EndoSequence®
Melding Endodontics with Restorative Dentistry
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In the past four decades, we have witnessed many changes in dentistry. The most significant (in our opinion) have been the advent of non metallic dentistry (bonding), the introduction of dental implants, and the use of nickel titanium rotary files to shape root canals. But, more importantly, what has become apparent is that dentistry is multidisciplinary in nature and must be treated as such. It is unwise, and often a mistake, to view any particular aspect of dentistry as a lone standing entity. So it is with endodontics.

Endodontics should be viewed, not as a lone standing entity but rather, as part of an Endo-Restorative Continuum. Even if a tooth is well treated endodontically, its long term success depends upon the quality of the final restoration. Furthermore, endodontic therapy should be accomplished in such a manner that it facilitates an excellent long term restoration. As a result of the intimate relationship that exists between endodontics and restorative dentistry, it is imperative that root canal therapy be done in as conservative a manner as possible.¹ Conservative in terms of preserving radicular dentin. If an excessive amount of radicular dentin (particularly in the coronal third) is lost during the endodontic procedure, this may lead to increased endodontic failures. It will be demonstrated in this article how endodontics can meld with restorative dentistry, as well as introducing an endodontic system (EndoSequence) that will help us attain this goal.

A significant number of endodontic cases that fail, do so not as the result of endodontics per se, but actually fail as a result of the restorative effort. An open margin on a crown that allows the continued percolation of oral fluids over time is a clear example. The entire root canal may become totally contaminated as a result of coronal leakage. The bacteria that caused this failure are not residual in nature but instead, are the result of coronal leakage.

Currently, we are seeing many endodontic preparations that are excessively wide in the coronal third of the radicular dentin.² Consequently, some of the questions we need to ask ourselves are the following. 1) What is the principle cause of this coronal enlargement and does it adversely affect the long term prognosis of the tooth? and 2) Is there a preferred taper for endodontic preparations and will performing it, enhance the prognosis of endodontically treated teeth?
Clearly, the most significant change in endodontics that has resulted in excessive coronal shaping has been the evolution of obturation techniques. As thermoplastic techniques (solid core and warm vertical condensation) became more popular, it was obvious that the larger the opening at the top of the canal, the easier it was to move heated gutta percha down the canal. That’s fine for manipulating gutta percha but the real concern is whether this larger coronal shaping has compromised the structural integrity of the tooth.

If there are any questions of how excessive coronal enlargement can adversely affect the long term prognosis of a tooth, think of the following case. This would be a recall xray of a silver point case done many years ago. Silver points are not being recommended as a preferred technique but here is the salient point. Think back, “Can you remember the last time that you saw a silver point case fail as the result of a root fracture?” Most likely the answer is, no. When silver cone cases failed, they failed apically not as the result of structural compromise. The reason is obvious when you examine the xray. Notice all the wonderful radicular dentin remaining in the coronal third of the root. The tooth has not been augured out by either gates glidden burs or large orifice openers. Yes, silver point cases failed on occasion, but not as a result of over enlargement in the coronal third of the root. Some of the obvious long term problems associated with excessive coronal enlargement are fractures, coronal leakage, and caries. This is why this issue is so important and needs to be addressed. In fact, the failure of some endodontically treated teeth to stand up long term has given the implant companies an excellent opportunity to market a “story” that endodontically treated teeth don’t stand up long term. Supposedly, they fracture. Real World Endo takes exception to this “story,” as we believe that, when performed in a conservative manner (particularly in the coronal third of the root), endodontically treated teeth will have an excellent long term prognosis and last as long as any successful implant. The truth is that there are indications for both treatment modalities and that endodontics performed as a minimally invasive procedure has an excellent chance of lasting a patient’s lifetime.

In addition to various thermoplastic techniques contributing to the problem of over enlargement, the recent use of carrier based obturation (both gutta percha and Resilon) has also resulted in wider than ideal orifice enlargement. The rationale behind this is again quite simple. The larger the hole at the top of the canal, the less likely it is to strip (denude) the carrier of gutta percha (or Resilon). This has been one of the challenges associated with carrier based obturation (stripping the carrier at the orifice during insertion).²
Consequently, we often see wider orifices associated with these techniques. Certainly, one can get good obturation results with carrier based techniques (as with other methods) if done properly, but this issue of stripping a carrier remains a significant one in endodontics. Therefore, when viewed from a truly endo-restorative perspective, we believe the wider coronal shape presently employed by many practitioners for both carrier based and thermoplastic obturation techniques may adversely affect the long term prognosis of the tooth. **The goal of endodontic therapy should be to satisfy all the biologic requirements of the procedure without compromising the long term prognosis of the tooth.** When performing a root canal, it is neither acceptable nor necessary to structurally compromise a tooth while achieving these goals (cleaning, shaping, and obturation).

