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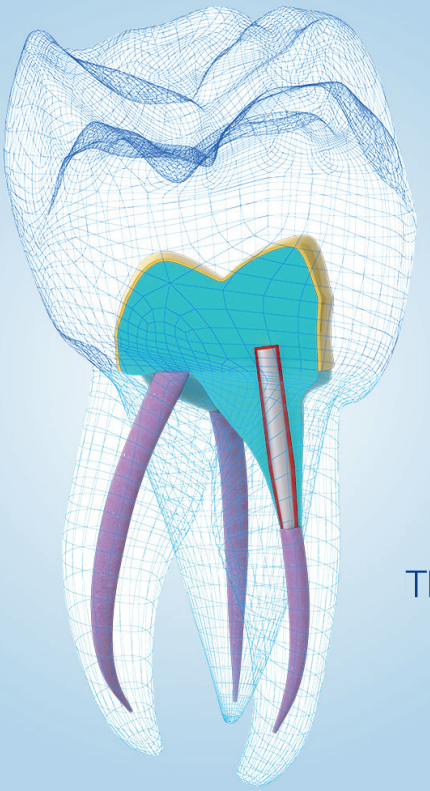

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introduction

Dear Doctor,

It is all too easy to reduce the concept of "modernity" to an opposition between past and present.

Experience helps us to progress, test, take risks and ultimately advance. And what if modernity is just the expression of each generation's experience?
The generation of those who made strides forward in dental skills, over time and for a long time to come.

The generation of those who worked to make dentistry more preventative and less invasive.
The generation of those who chose the path of new technology to allow practice to progress.
New technology is the sign of our modernity. And the most striking demonstration of this modernity in current dentistry is undoubtedly the coming of the digital age.
Of course innovation is only useful if it helps the practitioners and benefits the patients.
I work day after day with my teams to make progress in this direction, both in France and in the 90 countries where our solutions are available.

In this special edition, I will introduce you to some examples of what will make tomorrow's dentistry, while meeting the daily expectations of both practitioners and patients.
So let's take these bold steps forward into modern dentistry, here and now!

Lionel DESCOQS, CEO ITENA Clinical

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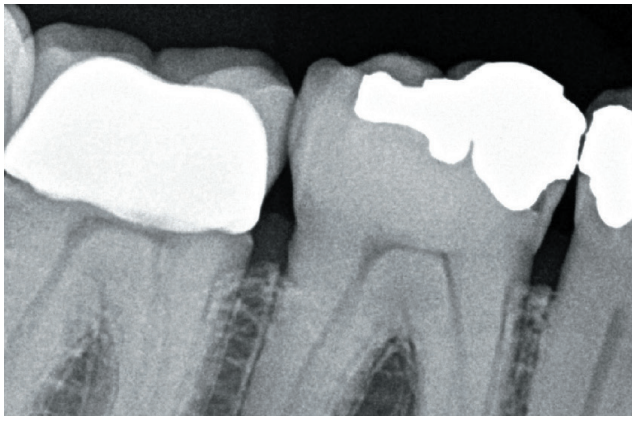
APPLICATION OF PARTIAL RESTORATION STUCK USING HYBRID CERAMIC: A STEP-BY-STEP GUIDE FOR HIGH-QUALITY AESTHETIC RECONSTRUCTIONS.

A 69-year-old male patient attended complaining of discomfort caused by repeated accumulation of food matter in sector 4.

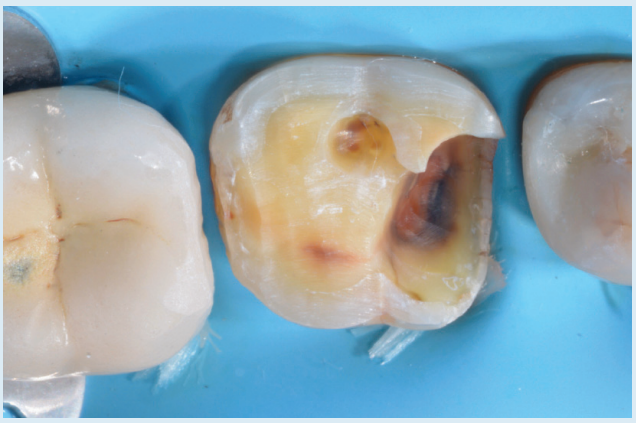
1. Clinical examination revealed that teeth 45 and 46 had been reconstituted using two amalgams located in the occluso-distal and the mesio-occluso-vestibular respectively. Tooth 47 bears a ceramic-metallic crown. All the teeth showed a negative response to the percussion and palpation tests, Pulp vitality was positive for teeth 45 and 46.

2. In tooth 46, a slight break of the amalgam was observed in mesial; this, following verification of all the contact points, appears to explain why the patient came for an appointment.
Several flaws or cracks were also noted in this tooth; this is not unusual when this type of reconstitution is present.
The bite test, however, remained negative.



3. An X-ray examination revealed resumption of decay under the amalgams in teeth 45 and 46. The fit of the ceramic-metallic crown no longer seems radiologically tight.
After discussion with the patient, it was decided to replace the amalgam in 45 with a composite resin, using the direct technique, and to restore 46 using an indirect partial bonded restoration in order to respect the therapeutic gradient. The patient deferred the repair work to 47 for financial reasons.

4. On the day of preparation, the surgical site was set up at the beginning of the treatment in order to withdraw the amalgams safely.
The dam also protected the exposed dentine against saliva and facilitated a visual examination of the tooth.
It should be noted that the shade was determined before the field was set up, in order to avoid errors connected with tooth dehydration.



5. After removal of the two amalgams and the decayed tissue, the occluso-distal composite for 45 was made. For 46, in view of the weakness of the remaining walls and the presence of numerous cracks, a partial bonded restoration with total overlay was decided upon, and work to prepare this was commenced.

6. The design of the preparation was optimised using a composite material, according to the principle of CDO (Cavity Design Optimisation). A classic bonding procedure was therefore performed.
The last photo-polymerisation of the composite was carried out using glycerine gel which covered the preparation, to avoid the presence of a non-polymerised surface layer caused by the inhibiting action of oxygen.

7. The dental dam was removed in order to provide the finishes. It is important to ensure that the enamel margins, essential for adhesion, are not covered with any excess of composite resin.

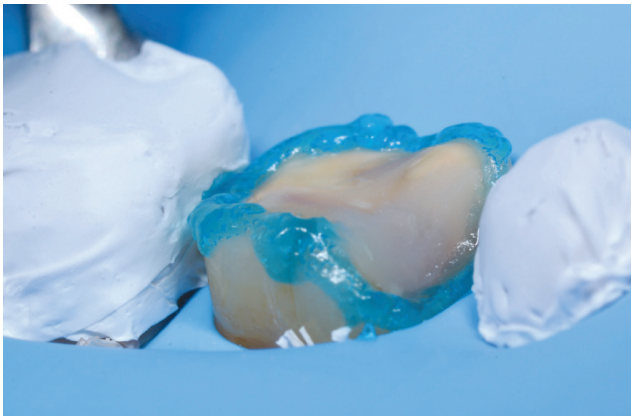
8. The double-mixture print was provided using silicone; the antagonist used alginate. The whole was then sent to the prosthesis laboratory.

