

## Creating quality long lasting dentistry is like creating a quality long lasting marriage.

*By: Dr. Dan Fischer*

For a “tooth centered restoration” to succeed for the long run, it is pivotal that it contains many of the important similar and necessary elements and principles required for a healthy, long lasting marriage:



- 1. Following a diagnosis (or part of the diagnosis) mutual discovery with effective discussions must occur early on.**

This must occur so to facilitate the prevention of future problems even catastrophic and expensive failures later via not placing for example expensive ceramic veneers on the teeth of a patient with active “meth mouth” or a patient with bulimia, etc. And additionally, it even means educating on the traditional very important aspects of preventative dentistry via hygiene, diet, fluoride, sealants, etc. and so to facilitate the prevention of marginal breakdown, recurrent decay of the dentistry you ultimately create and more. And finally, this feeds into prevention of periodontal disease, thus helping to facilitate the perseveration of your patient’s teeth and the dentistry you’ve created for them. The ever so important side or direct benefit: reducing many of the risks to systemic health; this could eventually even mean life or death.



- 2. There must be a strong MUTUAL attraction between BOTH parties.**

Modern Operative Dentistry relies to a substantial degree on adhesive dentistry. But, we too often forget that not only should our bonding agents, luting agents etc adhere at strong values to dentin or enamel, but in a very important way, they need to have a MUTAL high adhesion to the restorative material. And, it is important to remember that an adhesive complex is like a chain, it is no stronger than its weakest link. I asked our Director of R&D, to provide a quick approximation of the bond strengths of various “glues” to different substrates. The below shows the approximate “~”results and all with “quality technique:”

### **3.5mm Diameter Button Bonded to Dentin: Hydrophobic Resin Cement (dual/chem cure) bonds**

- a. Metal to dentin at ~ 15 – 30 MPa with LC bonding on dentin.
- b. Hydrophobic Resin Cement (dual/chemical cure) bond strength zirconia to Dentin at ~ 40-50 MPa with LC bonding (Peak) on dentin with sandblasting of the Zirconia and then MDP primer on the sandblasted surface.

*(However, many products DON'T and/or can't teach to light cure the bonding agent on the dentin as many bonding agents are too thick to facilitate such; hence bond strengths are significantly lower! As a general rule, LC luting resin cements will bring higher strength but such can't be used for many of the situations we have been discussing.)*

- c. Self-Etch Resin Cements bond metal to dentin at ~ 1 – 6 MPa.  
And Zirconia to dentin at ~ 1 – 8 MPa.

*For both metal and zirconia, these numbers can be doubled or Quadrupled with etching and with the use of a DBA on the preparation. But, being hydrophilic, they shouldn't be used under ceramics due to their water uptake. Such hydrophilic cements can swell and fracture the ceramic restoration, especially if a weaker ceramic such as feldspatic porcelain is used. Many clinicians use self-etch resin cements straight up, as they are taught to be "self-etch," and self-bonding hence supposedly not requiring the use of bonding agents. Furthermore, most clinicians don't realize they are hydrophilic and subject to water absorption and water degradation; therefore for this reason they often become "Trojan Horses." For example, it makes no sense that they be used to cement ceramic type inlays or onlays with the margins extending extensively on to the occlusal surfaces.*

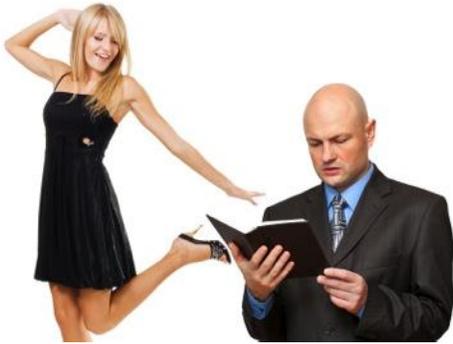
- d. RMGI bond strength metal to dentin = 5 – 15 MPa, However, depending on the brand, can almost double with an appropriate bonding agent on the preparation.
- e. RMGI bond strength zirconia to dentin = 2 – 8 MPa, However depending on the brand, can double or more, with an appropriate bonding agent on the preparation.

