

Discussion: The ideal restoration of endodontically treated teeth: structural and esthetic considerations

Edited by **Tidu Mankoo**

Tidu Mankoo

What is your choice of treatment for a tooth when there is no ferrule? When would you try to make some kind of post core reconstruction and maintain the tooth or when would you extract it?

Kony Meyenberg

If there is no core and we have the opportunity of doing the core build-up, I would check the quality of the dentin using the microscope to see if there are any cracks or craze lines, as this was one of the key factors when we analyzed failures. Ideally, endodontists should supply information about the quality of the dentin and/or photographs so that the size, distribution and position of any cracks or craze line can be assessed and we can decide whether it makes sense to keep the tooth not. Clearly, if we have heavily reduced tooth structure with a significant crack, we extract it as there is no long-term way to stabilize it predictably. If there is no crack and the root dentin looks good, I would go for a stiff core, ie, a well-adapted cast gold post and core. Sandblast and bond or cement with glass ionomer (particularly if there was a eugenol containing product in an endodontic retreatment).

The next consideration is what we do with the root. We have to take the occlusion and loading into consideration and

decide if it would be viable to extrude the root. Overall this can take a considerable amount of time and treatment. So in many cases, I try to simplify the approach and engage dentin on the palatal without extrusion.

Tidu Mankoo

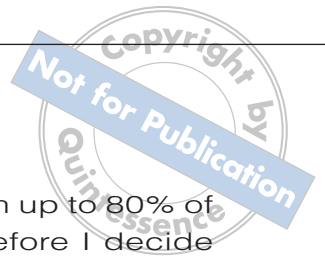
In these cases, how do you restore the tooth?

Kony Meyenberg

We may use PFM crowns because metal margins can be created very thin on the palatal and go 1 to 1.5 mm below the cervical level of the gingival tissue to create an additional ferrule effect. In most cases, this is not a problem from a periodontal viewpoint. Another important element is the thickness of the wall of the ferrule. In the anterior maxilla we must be careful not to over-prepare on the palatal or proximal aspects and make it too thin otherwise it is useless. That's why a PFM crown with a thin metal collar can preserve the dentin and work effectively for many years without a ferrule on the labial aspect because the load comes from the palatal.

Stefan Paul

Given that the diagnosis or verification of the success of our endodontic treatment is key, do we have to consider taking a



CBCT image of the completed root canal treatment before we decide on how to restore the tooth?

Kony Meyenberg

It's a very relevant question. On one hand, we have the problem of excess radiation and, on the other hand, there are a number of studies showing that the apical condition cannot be properly diagnosed with 2D radiographs. A CBCT can show a radiolucency around a recently treated root which had no radiolucency before and then disappears again after a few months. This is probably a reaction to the medication and instrumentation involved in endodontic treatment and we should not rush into treatment in the absence of clinical symptoms. So, we don't fully understand the relevance of the apical radiolucencies on CBCT.

For us, it is more important to use the CBCT to help diagnose existing problems, ie, a tooth causing pain, a tooth with a large radiolucency in the 2D radiograph, a suspected crack or furcation involvement, and so on. This is very useful, but I would not advise using CBCT on a routine basis because, at the moment, we do not exactly know how we have to interpret these results and we have to primarily base our decision-making on clinical signs, not only the CBCT image. In the absence of signs and symptoms, we still base our decision on 2D radiographs.

Oliver Pontius

I absolutely agree with you and I am very happy that you mentioned the importance of using CBCT today. Implantologists use it on a daily basis, but few people are using it for treatment plan-

ning. Today I use CBCT in up to 80% of the retreatment cases before I decide whether to retreat a tooth or to extract.