9. A temporary overlay using isocasting was produced in order to ensure dimensional stability while the prosthesis was being designed.

10. The impression was cast and the model scanned in the prosthesis laboratory (Laboratoire Burdigala, prothetists Guillaume and Julien). The piece was then designed and machined using a pre-polymerised hybrid ceramic disc (Numerys HC™, Itena) consisting of 75% ceramic and 25% resin. Finally, it was coloured (Optiglaze Color™, GC) and checked by the prosthetist.

11. The overlay was once again checked in the office against the working model and double (contact points and fit).

12. The prosthesis, after decontamination, was tried in the mouth before and after application of the field to ensure that the field did not interfere on insertion.



13a and b. The clinical procedure of bonding could then begin and required the application of a strict protocol which began with treatment of the surface of the tooth. Gentle sanding with alumina for 5 seconds, plus etching of the enamel using 37% orthophosphoric acid (Dentoetch™, Itena) for 30 seconds, were carried out in order to increase the bonding capacity of the surface.

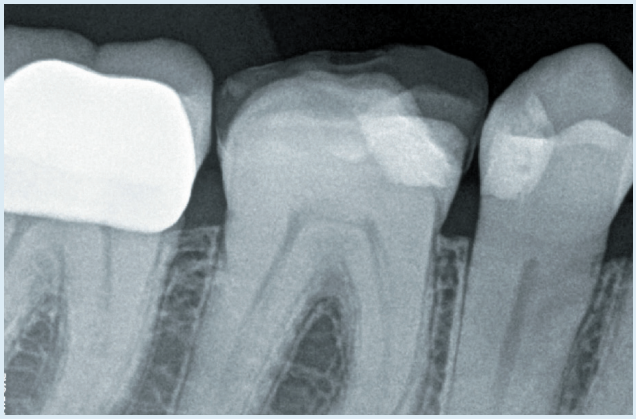
14. The universal adhesive Iperbond Ultra, provided by Itena, was then applied by 30 seconds of brushing, using a micro-brush. It was then dried for 5 seconds using compressed air, in order to produce an even spread on the surface of the tooth. The operation was repeated a second time, according to the manufacturer's recommendations, 5 seconds of application of adhesive and 5 seconds of drying. It was then photo-polymerised for 20 seconds. The tooth was now ready to receive the prosthetic piece.

15. At the same time, the internal surface of the prosthesis must also undergo surface treatment.
To achieve this, it was also sanded using alumina for 5 seconds. After that, silane (Silan-It, Italy) was applied, dried and left in the ambient air for one minute to make the piece more easily wettable. Finally, the same adhesive was applied to the piece and blown, also to allow good spreading.

16a and b. Assembly was carried out using a dual adhesive (Total C-Ram, ITENA Clinical). Some of the excess was removed before polymerisation, using a pincer impregnated with a modelling fluid for composite. The piece was then photo-polymerised for 20 seconds per face. The remaining excess was then removed using the scalpel blade.

17a and b. The dam was removed and the finishes applied using polishers for composite.

18. The occlusion was then verified in static and dynamic, in order to ensure that the prosthetic piece fitted perfectly into the patient's occlusal diagram.



19. A post-operative X-ray was performed in order to ensure that the restoration was suitable and there was no excess adhesive in the embrasures.

Clinical case carried out with the support of ITENA Clinical.
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RESTORING A SMILE: A CONSERVATIVE APPROACH

Adhesion in dentistry provides us with long-term therapeutic opportunities and saves on tissues. Very often, it also provides a stylish solution in aesthetically demanding cases. This article, using a clinical case, illustrates the modern way of thinking on methods of treating the maxillary incisor-canine block, and more specifically the depulped incisor, with the necessary aesthetically pleasing outcome.

1. Photograph taken on day of emergency consultation.

Clinical examination

This female patient first came to the surgery for an emergency appointment. The restoration of her depulped lateral incisor, made entirely of composite, had broken (Figure 1). The tooth was free of symptoms and the X-ray revealed an excellent quality of endodontic treatment, which remained tight (Figure 2). The patient wished for a quick, long-term, aesthetically pleasing solution. At the same time, she eagerly accepted our proposal to restore her old interproximal composites, which were showing some loss of fit.

2. X-ray taken on day of emergency consultation.

Operating field

Effective adhesion was achieved on the surfaces, which were clean and protected against mouth fluids [1]. The setting up of a watertight operating field will optimise the treatment session (Figure 3).

On one hand, saliva can reduce bond quality in several different ways:

- It interferes with the creation of resin extensions by penetrating the tubules of freshly milled dentine [2];
- its buffering capacities and glycoproteins will reduce the effect of acid etching [2];
- its constituent enzymes will degrade collagen fibres, and this can have the effect of altering the hybrid layer or thickening the smear layer.

Moisture originating from gingival fluid, blood or air breathed out in the mouth cavity also reduces the adaptation area between the tooth and the composite resin, thus reducing the adhesive force by 70% [2].

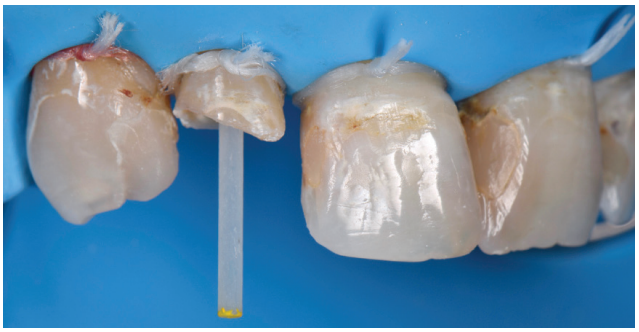
On the other hand, the operating field also helps:

- Widen the view field and the area of action, thus greatly improving its ergonomics [3];
- Access the limits (checking the edges of the restoration area at all levels in the clinical sequence);
- Prevent the risk of pollution by saliva, blood or gingival fluid, and thus avoid deterioration of the material and joint.
- Preserve the contact points, thanks to the fineness of the dam.
- Control excess levels of adhesive composite, especially in the interproximal area.
- Provide the patient with a sense of security, as the tongue is protected from the rotating instruments and products used by the clinician [4]. as well as from flying alumina particles used during sanding and the acid agents used during the chemical etching.