*Most of these can be improved bond strength wise with use of a DBA ON THE PREPATION but it must be one which can be thinned to a high degree, e.g. Peak LC. For example, the strongest Resin Modified glass ionomer (i.e. UltraCem) and most all RMGI cements can have their bond strengths significantly increased by using Peak first on the preparation and then light curing (aggressively air thing first).*

*Additionally, it is the norm with CAD- CAM type materials to create a "die space" of 60-90 microns. Now, envision flowable, very elastic (low Flex Modulus) composite cement filling in the space immediately adjacent to a very rigid material (any ceramic, but the most rigid would be zirconia) and the flexible dentin. And this is in the best of circumstances. What's worse? Think of very weak, hydrophilic self-etch cement that is subject to significant water degradation used in this "Grand Canyon"-like space. "Ouch!"; a potential cause of*

*disastrous failures. Furthermore, no "cement" (save hydrophobic luting composite) can withstand the wear generated on an occlusal surface with these large gaps.*

**IMPORTANT NOTE:** Non-compromising DBAs (again, only a handful of the 100 brands) bond to both dentin and to a quality composite at about 65 -80 MPa with no "die-spacer" space created, and as a side note, Peak was at the top of the heap in a recent CR report. The composite restoration and the tooth become intimately adhered together; a virtual mono-block of similar elasticity/flex moduli and with no cement margin! I like this a lot! And, the flexibility subject brings us to the next, very important ingredient for a successful, long lasting marriage



**3. If one partner in a marriage is overly rigid, even though the other is quite flexible, the relationship will probably suffer and eventually break. Such will usually happen sooner than if both were flexible. This is much more important than how tough one or both of the parties may be. If both parties have the ability to be flexible in optimal/respectful ways and they hold each other together with great glue, there is a high probability of a long term successful marriage.**

If one party (material) is overly rigid, it stresses the glue that holds them together, even causing destruction of the "glue!" And, if the glue is weak, the same thing will occur only much faster and result in a failed marriage-restoration much sooner. Zirconium is the most rigid of all the materials we use and with not only very high flex modulus but with the greatest of flexural toughness. It is often hailed as "the material of the future." However, for the vast majority of restorations, most of which occur posteriorly and into dentin, it can pose several challenges.

Flex modulus (also known as Elastic Modulus) is an important assessment and a way to describe the degree of flexibility and/or rigidity of a material. Relative to tooth structure, it is important that we compare to dentin because the majority of the surface area of most (or all) of the restorations of this discussion are in dentin.

*Below is an approximation of the Flex modulus of potential "partners:"*

- a. Dentin Flex Modulus = 12 – 18 GPa  
Composite flex Modulus = 5-12 GPa
- b. Enamel Flex Modulus = 80 -85 GPa  
Porcelain Flex Modulus = 70-85 GPa
- c. Emax Flex Modulus = 70-85 GPa

d. Zirconia Flex Modulus = 200 – 220 GPa

A marriage of ceramic-type materials to only enamel, such as for an optimum veneer preparation which is totally or mostly in enamel would be a much safer match, everything else being equal. This is because enamel is much closer in flex modulus to ceramics than dentin is. But where the majority of restorations extend significantly into dentin, especially for posterior teeth, and where additionally strong loading forces are the norm, one must think differently: It is much safer to build an elastic house

(e.g. frame) upon a rigid foundation (e.g. concrete) than the other way around. Everything else being equal one can expect better success placing composite on top of enamel only (or both dentin and enamel) even in the case of the veneer, than placing a rigid ceramic material on top of dentin, a more elastic substrate. But again, where most of the time, posterior restorations extend into dentin, and quite often into significant surface area of dentin, restorative materials which are not only very bondable at high strength but with flex modulus closer to that of dentin, can increase the prognosis for a long lasting and successful marriage.