The second question (concerning taper) must be initially discussed with a comparison of a variable taper technique versus a constant taper preparation. Presently, in endodontics, we have two methods of root canal instrumentation: variable taper or constant taper. Both of these methods can do a good job of cleaning the root canal system. However, there are some profound differences. A variable taper method uses rotary files that have the same common apical tip size but vary in their tapers. For example, one may use a variable taper technique that employs a .25 apical tip size and utilizes variable tapers in the range of .12, .10, .08, .06, .04, and .02. While a variable taper sequence tends to promote disengagement of the instrument, what is sacrificed in its use is the predictability of shape commonly associated with a constant taper preparation. Due to their lack of a constant, reproducible shape, most variable taper methods therefore are associated with thermoplastic obturation. Furthermore, with large variable taper sizes such as .12, .10, and .08 there is the concern of coring out the orifice and removing an excessive amount of tooth structure in the critical coronal third of the canal. Consequently, while a variable taper technique may facilitate the insertion of carrier based obturation methods, or thermoplastic techniques, extreme caution must be used not to remove excessive tooth structure and thereby compromise the long term retention of the tooth. **Obturation should not dictate shape.**

A constant taper preparation, on the other hand, is generally much kinder to the coronal dentin of the root canal. But it must be noted that a constant taper preparation can also remove excessive coronal tooth structure if too large a size and taper is utilized. A constant taper preparation routinely employs a series of files with a constant taper such as a .04 or .06 and with varying apical tip sizes. Because of the constant taper, the net result of using a series of constant taper files is a more conservative, reproducible shape. **A key factor in the use of constant taper preparations is that the consistency of shape facilitates the primary cone fit, which expedites the overall obturation process.** This is one of the principle reasons why constant taper preparations are the choice of most endodontic specialists. But a question still remains,
"Is there such a thing as an ideal taper?"

This question can be addressed in the following manner. As endodontic shaping has evolved, we have come to the conclusion that the preferred taper (in most cases) is a constant .04 taper preparation, rather than a .06 taper. There are multiple reasons for this (foremost being conservation of radicular dentin) but first we must acknowledge a shift in instrument design that has occurred from landed files to non landed instruments. The desire for greater efficiency and predictability of shape associated with non landed instruments (such as EndoSequence) has generated this change. But it was not always this way.

When rotary files were first introduced, the original constant taper files had lands and a .04 taper. This quickly evolved into an additional series of .06 tapers. As the acceptance of rotary instrumentation by endodontists grew, we saw an increased use of .06 tapers. This seemingly made sense from two perspectives. The first is that the wider .06 taper preparations are considered easier to obturate if performing warm vertical condensation and secondly, .06 tapered landed files are stronger and less susceptible to separation than .04 taper landed instruments. However, this concept of a .06 taper file being less susceptible to separation does not apply to non landed rotary files. In fact, with non landed instruments, cyclic fatigue is the key issue with the result being, .04 taper non landed instruments are more resistant to separation than .06 taper non landed files. So, in addition to conserving tooth structure, a move to a constant .04 taper preparation also makes sense (as a safety factor) if using non landed instruments.4

Additionally, recent studies have again demonstrated that .04 taper shapes are more than adequate to allow irrigation agents to generate a thorough cleansing of the root canal.5 So, when it is evaluated from a true endo-restorative perspective, the preferred taper should be a constant .04 taper.