3. Setting up of operating field (dam).

Choice of coronal-radicular reconstitution

This depulped incisor, which had lost more than half of its volume, required a coronal-radicular reconstitution (CRR) in order to hold the reconstitution material properly [5].
The good indication for the type and material of RCR, while avoiding a break, also helps hold the incisor within the arch for as long as possible. The reconstitution material should ideally transmit stress homogeneously to the coronal and radicular dentine, as in a healthy tooth. The interfaces between the various restoration elements should provide the same seal as the endodontic area, as well as homogeneous reconstitution (Figure 4). Depending on the type of CRR, the occlusal stresses are transmitted into the residual dental structure in different ways [6]: material of Young's module, positioned high and away from the dentine, favours a build-up of adverse stress in the root, thus increasing the risk of breakage. To avoid this phenomenon, priority should be given to reconstitution material that most nearly has the same elasticity as natural dentine [7-9]. An assembly method that gives priority to adhesion will better reduce stress [8, 9]. Scientific literature is currently tending towards a consensus: regardless of the type of radicular anchor chosen, it is the presence of a circle around the peripheral dentine, measuring at least 2 mm high and 1 mm thick on at least 3 walls, which provides the "ferrule effect", which in turn significantly reduces the risk of cervical breakage or separation of the restoration part. This circling effect is all the more effective when the walls of the residual cervical dentine are both high and parallel [10, 11].
Under ideal conditions, the CRR with fiber and adhered tenon is currently the reference option in relation to the inlay core [12]. The fiber post and the coronal reconstitution composite are glued to the dental tissues.
The assembling resin (adhesive) acts as a force "breaker" because of its low elasticity modulus. In addition, it provides chemical bonds between the various stages of the reconstitution, forming a homogeneous mechanical section between CRR and tooth. This CRR, with its anisotropic properties, thus transmits the functional stresses to the whole of the tooth, reducing the risk of a root breakage. Because of its translucent properties, the fiber post also helps preserve a cosmetic continuum. Amongst the solutions available on the market, those that prioritise a one-

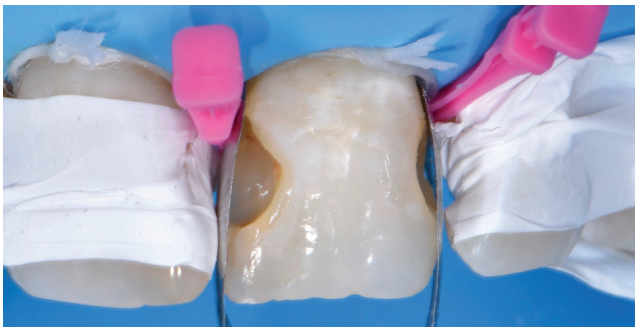


4. Fitting the fiber post.

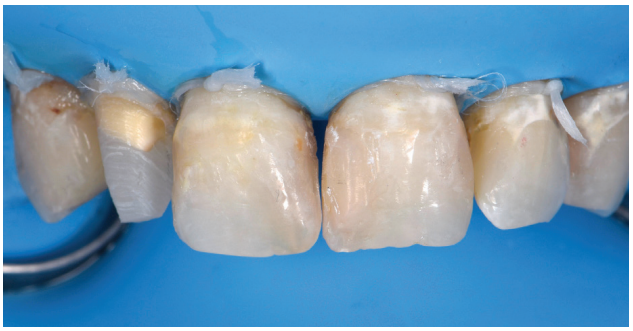
5. Calibrating the matrix after adjusting and cutting the fiber post. A scallop shape is made in order to let out excess composite during insertion.

6. Preparation is started immediately after the matrix is inserted. This helps assess the qualities of the adhesion interfaces and adjust the position of the boundary in relation to the dam.

7. Removing the composites.



8. Forging the edge of the future restoration areas.



9. Photograph of the incisor-canine block following stratification of the interproximal composites and final preparation of tooth 12.

10. X-ray after adhesion, intended to check for absence of excess adhesive.
11. Photograph after JO adhesion centred on tooth 12.
12. Photograph after JO adhesion of the incisor-canine block.
13. Photograph of smile (profile).

time injection technique appear to be the most ergonomic and ensure a homogeneous unit, avoiding a large number of interfaces.
Generally, they use a micro-hybrid composite that is injected in two stages, a «dentine» shade, and cements to the coronal and radicular dentine using a two-stage adhesion system [Figures 4, 5, 6].

Composite restorations

Once the CRR is complete, we then concentrate on the interproximal composites [Figure 7]. In order to ensure reproduction of an emergence profile compatible with good periodontal health, the edges of the restoration must then be forged [Figure 8].
The best possible cosmetic solution is obtained by matching the colour and shape of the original teeth as closely as possible.
With regard to colour, the method of stratification of layers of composite with progressively lower colour saturation levels will be required (the choice of colour is made before insertion of the dam as they appear paler because of dehydration). In terms of form, the application and finish of the composites shall comply with the teeth transition lines.
Thorough polishing [Figure 9] and photo-polymerisation with glycerine will be necessary in order to prevent the polymerisation inhibition layer caused by contact with oxygen.
The dam can then be withdrawn in order to complete the finishing touches of the lateral incisor preparation and take the impression.

Impression and temporary piece

The maxillary impression is taken using "wash technique" with silicone. Removal of gum tissue is not necessary as the edges are supragingival.
A mandibular impression using alginate is also taken, so that the prosthetist can adjust the level of occlusion using the articulator.
A temporary ion-mould piece is produced directly in preparation.

Peripheral crown

Producing a coronal-radicular reconstitution with adequate mechanical, optical and aesthetic properties only makes sense if it is combined with an underlying restoration that is translucent [14, 15].
Using a stratified vitroceramic frame reinforced with lithium disilicate appears to be the most sensible choice. This choice, however, recommends assembly with adhesion, in order to reinforce the whole entity.
Adhesion is carried out under the dam, and particular attention must be paid when polishing the joint, in order to ensure its cosmetic and biological integration over time.
A final control retroalveolar X-ray will be necessary, to check that there is no excess adhesive (Figure 10).
The patient declared that she was delighted with the work [Figures 11, 12, 13]. A clinical examination one week later confirmed good biological, functional and cosmetic integration.

Conclusion

Treatment of a maxillary incisor-canine block necessarily involves a carefully thought out approach to treatment. Tooth decay and discolouration are significant clinical criteria which strongly influence our choices of treatment.
When both the form and colour of the tooth have to be restored, recourse to a prosthetic piece proves essential. If a coronal-radicular reconstitution is necessary, recourse to fiber adhesion techniques is preferable. It is this type of reconstitution, with its high survival rate, that best satisfies all the conditions for preserving a depulped maxillary incisor, provided one remains within the field of application (residual dentine circling, limits consistent with insertion of tight operating field). Where the decay is more significant, recourse to a post and core with the "press on metal" technique would allow cosmetic continuum. This allows the best possible reconstruction of a homogeneous structure similar in both mechanical and cosmetic terms to the structure of a natural tooth.
This favourable environment allows maximum benefit to be derived from using adhered translucent ceramics. The item thus created will provide a long-lasting biomimetic and cosmetic restoration.

KEY POINTS

- Treating a maxillary incisor-canine block involves a carefully thought out therapeutic approach.
- Because of its optical properties, the RMIPP provides a cosmetic continuum between tooth and prosthesis.
- Management of the elimination of excess and adhesive components is a crucial point on which periodontal integration and the long life of the restoration, in both cosmetic and functional terms, depend.
- Adhesion gives the ceramic its final level of resistance, producing a single body with the underlying dental support.
- Use of an operating field will provide better views and ideal working conditions for gluing the composite and the ceramic.