In many cases, we see problems that we couldn't see on normal radiographs, as you illustrated. However, there is a learning curve with this technology and we can misinterpret images, for example due to the beam hardening effect with metal posts, which may look like a root fracture where there isn't one. On the other hand, for complex cases, a CBCT is a must before treatment planning. As regards periapical radiolucencies, I would refer to the periapical index published by Örstavik. This periapical index differentiates between 5 different states where you will have a periapical inflammation. Periapical index 1 or 2 means a very mild loosening of the periapical structures, and this you can see very clearly on cone beams and it is not an indication that the case is failing. We know from the Scandinavian literature that there are lesions that can take up to 27 years to show periapical healing. So I wouldn't decide success or failure of a questionable endodontic treatment at a 6 months' recall in the absence of clinical symptoms. On the other hand, if you see a big lesion on a CBCT, it doesn't make sense to ignore it even if there are no signs. Many patients we see have lesions in a chronic state of the apical inflammation and, even if the patient doesn't have any clinical symptoms, we should still treat them.

Tidu Mankoo

Oliver, can you summarize what is the correct instrumentation protocol for endodontic treatment of a tooth today?

Oliver Pontius

We have to choose the best instrumentation technique for each individual case and root canal system, respecting the biological principles and aims of treatment. The problem with rotary instruments is not so much that you may cause cracks in the roots if you misuse them (ie, if you use instruments that are not sharp or you use too much pressure), but that they create a lot of debris, which is forced laterally into lateral canals or into the dentin, which will make the sealing and bonding more demanding. There is not one technique or instrumentation you can use in every case. There are situations in which I don't use rotaries at all, there are other situations where I use systems like the reciprocating file, which allows me to minimize the instrumentation I have to do.

Aris Tripodakis

We all agree about cone beam technology giving us the best pictures 3-dimensionally. Nevertheless, the radiation of a full dental scan just for one tooth is a consideration. I think the ideal approach would be to use a partial cone beam that would give you better pictures, less scattering from metals, as well as the possibility to play 3-dimensionally through the software and really direct your cut to the area of interest.

Galip Gurel

What about removal of old posts and restorations?

Kony Meyenberg

We must avoid traumatic removal to avoid any risk of creating fractures, ie, cut restorations so they can easily be re-

moved. Whatever I cannot remove with my fingers, I remove by preparation. Also avoid creating heat by using smooth turbines with fine grain instruments and not rough carbide burs. It takes a little more time, but causes less vibration and helps prevent the creation of cracks.

With regards to posts, a fiber post is easy to remove as we can simply drill it out and use the microscope to see where our bur really is. The challenge is where we have old cast post and cores and we want to retreat the tooth. Here the microscope helps us to analyze if there is already a crack line present, as we often see little crack or craze lines. If it is well adapted and cemented, we would often choose not to remove it but carry out a surgical endodontic treatment. We need to analyze the case carefully and know what kind of cement was used. If it was a composite cement and metal post, we would probably leave it and not try to remove it. When I find a brittle cement, I would carefully use ultrasonic devices and limit the time. If I cannot remove it within 5 minutes, I would leave it and refer to a specialist endodontist for post removal, making use of the microscope and very fine rotary and ultrasonic instruments with fine diamond tips. We often leave the post today if we think removal is risky.

Angelo Putignano

With higher life expectancy we talk more about retreatment, but modern techniques often make this more difficult. When we compare the time it takes to remove an e-max crown bonded on a tooth against a PFM crown and post cemented with zinc phosphate, how much tooth destruction can occur because it is

difficult to visualize the limit of the crown, and the number of burs you destroy, we need to think a little bit more about re-treatability of these new technologies.

Kony Meyenberg

That's a good point and I think it supports using traditional techniques in the molar region. Retreating an anterior tooth is easier as you have better access and bonding techniques offer such great advantages here. For me, bonding a full all-ceramic crown on a second molar doesn't make sense. The problem when you see a composite core is to know the quality of the core and bond. Who did it? What kind of dentin bonding was used? Was the correct technique utilized? In my private office, we use well scientifically proven products such as Optibond FL and Clearfil SE bond. Our clinical experience has been very good with these products and I would absolutely advise you to use them and avoid the more simplified procedures offered by the so-called 'one-step' or 'universal' products.