Once the effects of taper are understood, the relationship between endodontics and restorative dentistry becomes obvious. The next challenge is to find a technique that will meld the two disciplines together. We believe that the EndoSequence System (Brasseler USA, Savannah, Georgia) developed by Real World Endo meets this challenge by creating precision shaping that allows for predictable obturation through a matching system of laser verified gutta percha cones. The significance of this is that as a result of the matching laser verified cones, endodontic synchronicity is now established between a machined preparation and the master cone.6 The key to achieving this endodontic synchronicity, which ultimately results in the conservation of radicular dentin, is the file. Let’s examine its design features and see why it’s unique.
Rationale:
The rationale behind the development of the EndoSequence file was straightforward. The goal was to create a file that would work equally well for the general practitioner doing 100 endodontic cases a year, as it would for the specialist performing 1,000 cases annually. Secondly, the instrument had to be a constant taper because such a shape would act as the foundation for creating endodontic synchronicity. Thirdly, an instrument was needed that would conserve radicular dentin. To satisfy this requirement, the EndoSequence .06 taper series of files ends at size 50. Anything larger than this size (in a .06 taper) is generally too large at the top of the canal. (The .04 taper series goes all the way to size 80.) Finally, the instrument had to be efficient. Endodontics can be performed well and it can be done in an expeditious manner. But, the key to having success with speed (in endodontics) is consistent, reproducible results. An efficient instrument is critical if we want to achieve these goals.⁷

Design Features:

**Blank Design and Alternate Contact Points**
The blank design of this instrument is a departure from previous generations. This is because the EndoSequence file is not a file. Rather, its blank design is that of a true reamer (triangular), not a file. There are many advantages to a reamer design, including that of greater efficiency. However, for a reamer to be truly effective in a rotary technique, it must have a centering device. A triangular design without a centering device incurs the risk of transportation.

The EndoSequence file is designed in such a way that there are alternate contact points (ACP’s) along the cutting surface of the instrument. This design not only keeps the file centered in the canal, but the alternate contact points limit its contact with the dentinal walls (thereby reducing torque) and simultaneously promotes disengagement. Consequently, as a result of its reamer blank design and alternating contact points, the file is never fully engaged (loaded) along its entire length.⁸ But, please think again what was just described. The reduced torque and the disengagement of the file (created by the ACP’s) give you the exact benefits of a variable taper system, but it occurs on a constant taper blank! So in fact, what you have is the best of both worlds; reduced engagement and predictable, reproducible shaping.

**Electropolishing as a Metal Treatment**
Historically, most nickel titanium files have been tumble polished in a drum. However, the EndoSequence file has been subjected to the process of electropolishing. Electropolishing is relatively new in endodontics but its benefits are significant. Anderson et al found that, “Overall, electropolished instruments performed significantly better than non electropolished instruments in cyclic fatigue testing and, to a lesser extent, in torsional loading.” They went on to conclude that, “Electropolishing may have beneficial effects in prolonging the fatigue life of rotary NiTi endodontic instruments. The benefits of electropolishing are likely to be caused by a reduction in surface irregularities that serve as points for stress concentration and crack initiation.” This was also shown in a study by Tripi et al that demonstrated that “an electropolishing surface treatment is able to remove machining grooves and can increase the fracture-related fatigue resistance” of an instrument. The net result is that electropolishing does make a difference. Furthermore, the creation of a superior finish (as the result of electropolishing) will keep the edge of the instrument sharper, easier to clean, and more durable.

**Cutting Efficiency**
The EndoSequence file has superb cutting efficiency. This is a result of its reamer design (lack of radial lands) combined with electropolishing that results in its extremely sharp edges. Additionally, it possesses a large chip space that allows for excellent debris removal. The efficiency of this instrument is such, that the clinician should be aware to clean or change it after every three engagements. Each file should work in the canal for no more than 2-3 seconds before cleaning or moving to the next sequential instrument. If the instrument is left in the canal longer than 3 seconds, the flutes will become clogged with debris and the file will no longer work as efficiently. In fact, in a recent study on cutting efficiency (and the benefits of a deep chip space), Shafer and Oitzinger noted that instruments with a true triangular cutting section are associated with an enhanced cutting efficiency.

**Expeditor**
Another innovation with the EndoSequence system is the introduction of a new file and concept. This is the “Expeditor.” The “Expeditor” is a 21 mm, size 27, .04 taper nickel titanium rotary file. The EndoSequence technique is based upon the concept of using an “Expeditor” file that helps the clinician choose the correct canal size and select the appropriate package of files (small, medium, large, or extra large) to properly prepare the canal. Canal preparation generally will require only three files, but there is a fourth file in each assortment pack for more challenging cases.