Recommended Reading

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Gerard **DUMINIL**
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Associate Member of the
French National Academy of
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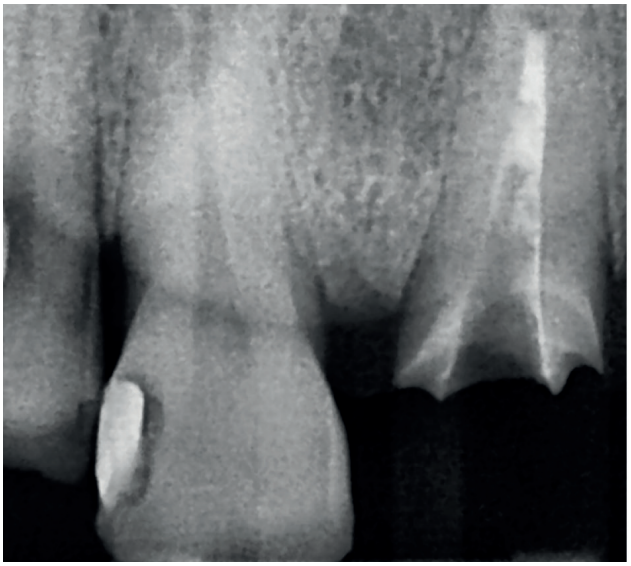
INDIRECT CORONAL-RADICULAR RESTORATIONS
USING THE CAD/CAM TECHNIQUE

This article describes the reconstruction of a maxillary central incisor using an indirect coronal-radicular restoration and a crown.

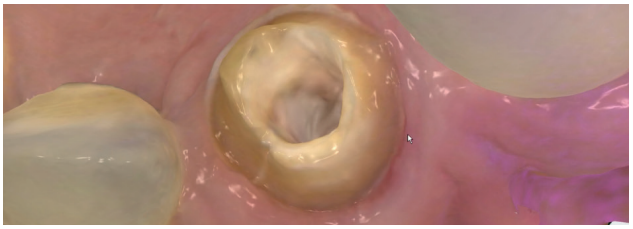
In certain situations involving significant coronal decay, recourse to coronal-radicular restoration (CRR) remains the only possible treatment.
There are two possible types of reconstruction:
- The direct method: a reconstitution carried out in the chair, with material inserted in the plastic phase in combination with glass fibre tenons.
- The indirect method: a reconstitution with a piece made in the prosthesis laboratory on a model obtained using the classic or digital method (core build-up or inlay core).
Within this article, we will illustrate a process by which a maxillary central incisor is reconstructed using an indirect CRR and a crown.
In the clinical case presented, we look at the restoration of a tooth with an existing pin, the cosmetic part of which has broken.
It is suggested that an inlay core is indicated because of the absence of residual dental walls (Figure 1). We will use a new hybrid epoxy and glass fibre material (Numerys GF®) for the machining of the inlay core. Secondly, an all-ceramic crown will re-establish the aesthetic and functional appearance. After removal of the existing prosthesis, the canal chamber is already too wide to take a standardised pin. Preparation involves regularisation of the walls using Largo burrs to eliminate the cement residue and other debris. In the occlusal part, a notch is produced to indicate the position of the future piece and thus prevent the possibility of rotation. As far as possible, the residual dental structure is shaped to preserve a crimping ferrule effect away from the peripheral edges of the future crown [Figure 2].

Optical impression

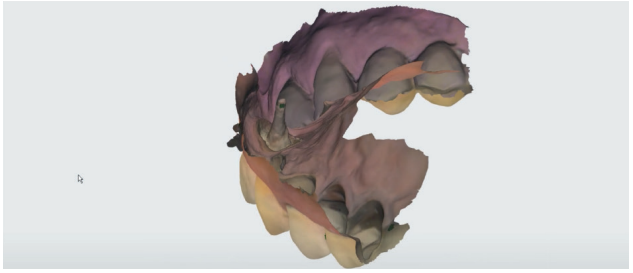
In the case of a CRR, a sectorial impression is sufficient. For this type of anatomical preparation of the canal, the impression is taken without a supervisor; the camera views the canal chamber throughout its depth [Figure 3]. Within the preparation zone, a switch to high-resolution mode is essential for capturing the anatomy of the canal. It requires excellent camera stability above the canal, with the tube slightly inclined to see all the sides.
This requires a camera that is technically capable of great depth of field. In this case, we used the Trios3 camera made by 3Shape.
The antagonist arch and occlusion were pictured.
The peripheral limit of the piece was set by the practitioner, in order to guide the prosthetist during the design process [Figure 4]. In certain cases, a first impression using the initial or temporary tooth still in place may be taken in order to allow simultaneous production of both inlay core and future crown.
In the laboratory, the prosthetist designs the piece using CAD tools adapted to this type of work [Figures 5-8]. The file



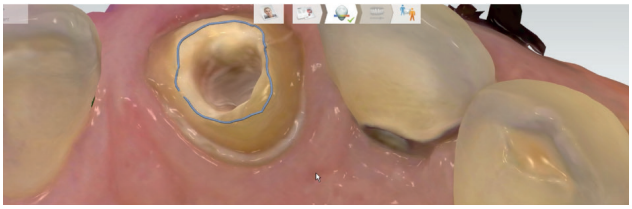
1. X-ray of tooth 21 following removal of the failed crown. The distal obturation of tooth 11 will be reproduced in a different operation.



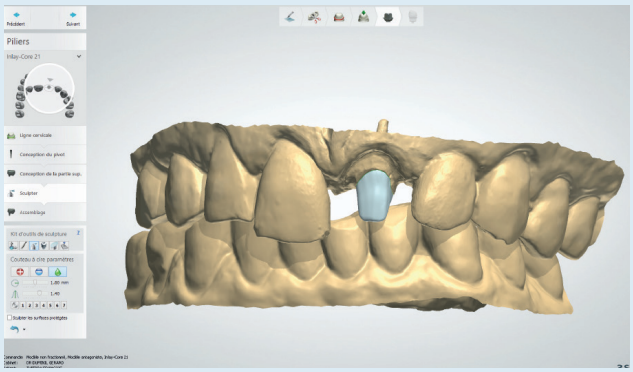
2. Occlusal view of preparation process



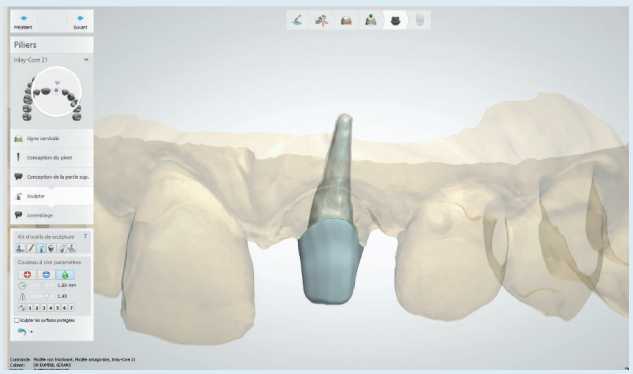
3. On the inner surface of the optical impression, the shape of the canal, as pictured, can be clearly seen.



