

Glass Ionomers—the Perfect Dentin Replacement

A dentist's perspective on the revolution in Contemporary Dental Conservatism

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Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6

Wilson and Kent introduced glass ionomer cements to dentistry in 1972¹. Since their release into the market in the mid 1970s, glass ionomer cements (GICs) have enjoyed somewhat of a rollercoaster ride, moving in and out of popularity for a wide variety of uses in the dental office. The two most remarkable characteristics of the early GICs were their fluoride release², reminiscent of silicate cements, and chemical bonding to tooth structure, only seen previously in polycarboxylate cements³. In oversimplified terms, the GICs were essentially a hybrid structure formed by combining silicate cement powder with polycarboxylate cement liquid. Hence, we had the first restorative materials that offered the benefits of continuous fluoride release and a chemical bond to tooth structure. In addition, these materials actually require some moisture on the dentin to allow bond formation⁴ and final maturation. This too was a benefit when considering working in a very moist environment such as the mouth. Excellent dental sales marketing would embrace this new "hydrophilic" property as a bonus in any dental material ranging from restoratives like glass ionomers to impression materials. With proper handling, microleakage was minimal even in the early glass ionomers⁵. The first proposed uses of GICs were limited to Class V erosion repairs (later renamed abfractions) and as a crown and bridge cement [photos 1-5]. Potential problems and failures arose with reported sensitivities and solubility issues. However, once these materials were better understood, including the fine balance of moisture on the tooth itself and on the surface of a setting restoration⁶, the remedies for such problems were quickly discovered. The prepped tooth surface must be kept slightly moist to allow GIC bonding while the surface of the setting GIC must be protected from excess moisture leading to degradation of the restoration.

Suddenly the "Ivory Towers" of tooth preparation designs that had reigned for so many decades from the renowned dental icon, Dr. GV

Black were in true jeopardy^{7,8}. The door to new preparation designs that had recently been opened by composites had now been kicked off the hinges as glass ionomers stormed in. The timeless truisms of extension for prevention and truncated boxes with undercuts for retention were no longer needed as with amalgam preps. These changes were only now useful in light of materials that would bond to the tooth without undercuts and would resist decay due to a therapeutic amount of sustained fluoride release. Unpublished volumetric studies we performed revealed that as much as 4/5 good tooth structure was destroyed to access and repair 1/5 decay with a GV Black Class II prep, however as little as 1/5 sound tooth structure was lost to access 1/5 decay when using a micro-conservative (modified tunnel) type prep. At least double the amount of good tooth structure is preserved in this method. No debate is needed to see the advantages for our patients. The epitome of radical rapid tooth destruction is exemplified with the "Australian Trench" as seen in a photograph from my operative dentistry text book [photo 6]. It is more time consuming to work cautiously to preserve all good tooth structure possible. Unfortunately, in our system of insurance reimbursement and coded procedures, there is no incentive or reward for the investment of time, effort, and equipment to be so discriminately conservative, other than personal satisfaction. Financial compensation is by surface, not time—this must be changed!

Glass ionomers went through an explosion of research and development by the manufacturers, which has ultimately produced a variety of outstanding acid/base reaction and resin-modified or auto-cure and light cured versions of GICs. The compressive strength, bond strength, solubility, esthetics, ease of manipulation, working time and biocompatibility all have been improved⁹. The exact role of glass ionomers in contemporary restorative dentistry, some 30 years after their introduction, must first be identified to fully appreciate the assets they possess.

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Photo 7



Photo 8

The dental profession continues to look for the one perfect material, the "Holy Grail" of dentistry, to replace two very different structural components of the tooth. The original manufacturer of our teeth used a two-part structural system (enamel and dentin) that has proven very successful, yet we continue to search for one material that will replace both, simultaneously, for our own convenience. Contemporary dentistry now has access to many outstanding restorative materials. Adhesive dentists and composite connoisseurs claim they have found the Holy Grail and the one perfect filling material in the form of composites. However, reflecting on the technique difficulties, material incompatibilities, lack of true fluoride release¹⁰ (token bound fluorides only) or a true chemical bond (actually a micro-mechanical bond) to tooth, this claim can be disputed. Despite composite's excellent esthetics, failures resulting in extreme tooth sensitivity, recurrent decay, partial and total debonding, and even nerve death would not add up to perfection as defined by Webster [photos 7-8].

