

Predictable cementation of all ceramic dental restorations: The “Noah” technique

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“Noah Technique comes from the biblical reference of Noah’s Ark... Since we have two hands, it only makes sense that we have maximum control of only two restorations at a time during the cementation process...”

Creation of an ideally prepared tooth and its detail being “captured” in a master impression are critical steps in the indirect dental restorative process. All can be for naught if a meticulous delivery technique is not followed. Most indirect definitive restorations are crafted with precision on carefully trimmed dies machined with pin placement to align the preparations on the cast in the exact position relative to one another as they appear in the patient’s oral cavity. The final test of accuracy, however, is in the patient’s mouth. Many times ceramic reconstructions may appear to have perfect fit and contact on the master dies relative to one another, yet require adjustment when tried-in the patient. This is to be expected from time to time when dealing with an indirect fabrication method. It is also true that multiple adjacent restorations may appear to have perfect fit and proximal contact upon try-in only to have a slightly altered fit after cementation. This can mean a remake if the restoration is placed in an improper position and it cannot be recovered before the set of the cement. Some clinicians espouse a “multiple cementation technique” placing eight to ten restorations at one time. This can often lead to a disastrous result, if even one restoration is placed in a slightly altered position affecting the correct seating of the remaining units.

Dental cements - an historical perspective

Dental cements, by definition, are “luting agents” meant to fill the microscopic gap between restorative materials and tooth structure. Zinc Phosphate Cements, while universally used for many years, are soluble in oral fluids and can “wash out” when restorative materials are not engineered to fit precisely. Polycarboxylate cements have a slight advantage in that they “chealate” to dentin, but the film thickness is greater than that of zinc phosphate cements and can sometimes be a problem with a restoration seating fully. Glass ionomer cements, which are still widely used as luting cements, offer some distinct advantages over both zinc phosphates and polycarboxylates. The film thickness is extremely thin and the material has a fluoride release which has been shown to remineralize dentin. The downside is that glass ionomers are still quite soluble in oral fluids. The next generation was to move into modified resin ionomers. These cements have the advantages of glass ionomers and are much less soluble in the oral environment. In fact, some manufacturers report “zero” solubility with these materials. The one common thread with all of these types of cements is again that they do not bond to the



Figure 1. A preoperative view of the maxillary prepared arch prior to delivery of the definitive restorations.



Figure 2. The maxillary central incisors have been cemented with self etching resin cement (Maxcem Elite, Kerr). The lateral incisors are placed on their respective preparations without cement so that the central incisors will be cemented in the proper orientation.



Figure 3. After an initial gel set of about 2 minutes, the marginal excess can be easily removed using an explorer.



Figure 4. Once cement removal is completed, the restorations are light cured according to manufacturer's instructions.



Figure 5. Notice the tissue irritation on the facial marginal gingival of the lateral incisor. Expasyl will be placed to displace the tissue and stop any minor sulcular hemorrhage in preparation for cementation.



Figure 6. Expasyl is packed into the sulcus using a dry cotton pellet in cotton forceps.



Figure 7. The preparation is disinfected with Tubulicid Red (Global Dental) prior to cementation.



Figure 8. A number two Keystone flat brush is bent at a 45 degree angle using a hemostat, then used to remove excess cement from the marginal areas of the seated restoration.



Figure 9. In this retracted full arch view, the maxillary canines are held in place with firm pressure while the cement reaches its initial set. The maxillary first premolars are sitting on their respective preparations ensuring the correct seated position.

restorative materials. The resin cement family evolved out of the total etch and dentin adhesive technologies. For proper use, they require pretreatment of the tooth surface with 37% Phosphoric acid and application of a dentin bonding agent prior to application of the resin cement. These cements truly form a micromechanical bond to both tooth structure on one side and restorative material on the other side. Also, they are insoluble in oral fluids. The latest advance in resin cements

are the self-etching resin cements that require no pretreatment of the tooth surface and appear to have many advantages of resin cement systems, with the ease of use of more traditional types of cements. It is important to emphasize that in some cases, bond strengths of self-etching resin cements are not as high as those for resin cements using the "total etch technique". More recent generations of self-etching resin cements, such as Maxcem™ Elite (Kerr Corporation) for

one, are showing significant increases in bond strength. The manufacturer reports up to 24 megapascals of bond strength *without* pretreating the tooth surface. However, it is important to remember that the purpose of any cement is to fill the microgap between tooth structure and restorative material and to *aid* in retention of the restoration. Proper resistance and retention form of the preparation is still more important for successful retention of any restorative material.



Figure 10. The contact on the distal of the maxillary molar is marked with articulating paper to identify the area to adjust.



Figure 11. A porcelain polishing wheel (Brasseler USA) is used to adjust the area indicated by the articulation paper. The restoration contact is then evaluated and the process repeated as necessary.