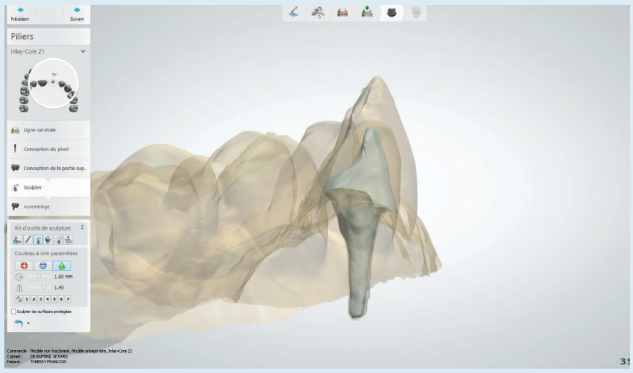
4. The practitioner indicates the desired position of the peripheral limit of the inlay core.



5. View of the core in the CAD software.

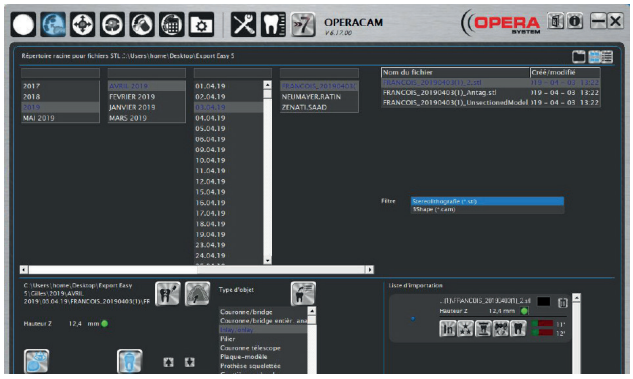


6. The piece as a whole, seen in transparent view.

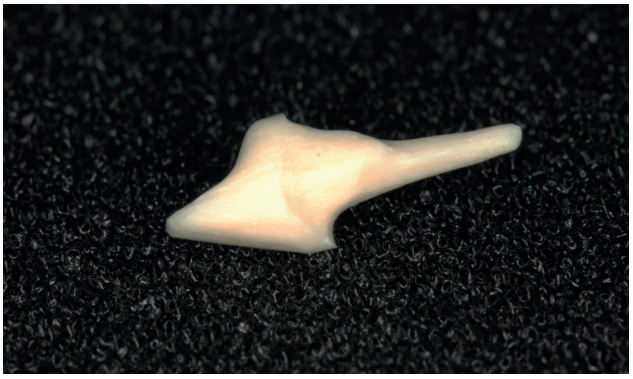


7. The piece as a whole, seen in transparent view

8. View of modelling of moulds to be printed.



9. Interface of machine software and production tool



10. The piece, on leaving machining.

11. Testing on the model

is then exported to the machining software, in STL format. Care must be taken to orientate the pin axis in the direction of the fibres in the block (or galette) of material. The machining range (choice of tools and cutting trajectories) is calculated automatically by the machining device software [Figure 9].
At the same time, moulds are printed out.
The piece thus produced is tested on the mould and sent to the surgery [Figures 10, 11].

12. X-ray examination of adaptation.

13. Etching of the canal using phosphoric acid.

14. The inner surface of the canal is coated with adhesive.

15. Silanisation of the piece before application of adhesive.

Clinical assembly protocol

The CRR is tried in the mouth to confirm its suitability. The radio-opacity of the material makes a control X-ray possible [Figure 12].

Prepare the canal

- Etching with phosphoric acid [Figure 13].
- Thorough rinsing followed by drying.
- Application of universal adhesive (IperbondUltra® + activator) [Figure 14].

Prepare the post and core

- Cleaning with alcohol and drying with dry air.
- Application of a layer of silane and drying for one minute (Silan-It®) [Figure 15].
- Application of universal adhesive (IperbondUltra®).

Assembly

- Using the specific end, injection of adhesive (TotalC-Ram®) into the canal from the bottom, rising in order to prevent bubbles.
- Application of a small quantity of composite adhesive on the canal section of the inlay core.
- Positioning of the structure within the canal, photo-polymerisation and removal of excess adhesive [Figure 16]. The product also has a chemical setting process, which guarantees complete hardening even at the canal bottom.
- If necessary, touching up can be easily achieved with a diamond burr [Figures 17, 18].

Although it is technically possible to produce the crown during the same laboratory phase, it is preferable to make another impression for producing the crown, as certain parts may have been adjusted following assembly of the inlay core.

The completed crown takes pride of place in the patient's smile [Figure 19].

Discussion

Choice of material

In order to achieve the aims, namely retention of the restored crown, and making the canal system tight and the prosthetic tooth biologically and structurally durable, the ideal material for a CRR must satisfy certain requirements [1]:

- Must have an elasticity modulus similar to that of dental tissue.
- Must allow restoration of an inlay core.
- Must be biocompatible.
- Must keep the canal sealed.
- Must be aesthetic if possible.

Traditionally, the indirect method uses precious or non-precious metals, using the foundry technique. These materials do not however meet all of the above criteria, especially elasticity modulus, aesthetic appearance and biocompatibility, especially when more than one metal is used [2].

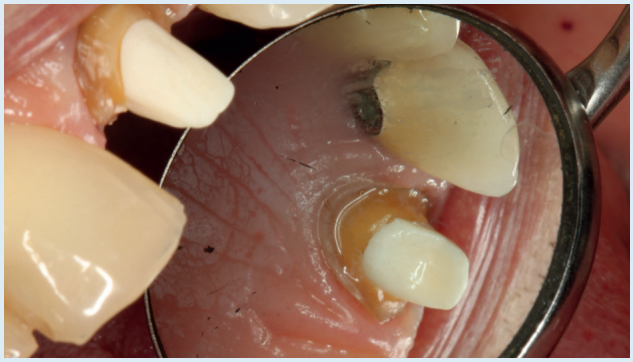
The advent of new materials has meant new solutions: Itena Clinical has now started marketing a hybrid product (20% epoxy resin and 80% glass fibre (Numerys GF®)). This material, intended for machining, is available in blocks or galettes and can be machined dry or dried under irrigation [Figure 20]. The original feature of this product is that glass fibres are all orientated in the same direction, along the desired axis of machining. This material has an elasticity modulus comparable to that of dentine; it is radio-opaque and its aesthetic appearance does not require the superstructure to be made opaque, It is for all these qualities that we will be using it for this reconstruction.

Preparing the tooth

Depending on the initial diameter of the canal lumen, preparation shall be carried out using standardised drills or Largo drills in a canal of greater volume; the impression technique shall be adapted to the type of preparation carried out [3].

