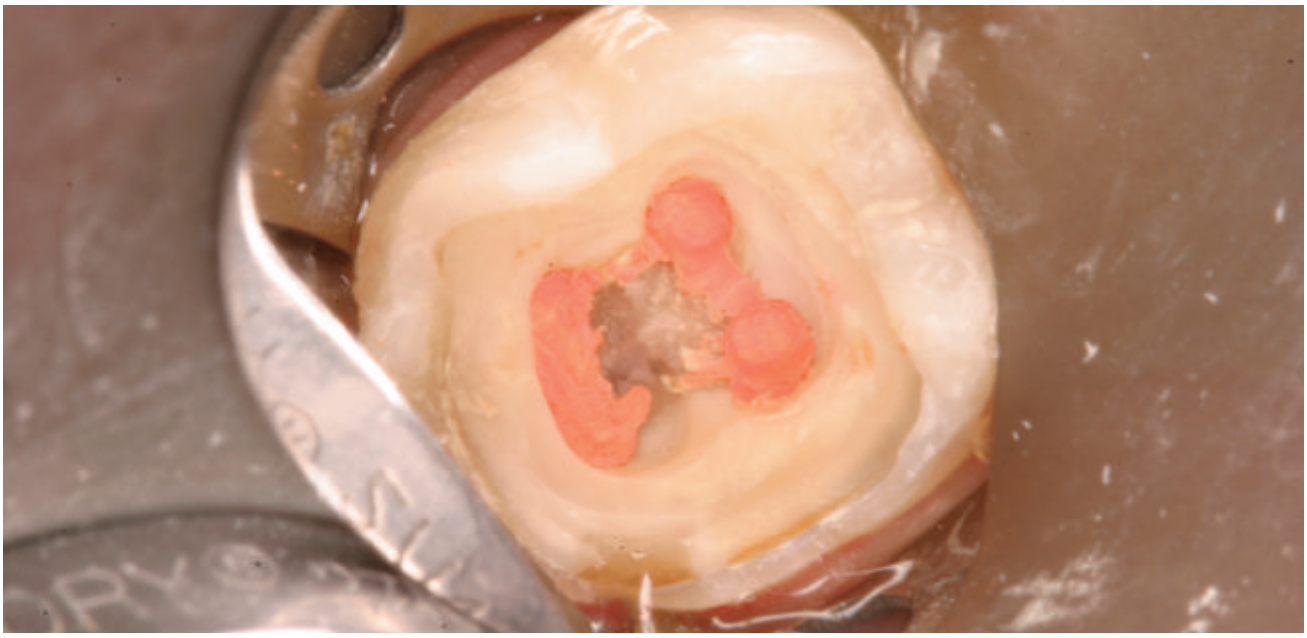

Figure 15. If we need more adhesion to dentin, we eliminate the gutta-percha from the floor of the cavity and from the entrance of the canals.