It seems we have virtually overlooked the concept of repairing each damaged portion of tooth structure with specific and similar replacements. Let us briefly consider some of our dental materials as either enamel or dentin replacements. Beginning with enamel substitutes, there are many good choices including gold or amalgams in non-esthetic areas, numerous composites or porcelains for esthetic situations, and even resin-modified glass ionomers in esthetic but non-load bearing applications. The two primary dentin replacements were historically in the form of zinc phosphate and calcium hydroxide bases or liners. Glass ionomers jumped into this arena exhibiting physical properties, such as dimensional changes, conductivity, opacity, and hardness that are very similar to those of human dentin. This combined with their anti-cariogenic and bonding characteristics seem to total an excellent dentinal substitute.

The 1980s brought attempts to utilize this concept of combining a dentin and an enamel pair which yielded the layered or sandwich (open and closed face) techniques¹¹. My January 1985 table clinic presentation entitled "Micro-Conservative Tooth Preparation" at the Dallas Mid-Winter Dental Clinic won the People's Choice Award. It described the preservation of the marginal ridge in a class II prep and the layering of composite over a glass ionomer base [photos 9-14]. Granted, some of these restorations have lost the marginal ridge of enamel years later, but direct bonding repair with a composite over the remaining restoration is easily accomplished, usually without anesthesia and ultimately remains far more conservative than other techniques. Also, the "slot" or facial class III approach to class II decay was introduced as an alternative design [photos 15-17]. These ideas were not at all my invention, but, with minor varia-

tions, have been the mainstay design for both new and replacement fillings in my office since that time. I have a rule, or better stated, a commitment in my practice that exposed dentin is covered with glass ionomer of one type or another. This is my attempt to emulate the original tooth form with my restorative procedures and materials (the exception being all porcelain restorations that mandate composite bonding systems for adhesion).

Thanks, in part, to the modern restorative materials of today, dentists are able to preserve even more of the original remaining tooth structure. In addition, with the advent of air abrasion, lasers, Diagnodent, caries indicators, digital x-rays, and lighted magnification dentists have the armamentarium to discriminate remove tooth structure on a micro level, rather than the macro scale we were historically forced to work on. We are certainly better equipped now to fulfill the oath we all have taken as dentists, which, simply stated is to preserve our patient's health and dentition, do no harm, and do not over treat. Unfortunately, a few in our profession are still willing to decimate good tooth structure solely in the name of cosmetics or simply the resistance to change their mindset.

Since GICs became my primary restorative cement, I rarely have crowns that disbond in use, however I have successfully recemented many crowns that disbonded with other types of cement. I routinely use glass ionomers for bases under composites, as build-ups under crowns [photos 18-19], and for abfraction and root surface fillings. GICs used as sealants and expressed into grooves without etching (the demineralizing of enamel similar to the first stage of the very decay we are trying to protect from) not only protects that tooth, but may offer protection due to fluoride release to the adjacent teeth. There are certainly no caries found under a partially dislodged or worn GI sealant as may be seen with composite sealants¹² [photos 20-21]. Undoubtedly, geriatric, pediatric, high caries risk and any



Photo 9



Photo 10



Photo 11



Photo 12



Photo 13



Photo 14

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Photo 15



Photo 16



Photo 17



Photo 18



Photo 19



Photo 20



Photo 21

impaired patients with limited hygiene skills can certainly benefit greatly by using glass ionomers [photos 22-25].

I am still a bit disheartened and unable to explain why all practicing dentists do not accept and use GIC materials for at least some applications. Having clinically used GICs since 1984, I have witnessed their ability to ward off bacterial invasion even in some of the worst situations. The opportunity they offer, in conjunction with good enamel replacements, to leave all remaining sound tooth structure and repair only the damaged areas in a layered technique in my office is what I consider state-of-the-art conservative dentistry and how I would like my teeth to be preserved [photos 26-28]. Their flexibility and ease of use allows me to repair otherwise hopeless teeth and buy much needed time for existing restorative work during phase one management of my patients. When heroics or ultra-conservative treatments are in order, glass ionomers have always carried the torch for me with excellent results [photos 29-38]. Without glass ionomers, much of the charity work done in third-world countries (ART technique) and domestic nursing homes, hospitals, and adolescent facilities with few dental conveniences would be impossible. Deciding which brand of glass ionomer is not critical, however, understanding the basic differences in physical properties, chemistry, and clinical advantages (or disadvantages), then consciously selecting the best material for the situation is appropriate.