16. Immediately after insertion, polymerisation begins and the excess adhesive is quickly eliminated.

17. Appearance of the inlay core before taking of the impression for the crown



18. Lingual view of adaptation

19. Final appearance, standard tooth in place.

20. The material is available as standardised blocks or galettes.

21. Inlay cores using direct method.

22. Direct method following shaping.

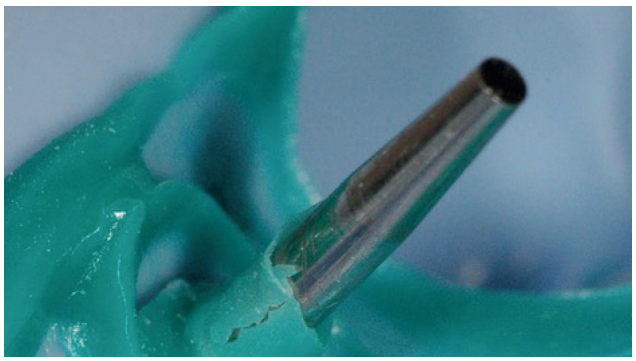
23. Impression with combination of elastomers and calibrated pins.

Impression technique

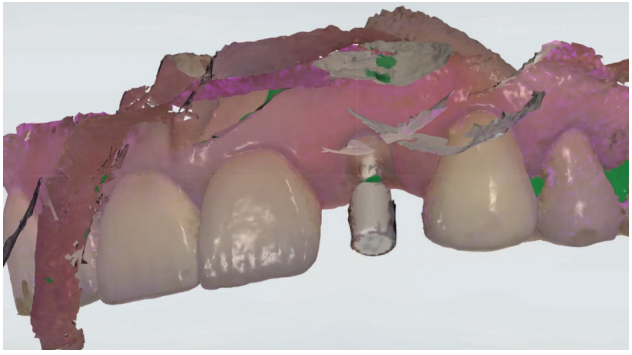
Traditionally, a CRR can be prepared directly in the mouth using self-polymerising resin [Figures 21, 22] or in the laboratory, on a model produced from a physical or digital print [4].

Classic impression

For standardised milling, the canal impression is taken using one or more calibrated pins combined with elastomer materials [Figure 23].



24. Detachment of material from stake, causing an error in moulding.



25. In the optical method, using a stake in a milled canal with standardised drills.

In a canal of greater volume, the impression material is injected directly into the canal right down to its end, and a rigid stake can be added to it [5].
In these two situations, there is a risk of the impression material becoming detached from the pin or stake [Figure 24], and if a stake is not used, distortion may occur during removal or moulding of the impression.

Digital impression

For standardised milling, the impression is made in two stages. The first stage pictures the dental sector in question and the occlusal part of the preparation process.
Then, a calibrated marker is inserted (scan post) and the second stage of the impression pictures the stake in position and the proximal teeth [Figure 25].
In the case presented, as the selected material must be machined, the optical impression was the best choice for allowing simple access to the CAD chain. The resulting 3D impression of models retains all the accuracy of the image pictured.
In the case of a classic impression, the laboratory scanners cannot picture the canal chambers in the moulds; the impression has to be digitised directly. The accuracy of laboratory scanners is increasing all the time, but remains limited to the initial quality of the impression and its angle.

Assembly

Mechanical retention to ensure good adaptation of the piece remains the principal criterion for success of the assembly. For metal CRRs, sealing or adhesion is possible, and the process of cleaning the canal must be meticulous in order to remove the various traces of disinfectants and materials that block the canal [6]. Adhesion using the new self-etching adhesives is very efficient, but requires great care and respect for the protocols recommended by the manufacturers. For the material used by us, only adhesion is indicated. The work must be done in a carefully-insulated site.

Conclusion

The appearance of new materials associated with new impression technologies increases the scope of therapeutic solutions. The qualities of these materials mean that they can take the place of metal in indirect CRRs. In France, it can only be regretted that within the new nomenclature, the codes HBLD090, HBLD 745 and HBLD 245, which correspond to the inlay cores of the various carts, mean that the treatment is limited to the cast metallic coronal-radicular infrastructure. By definition, this excludes pieces obtained after CAD by laser melting of the metal or machining in a non-metallic material.
A change to the definition of the inlay core in the nomenclature should take account of technological advances that favour the health of patients, in accordance with the ethical framework of our practice.

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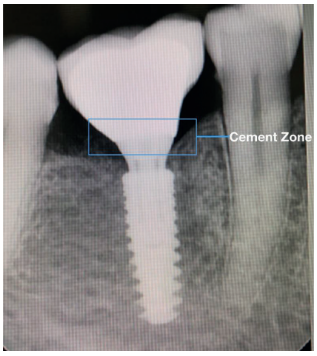
CEMENT-RETAINED RESTORATIONS, SHOULD WE STILL FEAR THEM?

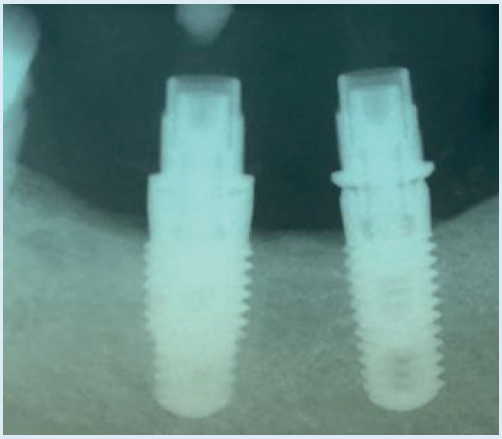
In the past decade, research has made us fear cement retained implant restorations and their complications in implant dentistry. [1-3] With recommendations to use screw-retained restorations to provide more predictable treatment results, although cement retained restorations are more simple, economic and provide passivity of fit. The aim of this article is to enable us as clinicians to provide a predictable treatment using cement-retained restorations when needed and to be able to use the appropriate cement in implant restorations without fear. Cement retained restorations has been always used with caution due to its effect on peri-implant tissue. This can lead to crestal bone loss, the most common complication in implant based restorations. Crestal bone loss around dental implants has always been a finding that we all fear. Sometimes we can prevent it, sometimes we can't. In recent years a new theory has emerged that helped clinicians understand and predict peri-implant bone loss. [4] Around teeth bone loss is always due to disease, but not in the case of dental implants. It could be due to disease or a foreign body reaction.
Research and clinicians have been trying their best to minimize crestal bone loss recently, which we succeeded at.[5] One of the factors that led to this success was our understanding to the relation between excess cement and peri-implant tissue.