The main concern is predictability, not bond strength, as some products show very high bond strengths but not consistently on all samples. That's why we still use gold cast post and cores with glass ionomer cement because it always sets, it has some good self-healing properties and good compressive strength. It's a safe and proven concept and easy. If you make one mistake with these more technique sensitive products, then the result is much worse. I think this is a critical issue we have to consider as we try to produce a core for the lifetime of the patient and we have had very good service from cast gold post and cores, but can we say the same for our fiber posts?

Angelo Putignano

What do you consider an acceptable failure rate, since it is difficult for the general practitioner to decipher the literature and choose the best approach as the literature often shows similar success rates for different techniques and yet we are aware of some problems. For example, we moved to fiber posts because of failure and back to cast posts because of failure. What is the key point in order to make the right choice?

Kony Meyenberg

There is no single universal "perfect" solution and the key point is to understand the indications and limitations of each technique, when to use a fiber post and when not. For example, the Ferrari group nicely demonstrated that in premolars you have to consider the amount of destruction of tooth structure and, when this is extensive, stick to cast post and core systems or metal post.

We have to accept that failures are part of life and I would suggest an acceptable failure rate is 5% at 5 years, and 10% at 10 years.

Walter Devoto

My first concern is debonding of the post core: should I over-prepare in order to adapt the post perfectly inside the root or do I need to leave room for the cement? I try to avoid deep chamfers or butt joints today and work more vertically as the length and thickness of the ferrule are both important. Which restorative material would you suggest for this more vertical approach: lithium disilicate, alumina or zirconia?

Tidu Mankoo

You have to differentiate between a first time or replacement restoration as the latter is often predetermined by the pre-existing preparation, caries and other factors. If you have a preexisting restoration that you are replacing, then you cannot necessarily keep your preparation as conservative as you are suggesting. When you have a tooth that you are restoring for the first time, then a partial crown or veneer is probably the most appropriate restoration to minimize tooth structure removal. But if you have a large composite restoration in the palatal, it may be better to do a full-coverage with a conservative preparation and bonding concept.

Kony Meyenberg

Referring to the problem of the root canal, we all know that there is no round root canal. I showed the problem of retention is not so much related to the thickness of the post, but to proper adaptation with the right material between the tooth surface and the post, which should have a reasonable diameter, I would say 2 mm at the cervical exit. It is essential that remnants of gutta-percha are removed and the post and core is sandblasted correctly. I must clearly state that loss of retention should not occur if the post placement is performed properly and the right indication for the type of post and cementation (bonding or GIC) protocol followed. I suspect that fiber post debonding, in most cases, is due to an inadequate bonding procedure or to the wrong indication for the post type and cementation. For us the problem is not debonding, but fractures. The worst case scenario is when I see a loose res-

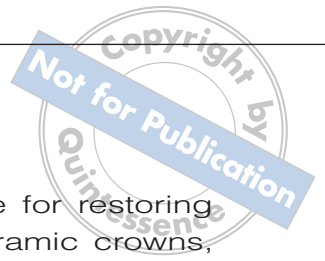
toration, then I know there will be heavily weakened dentin, loss of mineral content, loss of collagen, it's infected, and you have to enlarge the root canal to engage reasonably mineralized dentin. Also the dentin takes up water and this can make the post still stick even though it is loose or debonded. That's why I think it's a very dangerous concept to say: "the fiber post is better because if it comes loose you can simply place another one." In the Ferrari study they had many posts debonding.

Pascal Zyman

Do you think that you can increase the strength between the post and the resin by pretreatments like silica coating or silane on the post?

Kony Meyenberg

First of all, you need to know how the post is manufactured. Some, like the new DT-light post, are already pretreated; so, if you believe the manufacturer, you can directly bond on the surface. The RELY-X post from 3M Espe already has a very rough surface because of the special fiber arrangement; so, they don't recommend any additional treatment, although I would still use very soft sandblasting, just 2 bars at a 2 cm distance to have a freshly cut surface and then immediately use a silane. I would do this with all the fiber posts, and there are at least 2 studies that confirm that you do not harm the post if you bond it afterwards. I recommend sandblasting and silanization and, then, the use of an adhesive that contains MDP to obtain a good bonding to the glass materials and to seal the post.



Nitzan Bichacho

I saw in Galip's office a very interesting technique of removing bonded veneers and crowns with a laser.