If I were forced to select only one type of dental material to use exclusively in my office, I could not practice without glass ionomers. I have not placed an amalgam since my state board exams. This is not due to a lack of confidence in amalgam, rather a result of discovering the virtues of glass ionomers as a dentin replacement in conjunction with gold, porcelain, or composite as enamel substitutes. I am not an advocate of removing old amalgams until their usefulness has expired, but I have certainly rebuilt countless teeth with failed amalgams due to fracture or recurrent decay. Make no mistake that if and when the day comes that the one perfect filling material is found, I will probably use it. No doubt it should go nicely with the pill we can all take to prevent decay and the dental bonding agent isolated from barnacles that adhere to boats, promised for decades, but neither of which are yet completed. In the meantime, I will continue my conservative approaches in dentistry, placing my enamel and dentin-like combination replacement fillings, repairing surviving elderly teeth, building up and cementing crowns, and enjoying the high success rate I have had for the past 18 plus years with these revolutionary materials.

I must commend dentistry for the efforts and strides it has made to prevent dental disease. No other profession has worked so hard to put itself out of business by promoting fluoride in public water systems, in toothpastes and rinses, and even in chewing gums that can each promote re-mineralization of weak enamel. In addition to tremendous education and prevention efforts, the aforementioned armamentarium of equipment, materials (including GICs), and techniques that have been developed to detect and repair tooth damage have allowed dentists to do far less invasive treatments on a decreasing population of diseased adolescent patients than in the past. Genetic engineering and bacterial alteration may eliminate the need for many restorative procedures in future generations. Conversely, as the baby-boomers mature and contemporary medicine increases our expected lifespan, the geriatric



Photo 22



Photo 23



Photo 24



Photo 25



Photo 26



Photo 27



Photo 28

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Photo 29



Photo 30



Photo 31



Photo 32

population and their dental needs may soon explode. Despite these developments, micro-techniques for restorative are not currently mainstream views in either the practicing or the academic worlds of dentistry.

My exposure to GICs, as a dental student shortly after their introduction to the USA not only helped shape my practice philosophy and techniques, but allowed me to meet and associate with some of the finest people in dentistry. These leaders, acquaintances, and even mentors of mine include John McLean, Graham Mount, Joe Simmons, Nels Ewoldsen, Geoffrey Knight, Tim Rainey, Don McKenzie, and the late Ralph Phillips. It was my good fortune to practice with Dr. Joe Simmons, originator of the Miracle Mixture, for my first three years out of dental school. Our goal was to help improve these materials and techniques as they related to the practicing dentist and their patients. Corporately we worked with many companies including 3M, ESPE, and Caulk, but none have done as much as GC to promote and embrace the wonders of glass ionomers. I feel GC's commitment to glass ionomers, especially in the early days, led to the success and recognition they enjoy today. For this I applaud GC. I have had the opportunity to participate in clinical studies, laboratory research projects, product development and evaluation and given numerous presentations both here and abroad related to glass ionomers. Without these experiences I might not have the passion and desire to contribute to the future direction of our profession that I still feel today. Dentistry has advanced by leaps and bounds (or bounds) during my 23 year affiliation and I cannot wait to see what the future holds for us and our patients.

Dr. Larry Herwig received a B.S. from Southwest Texas State University in 1980 and a DDS degree from Baylor College of Dentistry in 1984. He was Chairman of the 1997 Dallas Mid-Winter Dental Clinic and President of the Dallas County Society from 1998-1999. Dr. Herwig practices general dentistry in Dallas, Texas and was nominated for TAGD's Texas Dentist of the Year in 1999.

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Photo 33



Photo 34



Photo 35



Photo 36



Photo 37



Photo 38

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