Effect of excess cement

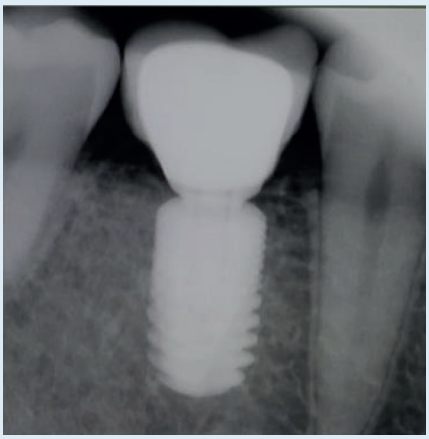
Fixed implant supported restorations are either screw-retained or cement-retained. Both methods of retention have been clinically tried and tested for decades. Each method has its own mechanical and biological risks. When comparing the survival rate of implant and restoration, the two methods of retention do not seem to differ significantly[6-8]. Cement retained restorations have the advantage of simplicity, passivity of fit and economy compared to screw-retained prosthesis [9].
Unfortunately there is one main disadvantage of cement retained restorations, the possibility of leaving excess cement on the implant, abutment or in the surrounding soft tissues.[10] Which has been associated to peri-implant disease.[11][12]. In this situation, bacteria play a major role, whether restricted to the soft tissue (mucositis) or progress to the supporting bone (peri-implantitis)[13] .
Excess cement can cause mechanical irritation when rough or a repository of bacteria. In either case it is better to be removed by any method. Some authors even recommended surgical intervention to remove the excess.[1]. It was also recommended to use screw-retained restorations if excess cement would be difficult to remove. The role of cement in etiology of peri-implant disease may be compared to the function of dental calculus in the development of periodontal disease. Cement has a rough surface like calculus, which can cause bacterial accumulation and therefore tissue inflammation. The bacteria in the sulcus can cause peri-implant mucositis and later on peri-implantitis with bone loss. [2]
Studies haven't described abutment designs when studying the effect of excess cement on peri-implant tissue, as this could alter the behavior of tissue to the excess cement. Therefore abutment designs and cement zone position should be mentioned in related studies.[14]
Would we rather go through surgical procedures to remove excess cement or be directed to screw-retained restorations and put patients through more complicated and more expensive treatments? Or should we use more simple techniques but with research based guidelines that would result in long-term predictable results.



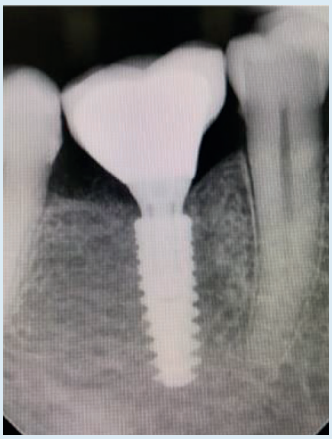
1. The subcrestal implant position enables freedom in choice of abutment finish line position and therefore "cement zone" position. Note the safe distance from the cement zone to the implant shoulder which should be more than 1mm.



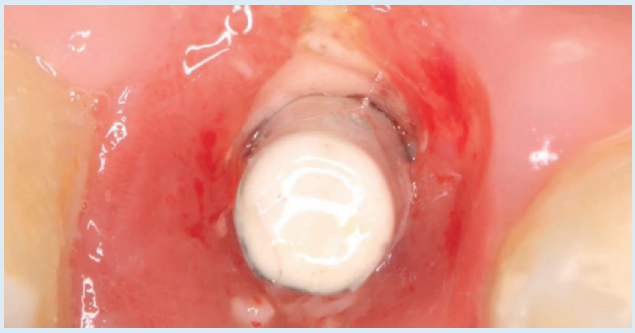
2. A the cement zone would be at the level of the implant shoulder, this should be avoided. The bone loss that occurred here was due to biological width formation, since this was a screw-retained case.



B cement zone is 1.5 mm away from the implant shoulder.



C cement zone is 3mm away from the implant shoulder. This is the ideal situation.



3. Bleeding points are seen surrounding the excess cement which indicate areas of previous epithelial attachement, with absence of inflammation. Note the cement covering the screw access that can be removed easily as one piece.

Guidelines forcement retained restorations

The following are some guidelines one should follow when using cement retained restorations in order to prevent complications in the prosthetic phase of implant treatment :

Properties of the cement:

One of the important factors in determining the choice of cement to use is its properties and clinical performance. A cement that would be hard to remove its excess or does not provide enough retention would be a wrong choice. The following are the clinical requirements that cements should provide :-

- Ease of application.
- Ease of excess removal
- Provide a good marginal seal
- Provide long-term retention and also ease of retrievability.
- Radiopaque
- High elasticity
- Not cause irritation to tissues.

Position of the cement:

Material selection can determine your treatment outcome. But more important is your treatment plan and its implementation. When placing a dental implant, it should be placed deep enough to give freedom in the position of the "abutment finish line ". This will in-turn determine the position of what we will call the "cement zone",

Fig 1&2. The proximity of cement to bone even in periodontally healthy patients can lead to early peri-implantitis[2]. Around dental implants there are no attachment fibers as they are aligned parallel unlike teeth. Therefore the peri-implant tissue is less resistant to pressure and cement can be pushed deeper around the implant[15]. If the cement zone is away from bone, no early peri-implantitis will occur even in peridontally compromised individuals. But it may cause a chronic process and lead to delayed peri-implantitis.[2]. This may also be prevented by the choice of cement used.

History of the periodontal condition:

Patients with history of periodontitis have a higher risk to develop peri-implant disease from residual cement [2] .Therefore the guidelines presented here should be followed.

Abutment selection:

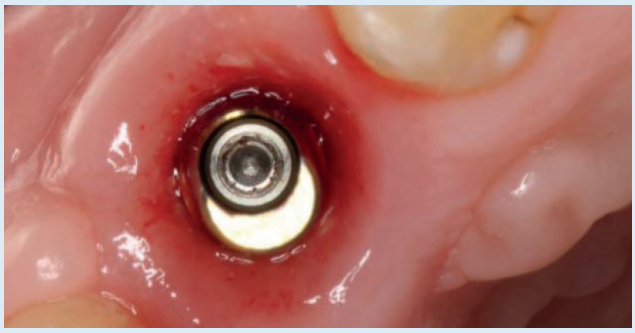
When choosing an abutment one must consider several factors:-

- Tissue thickness/gingival height
- Bone level.
- Periodontal history.
- Customized prosthetic abutments are preferable.
- Type of finish line.

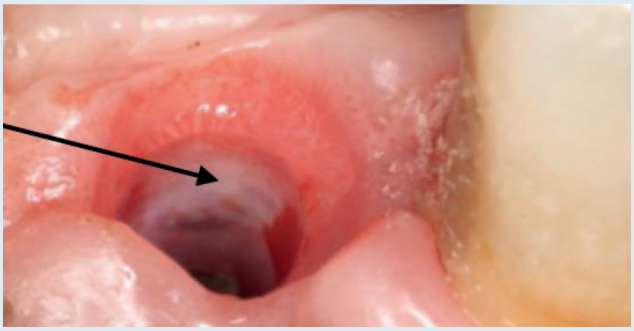
Cement choice in immediate loading

When placing implants immediately after extraction, we must understand the biology of socket healing. This will in turn affect your treatment protocol. The question here will be do we have to use screw-retained restorations to avoid presence of cement in the socket? Or will the tissue heal inevitably and not be affected by the excess cement? To find out we have to follow-up closely the tissue reaction to cement during healing of extraction sockets.