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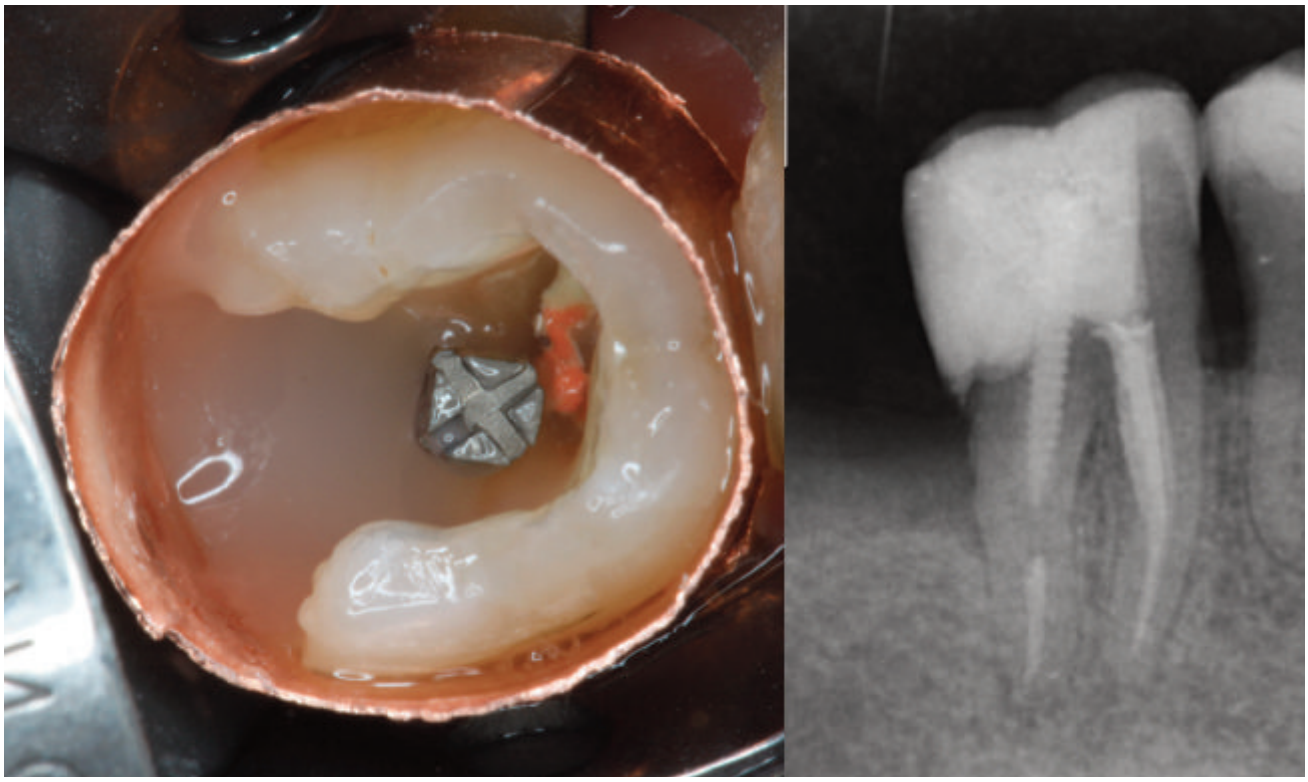

Figure 16. The post is cemented with auto and photopolymerisable composite fluid and the restauration is adapted to the gingival margin, carefully carving it with a bur.

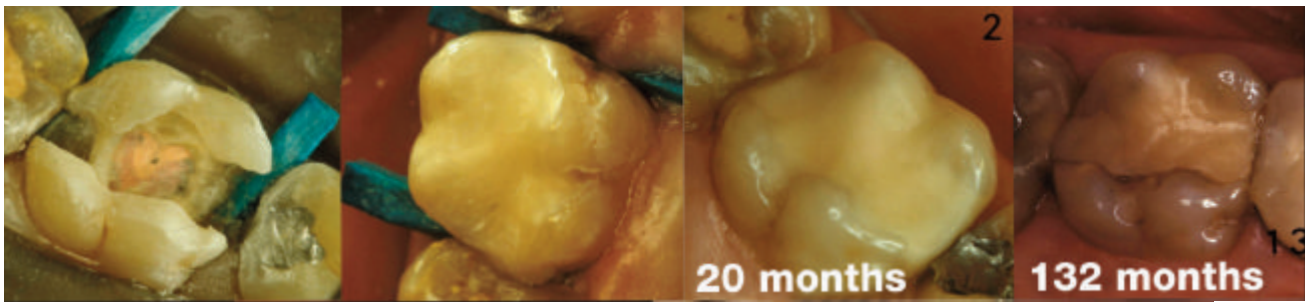

Figure 17. Photographic composition of the preoperative state of the crown of an endodontically-treated first molar (observe the bevelling of the crown margins of the buccal and palatal walls), its final restoration and a check-up at 20 and 132 months.

We also agree with Magne et al.[9], and one must note that it is fundamental to protect the cusps or at least a bevel marked in the crown margins of the cavity so that the retention of the composite is more effective.

We do think that the placement of the fibreglass in a circular sense, when it is possible and, better still, if it embraces, overlapping on the vestibular and lingual sides of the crown walls, increases the resistance to the mastication forces, avoiding a vertical fracture occurring in the dental crown and for this reason we have shown how to do it with a clinical case. We must now wait the necessary time to verify its comportment in the mouth over the years.

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