Galip Gurel

I am not an expert, but it involves using an Erbium-Yag laser and it sort of melts the luting resin and pops off the veneer. It is under investigation and we are waiting for the results of some studies.

Douglas Terry

You didn't discuss the 3 to 4 mm length of the apical seal. Do you think it is still important? From the radiographs you showed, it is clear that some clinicians do not understand this principle.

Kony Meyenberg

I thought this would be too basic, but the numbers are: at least 4 mm for the apical seal, then 7 mm of retention in the root canal, 4 mm of retention for the crown, 2 mm ferrule height, ferrule thickness is not discussed but I would say at least 1.5 mm. Certainly the worst mistake is to go too close to the apex with the post because we have invaginations, curved roots and anatomy we don't see in any 2D radiographs. So, stay away from the apex. With bonding technology, retention is not the problem: you can use shorter posts and at least avoid perforation problems with the post and maintain more than 4 mm of the root filling.

Guido Brachetti

You said that, once a tooth is crowned, the type of post is less important, but then you mentioned that in anterior teeth with all-ceramic crowns you prefer to have a high modulus of elasticity post. Can you

summarize your rationale for restoring anterior teeth with all ceramic crowns, with and without cervical structure?

Kony Meyenberg

For a classic veneer extending no more than 2 mm palatally, the post is not required. For a veneer-crown, that is a very thin 360 degree crown with some palatal destruction, I would place a post. If it is a very thin crown and you have a lot of remaining dentin, I would use a short but thick fiber post. When you have a thicker crown with a 4 mm ferrule, it's like having a 4-walled situation. So a fiber post is OK. Once we are heading towards a short ferrule with reduced tooth structure, I would go for zirconia post that is not too long and fits passively into the canal and I still would go for a composite core build-up. I don't think it is necessary to use ceramic.

Tidu Mankoo

Would you cement the zirconia post with resin or with glass ionomer?

Kony Meyenberg

Definitely with the resin, not glass ionomer, but in this case the post is not sandblasted. What I do personally is pre-bond whatever part of the tooth is accessible to light with 3-step Clearfill SE bond to ensure it can be properly cured and then cement the post with RELY-X Unicem and remove any excess from the areas accessible to light. Then the rest of the core is done with light-cured composite. Our preference is to make the crown with Emax although we have some concerns with their veneering ceramic. If there is more destruction and you have to think of extruding the

tooth, I would use a cast post and core system and porcelain fused-to-metal (PFM) crown as previously explained.

Guido Brachetti

How would you mask this post if you wanted to?

Kony Meyenberg

I don't mask the post at all if using a PFM. If there is a preexisting cast post and core and it is just a small coronal part of the core, just polish it to a high-gloss and you still have enough surface to bond the restoration to the dentin. If the whole buccal aspect is in gold and I want to go for a full ceramic crown then we mask it out as I showed, but just on the buccal surface, not on the palatal one.

Tidu Mankoo

Is there an indication for a metal post in the anterior with a composite core?

Kony Meyenberg

Yes and I should restrict my previous comments regarding fiber and zirconia posts to centrals and laterals because for canines I would definitely go for a metal post and composite core. The most critical teeth in terms of loading are canines and premolars. In molars we have larger surfaces that are easier to bond, and are easier to distribute the forces; so, a post is not generally required and a composite core is perfect. Premolars and canines are more delicate. I never use zirconia posts or fiber posts in a canine. I use titanium posts.

Aris Tripodakis

I am a little bit confused because you've mentioned how important it is to pre-

serve tooth structure upon preparation of the canal and to achieve passive fit of the post. If both are successful with the custom made post either in ceramic or metal, why would you go for a pre-fabricated post that needs more tooth reduction, is difficult to bond and technique sensitive. Why not always go for a custom post core?

Kony Meyenberg

Because I showed that we use a defect oriented concept: if you have a small defect, a cast post and core is not needed and it is not the concept of choice.

Tommy Meier

Do you feel that with endodontically treated teeth we always have to make a crown or with today's materials can we also make onlays?