**4. A healthy long lasting marriage and restoration cannot survive unless adequate energy is put into the relationship.**

Even with the best of “glues” (for strong “mutual attraction”) and best of composites including a flex modulus close to that of dentin, if they are not adequately light cured/energized, one loses the opportunity of creating a strong mutual attraction and further one loses the opportunity for the composite to come close to the flex modulus of dentin; additionally the composite will be weaker. Furthermore, for the adhesive to have a strong “mutual” attraction with the composite, the MOST important aspect of the composite which needs to be polymerized completely, is the thin increment immediately adjacent to the adhesive itself. This is one of the major drawbacks to bulk curing as it puts this very important portion of composite in the shadows of overlying composite. The worst case would be when this occurs on the gingival floor and gingival margin of the Class II box posteriorly. Additionally, if a metal matrix is used here, and a standard light guide positioned, there is a good possibility that this most critical aspect of the class II restoration is in the shadows! This works against a long lasting restoration. In a similar way, one can’t expect a quality marriage to start and/or last, if lack of attention to energizing the relationship occurs. Sadly, there are a large number of curing lights on the market today which are simply “not up to the challenge”. This inadequate energy sets the restoration up for failure. The Valo, with its low profile head, high power and unique

reflector and lens, was designed to facilitate optimum energy reaching into even the hard to reach, critical areas of all preparations/restorations.

**Important note:** *MW/cm<sup>2</sup> measures the irradiance output of a curing light. This number can be made to be a large number by either increasing the numerator and/or decreasing the denominator. This is a “game” that some light manufactures use as they will decrease the diameter/footprint small enough to make the irradiance appear to be a large number portraying great power. For practical purposes, with modern resin dentistry, one needs a footprint of 9.5 to 12 mm or multiple locations of cures are required with each layer etc. Additionally, Light Guides (fiber optic or solid) do not enable one to predictably cure in the deep gingival areas of the class II box with metal matrix, regardless of the footprint size as the angulation can often be an issue. Furthermore, is the beam so divergent that it can't deliver adequate energy to deep in the class II box? Additionally, a broad band of wavelength, ideally from 405 up to 465 brings added value and for some resins, critical value. Finally, it has been shown by Professors Price and Rueggeberg (and others) that dependent on the brand, the shade, and the level of opacity/translucency of the composite, to cure the bond resin adequately, to cure each increment of composite adequately, requires not just power but adequate energy. Some composites require only 5 joules of energy while others can require as much as 16 joules of energy per increment per cure to bring about adequate polymerization. How much energy is this?: It requires about 3.2 joules of energy to vaporize one ml/cc of water. For some composites, that would be equivalent to the amount of necessary to vaporize 5cc of water!! (Note, in the case of resins, this is not a heat energy subject but a light energy subject but one joule is one joule.) Do composites for luting or filling fail because they are composite or do they fail due to under curing, namely not putting enough energy into the material? (Plus the several other factors, some of the most important ones of which are indicated here!)*



**5. It can destroy even an apparent healthy marriage if either partner allows a trouble making/breaking third entity to come between them and their spouse/partner.**

Tragically, otherwise sound and healthy marriages can be destroyed. Many states even have laws facilitating legal charges to be brought against such entities under the statute of “alienation of affection.” In the case of the tooth-restoration “marriage”, I refer to the analog as: “alienation of adhesion”. In both cases, the glue that binds them or could bind them is compromised or even prevented from being able to function. As dentists, it is false logic to facilitate this interference via placement of weak substances such as a Glass Ionomer or even stronger “dentin substitute” materials for that matter, which don’t adhere at high strength between the dentin and the restoration to be bonded. This results in precluding the adhesive from being able to reach and integrate with the underlying dentin. This prevents any significant adhesion from occurring. Furthermore, this relatively weak and unnecessary material creates a much weaker foundation for supporting the stronger restoration (of which several materials could be) which is on top of it, acting as a weak foundation covering the much stronger dentin substrate.