Figure 12. The completed maxillary restoration is cemented and shown in this full arch retracted view in centric occlusion with the mandibular provisional restorations. Note the precision of the intercuspation between the maxillary definitive restorations and the mandibular provisional restorations. This is a result of being able to cross mount the ceramic and provisional casts in the laboratory.



Figure 13. In this Class II reconstruction, the mandibular central incisors and the most posterior restoration on each side are seated and mandibular closure is evaluated.



Figure 14. The ceramic units are checked with articulation paper to evaluate occlusal contacts.



Figure 15. A small 30 micron diamond is used to adjust the premature contact. After it is rechecked in the mouth, it will be polished using medium grade pumice with water; rubber abrasives and diamond polishing paste.



Figure 16. Maxcem Elite (Kerr) is used for this placement of porcelain to zirconium crowns (Venus Porcelain, Heraeus).

The “Noah Delivery Technique” utilizing self etching resin cement

The term “Noah Technique” comes from the biblical reference of Noah’s Ark. The animals entered the ark two by two. Since we have *two* hands, it only makes sense that we have maximum control of only *two* restorations at a time during the cementation process.

For any multiple unit case involving the maxillary anterior region, the maxillary central incisors are the most important aesthetically. These are the “main actors” on

the stage; the first teeth the patient sees. The maxillary central incisors should be cemented first. The following sequence will describe a delivery for a complete maxillary and mandibular restoration. First, all maxillary restorations are tried-in individually and evaluated for marginal integrity and fit. Next, proximal contacts are evaluated with dental floss as the dental assistant stabilizes adjacent restorations. At this point, proximal contacts should be adjusted with porcelain polishing wheels as needed. Next, evaluate the “collective

fit”. Place all restorations on their respective preparations and evaluate whether or not the restorations fit passively. Any minor displacement of individual restorations or resistance to complete seating is indicative of a tight contact that will need to be adjusted. To make this process easier, replace the restoration on the master die in the appropriate position on the master model. Place a piece of articulation paper between the restorations to mark the contact area. Then, “erase” the spot with the porcelain adjuster and evaluate the fit again. This process may need to be repeated a few times before the fit is passive, yet the contact is maintained being “lightly resistant” to dental floss. It is important to note that this alone does not mean that the restorations will fit passively in the mouth. Remember, dies can move a bit on the master model even though they are pinned; teeth don’t move!

Facebow transfer and centric occlusion records taken between 1) the maxillary and mandibular preparations and 2) the maxillary provisional restorations and mandibular preparations allow the laboratory technician to “cross mount” the provisional casts and master casts during the fabrication process. This will allow a very accurate approximation in centric occlusion of the maxillary definitive restorations to the mandibular provisional restorations. Because of this, after the maxillary restorations are adjusted for proximal contact and a passive, collective fit is achieved, the entire maxillary case can then be cemented.

Delivery of the maxillary definitive restorations

The first step is to place the maxillary central incisors in position and verify seating again visually and then radiographically. Digital x-ray, such as Dexis, allows immediate verification of complete seating on the operator monitor. First, the preparations are cleaned and disinfected with Tubulicid Red (Global Dental) on a cotton pellet. Next, self-etching resin cement (Maxcem Elite, Kerr Corporation) is placed via automix syringe delivery into the restoration. Once both centrals are completely seated with positive pressure expressing excess around the periphery of the margins, a #2 Keystone brush (Patterson Dental) is used to wipe away all excess material. The adjacent restorations, the lateral incisors, are placed on their respective preparations to "hold the space" while ensuring that the central incisors are properly positioned spatially during the gel set of the cement. One must be sure that no cement is on the lateral incisor preparations, or the restorations may not be able to be removed after the central incisors are completely set. This process is then repeated for the lateral incisors. If the tissue at any time is unintentionally irritated and starts to bleed, Expasyl is syringed into the area, tapped to place with a dry cotton pellet and left undisturbed for about a minute. After that period of time, air and water spray remove the Expasyl and as a result, the tissue is now displaced away from the restorative margin and the bleeding is stopped. The preparations are cleaned with Tubulicid and the lateral incisors are then filled with self-etching resin cement and placed on the preparations. The number 2 Keystone brush is used to remove marginal cement excess as before and the canine restorations are placed on their respective preparations to hold the space as the cement cures. This process is completed respectively for the maxillary cuspids, first premolars, and second premolars leaving only the first molars to cement next to the natural remaining second molars. Invariably at this point, even though there was a previously passive fit, these restorations will now probably be tight and not go to full seat. Proximal contacts should be marked with articulation paper on the master model, as previously described, then adjusted and checked with dental floss in the patients' mouth. When the restoration has a passive, full seat, it is cemented with self-etching resin cement.



Figure 17. The self etching resin cement (Maxcem Elite, Kerr) is dispensed from the auto mix syringe via its specially manufactured curved tip.



Figure 19. This full arch retracted view shows the mandibular incisors in place as the molar and premolar units are placed from the most posterior unit on each side moving forward toward the anterior region.