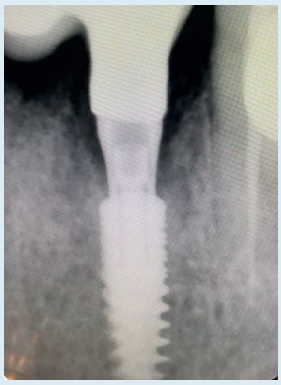
The following case (Fig3) we decided to use cement retained restoration to temporarily restore an upper canine immediately after extraction. To provide an esthetic emergence profile and to ensure good bone support after healing of the socket, the implant had to be placed deep below the socket margin. Therefore we are sure that excess cement could easily be present within the socket. Due to the previous experience with the cement used (DentoTemp, Itena) we took this risk. But the result we observed 5 months after placement of the temporary crown was not one would



4. Healthy soft tissue environment is seen after excess cement removal.



5 A. L'excès de ciment s'est agrégé au tissu avec des points de saignement qui montrent des signes d'attachement épithélial antérieur malgré la position très profonde de l'implant.



5 B. Note the safe distance from the cement zone to the implant shoulder.

6. Note the excess cement fused within the tissue without any signs of inflammation.

expect. What we saw was that tissue healed normally around the excess cement. (fig 3). not only that, but there was epithelial attachment to the temporary crown in areas with excess cement indicated by bleeding points. If there was any inflammation, there wont be any attachment and therefore absence of bleeding points. This observation is similar to healing of tissue around xenograft bone particles. Where you could see bone particles trapped in tissue and presence of epithelial attachment to a restoration without any signs of inflammation.

According to research our observation should not happen. As explained above, excess cement could lead to tissue inflammation and bone loss, this in turn could lead to failure of osseointegration in immediately loaded implants where every clinical step is of vital importance. In fig 4 you can see how healthy the tissue is after excess cement removal.

Fig 5 is another immediate loading case where the same observation was seen 4 months after placement of the temporary fixed restoration. But in this case the amount of excess cement was less. Note also the deep position of the implant with healthy tissue around it.

In fig 6 again you can see the same observation but with delayed implant placement. The temporary fixed restoration was removed 1 month after placement and the excess cement was seen fused within the tissue. Again no signs of inflammation was seen.

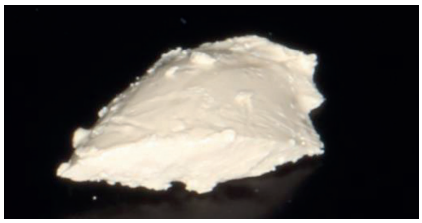
It's also important to note that no particulate bone was used in any of these cases. In all cases the same cement was used. (DentoTemp, Itena). Cement zone was at least 2mm away from the implant shoulder. All temporary restorations were polished with special consideration to the part in contact with tissue. In the immediate loading cases, the excess cement was even present below the abutment finish line. PMMA was used for all fixed temporary restorations.

Clinical factors to consider

When choosing a cement to use in cement-retained implant restorations one should choose wisely. We always face the problem of wanting good retention but could still give ease of retrievably when needed. For example, glass ionomer cements are very hard to retrieve but offer very good retention. But it's also very hard too remove excess cement. On the other hand TempBond (Kerr) does not provide the needed retention but provides ease of retrievability, Excess cement removal of TempBond is also not easy. A cement like DentoTemp (Itena Clinical) have solved the problem of providing long-term retention, yet ease of retrievability when needed. It also has high elasticity, which provides shock absorbing and flexing under daily occlusal load to resist breakdown and therefore minimizes the possibility of screw loosening.[16] It cures with a gel-phase, which makes excess cement removal easy. (Table 1) Once set the cement is smooth and polished and remains in that state. Unlike glassionomer and TempBond, once set they start to dissolve and become rough with time. This will lead to more bacterial and plaque retention. Therefore epithelial attachment around the excess cement would not be predictable.

Bacterial accumulation around Dentotemp and TempBond is similar (Table 2), but TempBond is not as smooth as Dentotemp (Fig 7). As long as the cement line is far from the implant shoulder then bacterial retention should not cause problems, but surface roughness will. Another important advantage of Dentotemp is that there is no need to cover screw access channel of the abutment with another material. Since this could be done using the cement itself which would be easily removed as one piece when needed. (Fig2). This removes the problem of using another material that could be hard to remove or interfere with cementation.

7. The more smooth the cement is when set, the less interference it has on epithelial attachment.



A under low magnification surface roughness can be seen for Tempbond NE.

B smooth surface can be seen for DentoTemp when set.

Conclusion

With our understanding of peri-implant disease and peri-implant bone loss, with the observations we found in the cases mentioned in this article, the fear of using cement-retained restorations on dental implants should be gone. Although more clinical studies focusing on cement-retained restorations and their direct effect on peri-implant bone loss are still needed.

Screw-retained restorations need certain considerations, like implant bucco-lingual position, likewise cement-retained restorations also need certain considerations to prevent complications. Certain guidelines have to be followed to make results more predictable. Implant position, abutment selection, choice of the appropriate cement all have a big impact on the prosthetic restoration phase and its outcome. After all we seek to provide easy, predictable, economic treatment options for patients. Close follow-up and recall appointments of dental implant treatments are vital to prevent complications before they occur whenever possible. In the end, cement is just one of the many materials used in implant based restorations that requires careful decision making like choosing your implant design.

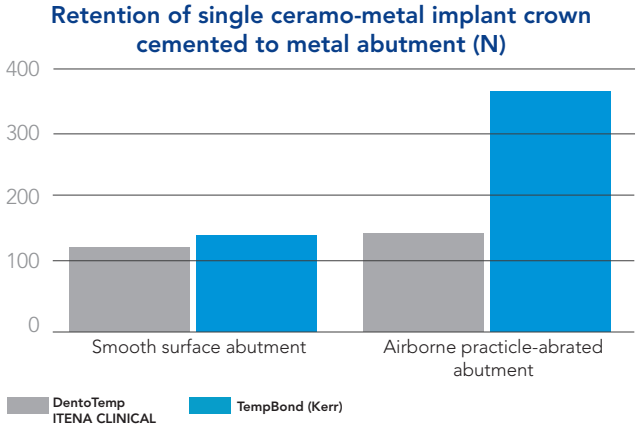


Table 1: The retentive effect of cement increases dramatically when abutments are micro-roughened, with DentoTemp cement being more retentive. (Itena Clinical R&D)

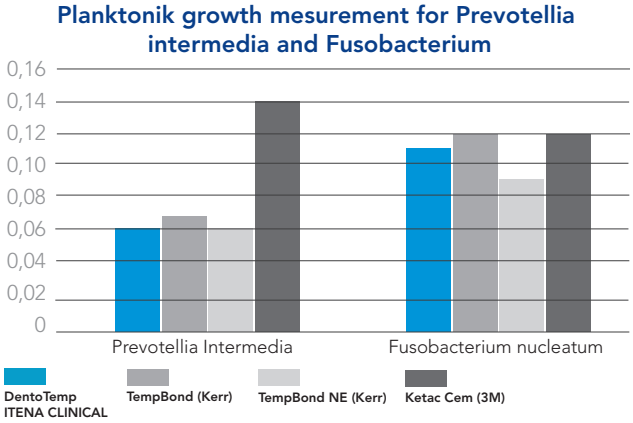


Table 2: DentoTemp and Temp Bond NE have similar bacterial accumulation. Note the very high level for KetacCem. (Itena Clinical R&D)

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