**6. Marriages are killed out of the gate or don't last long if ugly contaminants exist.**

For example, baggage from a former marriage or a challenging childhood has the potential to kill a marriage. Anything preventing a quality adhesion from occurring in a quality way will cause the “downfall” of the relationship/partnership. When contaminants come between the adhesive and the conditioned mineral mother dentin, this prevents what otherwise would have been a quality (less than quality if not “non-compromising”) bonded relationship. Allowing drugs, such as blood or saliva, into the relationship will kill the relationship right out of the gate. Furthermore, inadequately curing, even light curing *all* of the ingredients decreases the likelihood of long-term success. There are many similarities on this subject that influence the success or failure of the marriage-restoration.



**7. Occasionally, there can be value when one party is in a greatly weakened condition and the other compensates by being very strong (potentially measured by “fracture toughness”.)**

This shouldn't need to be the norm early on when the relationship is young (even young teeth) albeit occasionally such is the case. Hopefully, such would be needed mostly later in life, be it for human relationships or for teeth. Then bring on the gold or zirconia! 😊 For me and my daughter, (and therefore the rest of our patients) this would be when the tooth is so weakened that it really needs the full crown – gold or zirconia. This is desirable when the tooth has become so weakened after substantial coronal tooth loss or with the loss of vitality plus

significant coronal loss, that a crown (and at times with a bonded post and core) is indicated. A quality, strong partner can, at least for some period of time, compensate for a weaker one. Even then, the weaker partner can continue to be compromised (for example, with the wrap around root caries under and beyond the margins of the full coverage crown). And yes, while I agree that zirconia appears to be the material of the future, let's do all we can to push it as far into our patients' futures as we reasonably can!



**8. When problems (outside of the catastrophic ones) occur in a marriage, are the partner's characters/capabilities such that the marriage can potentially be repaired and saved? Furthermore, can such a relationship be renewed and made better?**

Reparability of the dental partners, be they the restorative dental material or tooth, is a BIG deal! This is even more important today where fewer humans have dental insurance and many are on a limited income. However, repairing a restoration verses replacing it are also often the right thing to do for those with more money; saving a restoration can often prevent additional and unnecessary trauma to the tooth. Reparability becomes a very important contributor to the overall concept of "minimal invasive dentistry". I often say, and as a general rule: "The more you cut tooth, the more you weaken tooth," and "The more of the tooth you cut and the more times you cut it, the sooner you kill it. Trauma to a tooth is additive." This can often (not always) be the case in trying to save a marriage, complete with the very deep and/or long term scarring and severe pain that too often leads to the death of a marriage.



**9. Critical for a quality marriage to last a long time is great communication with quality LISTENING.**

Albeit this is true so to increases the chance of success with all dentistry, there is no place it is more important than when diagnosing the condition and treating the needs of an insulted or diseased pulp the tissues which form and shape it.



**10. Listen to the needs of the tooth/canals. Be guided by the anatomy of the tooth/anatomy.**

This is one of the reasons we recommend minimally invasive oscillations with files that enable you to lean against the canal walls so to guide you. Remember, most canals in cross section, are flat ribbons to oblique in shape. They are seldom round.

And additionally, where dentin in the root is always moist to wet, we should listen to this and use hydrophilic sealers and fillers which can even self-prime and bond to the prepared endodontic conditioned (via EDTA). Research shows that the optimal seal with EndoRez is obtained with the last paper point shows 1-3mm of “wet” on the last paper point used. Then, listening to science and the needs of the canal preparation, deliver the sealer (in this case EndoRez from the Apical regions outward (ADO, apical delivered obturation) using a tiny gauge Navi tip measured with tight fitting stopper to 2 mm shy of the apical preparation orifice/terminus. By delivering from the depth outward, the air is pushed out ahead of the sealer. In the case of the post channel, deliver via a bendable EndoEze tip for the same reason. Remember that Lentulo spirals are not effective and in fact “unacceptable”.