Figure 21. It is apparent from this view that the canine needs proximal adjustment prior to seating even though it fit passively when all units were tried in collectively without cement. The canine ceramic unit can be adjusted on the die as previously described. It may also be desirable to "lightly dust" the contacts on the adjacent cemented teeth using an 8 fluted carbide bur, and then polished with high gloss abrasives.

Delivery of the mandibular definitive restorations

Once the maxillary restorations are delivered, the individual mandibular restorations are tried-in on an individual basis and evaluated for marginal fit. A collective try-in is also done to help identify possible proximal contacts that may need adjustment.



Figure 18. This is a unique view of the cemented mandibular molar in centric occlusion demonstrating the "occlusal lock" in centric occlusion with the opposing maxillary first molar.



Figure 20. All mandibular units are now cemented except the right and left mandibular canines. As each unit has been placed, occlusion is rechecked to identify possible prematurities.



Figure 22. A retracted full arch view of the completed cementation in centric occlusion.

Digital radiographs (Dexis) are taken to verify positive seating during the collective try-in. Once this is accomplished and everything looks acceptable, the following regimen is followed in the delivery of the mandibular restorations. First, the mandibular central incisors are placed on the preparations as well as the most posterior



Figure 23. All excursions from centric occlusion are checked and verified.



Figure 23. All excursions from centric occlusion are checked and verified. Figure 24. A two week post operative view of the cemented case. Occlusal stability and aesthetic beauty has been achieved in this Class II reconstruction. The second molars will be restored at a future appointment.

restoration on each side. The patient is instructed to close into light occlusal contact on Accufilm II (Parkell) articulating paper. One of three possibilities will occur: 1) the patient will contact and mark only on the occlusal surface(s) of one or both of the posterior teeth; 2) The patient will contact only on the incisal edges of the mandibular incisors; or 3) There will be simultaneous contact on both posterior units and the mandibular incisor restorations. If one or both of the posterior units contact first, the centric prematurity, or prematureties, are identified and adjusted using 30 micron (red stripe) composite finishing diamonds (Axis Dental, Braseler USA) and rechecked with Accufilm until simultaneous contact on both anterior units and posterior units is achieved. If the anterior units contact first, either the incisal edges need shortening, or the maxillary lingual concavities of the maxillary central incisors need deepening. Again the goal is to achieve simultaneous and even closure with these units in place. It is important to think of occlusal stability like a "three legged stool". One can sit on a "three legged stool" very easily, but cut one leg off, it gets harder to balance. Muscles are activated to maintain a stable seating position that may have been at rest before. Cut off two legs - the task of maintaining stability is even harder! The minimal contact for a stable situation is a contact with the maxillary and mandibular central incisors and a posterior contact (as far posterior as possible) on each side.

This does not mean that the occlusion is considered stable with only three points of contact, but this is a start. The ultimate goal is to have even and simultaneous contact of all maxillary and mandibular teeth in centric occlusion (maximum intercuspation). Posterior teeth should touch only in centric occlusion. Any eccentric movement from that position (working, balancing, protrusive) should result in immediate disclusion of all posterior teeth because of canine guidance and anterior coupling (Anterior Guidance). Once the mandibular incisors and the most posterior units on each side are cemented, the next posterior tooth moving forward toward the anterior teeth is placed on each side and the occlusion is checked with Accufilm once more. If the proper regimen was followed and each of the cemented units that were placed prior has correct occlusion. Any prematurity after placement of the next two units can be easily identified and corrected. It is much easier to identify prematureties in this fashion than when trying all units in at the same time! As with the maxillary cementation, all of the mandibular posterior units are placed leaving only the mandibular cuspids. And again, with both approximating restorations now cemented, the mandibular cuspids will probably need minimal proximal adjustment to go to full seat in a passive fashion. Once all the units are cemented, centric occlusion is rechecked, all adjusted areas are polished with porcelain rubber abra-

sives. Working, balancing and protrusive movements are also rechecked verifying canine guidance and posterior disclusion upon engagement of the anterior teeth in any movement from centric occlusion.

Conclusion

A technique has been described for methodical and predictable cementation of multi-unit dental reconstructions. It can be applied to any cementation scenario, regardless of the number of units involved. It should also be mentioned that it is very important to verify final cementation with vertical bitewing radiographs (Dexis) to ensure accuracy.

About the author

Dr Robert A. Lowe graduated magna cum laude from Loyola University School of Dentistry in 1982 and was an Assistant Professor in Operative Dentistry until its closure in 1993. Since January of 2000, Dr Lowe has been in private practice in Charlotte, North Carolina. Dr Lowe lectures internationally and publishes in well-known dental journals on aesthetic and restorative dentistry. He is a clinical evaluator of materials and products with many prominent dental manufacturers. Dr Lowe received fellowships in the AGD, ICD, ADI, ACD, and received the 2004 Gordon Christensen Outstanding Lecturers Award at the Chicago Midwinter Meeting. In 2005, he was awarded Diplomate status on the American Board of Aesthetic Dentistry.