Kony Meyenberg

The concept is to create some kind of occlusal ferrule effect with cuspal coverage. But I would not use composite because we need to use a material which is stiffer than dentin otherwise there is still too much stress in the dentin that can cause fracture lines to expand. Gold is the material of choice for this but, as we know, nobody wants gold anymore today.

Hannes Wachtel

In your strategy, is there a place for apical surgery and, if so, when?

Kony Meyenberg

I agree completely with Oliver Pontius that we need a CBCT to make this decision, because two questions are relevant. The first is: from where is the problem coming? If it comes from an

accessory canal and the access is viable, then we re-treat. But if it is not accessible, we treat it surgically. The second consideration is: what is the cause of the pathology? The more likely there is a fracture, the more likely we extract and restore with an implant.

Massimo Fuzzi

I have some selected patients who have a lot of failures due to vertical fractures. Do you see the same in your experience and do you have any advice to identify and check this type of patients?

Kony Meyenberg

I asked myself also why I see more fractures today. I think there are two reasons for this. First of all, people keep more of their teeth for longer and, secondly, we are able to conserve periodontally affected teeth so we see more mechanical problems.

Massimo Fuzzi

My feeling is that it is not mechanical but that some patients seem to have a more fragile kind of dentin.

Kony Meyenberg

I agree, I too see these 'glass-like' teeth. We also have an aging process with sclerosed roots and no root canals.

Danuta Borczyk

We have two more kinds of tooth-colored posts we have not discussed. One is custom-made press-ceramic posts. The second is custom-made glass fiber posts, made in the lab, then you can have the glass fibers in different directions and keep the same material in the root canal and the core-build up.

Kony Meyenberg

For the first the material it is too fragile, forget about it and the second is technically impossible. I must say forget about it too.

Deborah Vilaboa

I see nobody has argued with the recommendation to avoid posts in molars, I am talking about custom-made posts, for example gold alloys in the posterior area and I feel that I am being left out of the group because I do a fair amount.

Kony Meyenberg

I have used a bonded concept for the past 20 years with composite irrespective of the missing tooth material. It's technically demanding because I use a rubber dam and a layered light-cured material. Because there is a larger tooth surface for bonding, it works well in terms of both resistance to fracture and retention and it is cost effective for the patient. I don't see any indication for a post in a molar particularly when we look at CBCT images and see the root curvature and indentations. We don't go more than 2 to 3 mm into the canals with the composite usually in the palatal canal on the upper and distal canal in a lower molar, carefully removing the gutta-percha without enlarging the canal. In addition, we never splint molars to distribute forces as there is a strong risk of de-cementation due to occlusal forces and this can go undiagnosed until it is too late.

Tidu Mankoo

Can you rely on your bond, as the dentin in many of these molar teeth is very sclerosed?

Angelo Putignano

In the literature, the 3-step bonding process is shown to be the best option, but it is not so clear what is the mechanism at the end. As Kony showed, the collagen fibers in endodontically treated teeth degrade and after 12 years they are completely gone. To have a reliable adhesion is not so easy. Probably using the mild self-etching agents today that achieve 20% of chemical adhesion with calcium is the best option, but there are not many papers about this point. Adhesion in endodontically treated teeth is a controversial topic.

Nitzan Bichacho

It is not controversial. Show me one person who proved that after 3 years dentin is still bonded as it was when it was bonded it freshly. We know that the bond degrades with time, so there is no true bond to dentin after some years.

Kony Meyenberg

The point is not only bond strength, but to have intimate contact between the two materials so forces are well distributed inside the tooth. There is no bond with a gold post and phosphate cement, but it works beautifully. Why? Because there is perfect adaptation, this is a mechanical basic principle, so we should not focus on bonding to dentin, we should focus on how to have an intimate contact. Dentin bonding agents improve the wettability of dentin. When I check this by cutting all my extracted teeth I built up with composite cores, I am amazed to see how good the contact is with the 3-step bonding process. At the same time, with a micro-tensile bond strength test you would probably laugh at me because you may find it to be 4 to 6 MPa, but that's not the point.