Listen to the tooth and patient. Respect biology; respect with patience what the tooth/pulp is telling you. For example; Pain with only sugar or very cold things? Leave the pulp alone. Reversible pulpitis, don't remove the pulp, potentially pulp capping. Vital pulp with irreversible pulpitis? Infection only in pulp? Don't over instrument; safe to do in one appointment, sodium hypochlorite but principally for dissolution of pulpal tissues where metal instruments can't reach. With regard to periapical infection, more thorough instrumentation (don't over cut), sodium hypochlorite; two appointments are highly recommended with interim antimicrobial treatment, ex. Calcium Hydroxide.



**11. A marriage is kept vital and not only enduring but endearing, by keeping it interesting.**

Complacency will put both the marriage relationship and oral health (including the dentistry) at risk. A fun new hair style, quality time alone, going out to dinner etc, on a cruise etc., all bring invaluable renew and enhancement to the marriage.

It goes without saying that yearly or bi-yearly checkups, a quality diet, reinforcing fluoride and daily hygiene are important in the case of oral health, including the dentistry. But furthermore, caring for the smile with tooth whitening or other esthetic procedures, often causes the patient to pay more attention to the value of teeth, of smiling, of esthetics and even then to give greater attention to their oral health, including the dentistry. This furthermore can even cause the partner, to pay more attention to their spouse, even contributing in fun interesting ways to the quality marriage relationship.



**12. In passing: All too often, there is an inverse relationship between the amount of money spent for the wedding and the quality and length/duration of the marriage.**

*Important afterthoughts:*

First, I quite like the term “Biomimetic”. However, I feel that our man made dental materials are still just different enough from natural dentin and enamel, that it is a stretch to suggest we can “mimic” them. I do like the emphasis that “Biomimetic Dentistry” puts on quality adhesives and Flex Modulus etc. However, I believe the need to replace/mimic enamel via ceramic onlays etc. Can cause the unnecessary removal of sound enamel plus bring other challenges including economic ones. I like what Henry Ford said, when he stated: “True Progress is not realized until technology is made available to masses.” Therefore, I see our greatest opportunity is in discovering and using similar, compatible materials thereby bringing to the equation practicality with affordability. Hence, at present, I see our greatest opportunity to be more in keeping with creating a compatible marriage-restoration, as the material “partners” we have today still can’t mimic the tooth/substrate “partners” in a perfect enough way. However, they can at least be similar enough to increase the likelihood of being “compatible” in a quality way and for a long period of time.

Finally, “A chain is no stronger than its weakest link.” In a similar way, a marriage is no stronger than its weakest link. I believe it very important, especially with “evidence-based” dentistry, that we stop forming conclusions relative to the success or failure of a “restoration” simply on what type of material was used, even wrongfully equating such to be the “restoration” type. For example, “350 amalgams were placed and X percent failed and/or “300 composites were placed and Y percent failed and ...” or 200 zirconia inlays were placed and Z percent failed.” Instead, we need to ask: “How many successful marriage-restorations were created using sound compatible principles and with attention being paid to the important details (such as what is shared above) and how well did they perform while in service (complete with their contribution to aesthetics, preservation of tooth structure, occlusion and the level of their abrasitivity

against the opposing dentition etc.) and “How much did the patient like them (or not) while they were in service” and then finally,” How long did they last?” But additionally and importantly, how well did the tooth survive the “restoration” and were they able to be repaired and/or renewed in a quality sense later in their life when needed?

A long lasting quality marriage is the evidence of great synergy occurring early on and then maintained, decade over decade. Just as the principles described above contribute in very important ways for the human marriage, so they also do for the “marriage restoration”. Most or all of the design decisions and materials selection for what we create is in our hands. Are we driven to be caring, professional “matchmakers” with the goal of creating great long lasting “marriage restorations” which are both tooth centered and patient centered? It’s our call; it’s our opportunity.

***\*Copyright; Dr. Dan Fischer, 2014.***