**Obturation:**
It has been a continuing goal of Real World Endo to develop products and techniques that will deliver excellent endodontic results in the most efficient manner. It has been an additional goal to design these techniques in such a manner that the greatest majority of practitioners will be able to perform these procedures successfully and in a predictable manner.\textsuperscript{12} The basic EndoSequence file system has given all clinicians the ability to machine predictable shapes that ultimately lead to synchronicity between the preparation and the master cone fit. Embracing this concept, and taking it to the advanced level in obturation are sealer based obturation systems (developed by Real World Endo) such as the Activ GP Obturation System and EndoSequence BC Sealer (Brasseler USA, Savannah, Georgia).

Activ GP is a system which utilizes improved glass ionomer technology (both as a sealer and as a special glass ionomer coated gutta percha cone) to create a true single cone monobloc obturation. This is very significant because a true monobloc will allow us, for the first time, to create a hermetic seal within the root canal space. A hermetic seal has been a goal of endodontics for more than fifty years. Furthermore, a true single cone technique is a method that is now clinically achievable as a result of improved material science. More importantly, such a technique (when performed properly) will give the greatest percentage of clinicians the ability to produce superior obturation results.\textsuperscript{13}

In the original pursuit of this goal, glass ionomer (Ketac Endo) was selected because of its superior biocompatibility and its physical properties. However, a problem historically with the early generations of glass ionomer, and resin sealers, was that neither method was able to develop a true monobloc. Although there were advocates on both sides of the argument, research showed that both the glass ionomer and resins sealers each had some advantages and some limitations. However, one thing that both the resin and glass ionomer advocates could agree on was that obturation was headed in the direction of sealer based techniques rather than the mechanical packing and melting of gutta percha. This made sense from both the technical and science sides.

It is also very interesting to see how the two materials differed. The resins were shown to have a good seal between the sealer and the gutta percha cone but their seal to the canal wall was questionable. The glass ionomer cements, on the other hand, displayed an excellent seal to the canal wall but their seal to the gutta percha was less than ideal. So as the 20\textsuperscript{th} Century came to a close, we still found ourselves searching for a technique that could consistently deliver a true monobloc obturation.\textsuperscript{13}

Activ GP obturation is, in fact, a single cone technique that requires a minimal amount of sealer, rather than the excess that is utilized in other methods. This is because the system is precision based. As previously mentioned, precision-based endodontics
requires accuracy between the file and the master cone. Similar to the regular EndoSequence gutta percha, all Activ GP points are laser verified (and calibrated) to precisely match the preparations made by the .04 or .06 tapered EndoSequence file system. The precision matching of the primary cone to the preparation (endodontic synchronicity) is very important with any single cone technique because the accuracy of the cone fit to the preparation minimizes the amount of sealer and any dimensional change. Although dimensional change can occur with all sealers, glass ionomer is very stable and does not shrink. Furthermore, due to the predictability of shape associated with constant tapers, it may be stated that a true single cone technique should be accomplished with a constant tapered preparation such as a .04 or .06. A variable taper technique is not recommended because its lack of shaping predictability (and its corresponding lack of reproducibility) will lead to a less than ideal cone fit. This lack of endodontic synchronicity is why all variable taper preparations are associated with thermoplastic techniques.

While glass ionomer has been a huge help in establishing a true single cone filling technique, the obturation equation has further changed with the introduction of a new material. This is bioceramic technology and the specific material is EndoSequence BC Sealer. But before we discuss how this specific sealer is changing obturation, we need to address some of the merits associated with bioceramics.

The first question we need to ask ourselves is, “What are bioceramics?” Bioceramics are ceramic materials specifically designed for use in medicine and dentistry. They include alumina and zirconia, bioactive glass, glass ceramics, coatings and composites, hydroxyapatite and resorbable calcium phosphates, and radiotherapy glasses. Bioceramics are also widely used for orthopedic applications, such as joint or tissue replacements, as a coating to improve the biocompatibility of metal implants, and they can also act as resorbable lattices which provide a framework that is eventually dissolved as the body rebuilds tissue.

The properties associated with bioceramics make them very attractive to both medicine and dentistry. In addition to being non toxic, bioceramics can be classified as:¹⁴,¹⁵,¹⁶,¹⁷

- **Bioinert**: non interactive with biological systems
- **Bioactive**: durable tissues that can undergo interfacial interactions with surrounding tissue.
- **Biodegradable, soluble, or resorbable**: eventually replace or incorporated into tissue. This is particularly important with lattice frameworks.
There are numerous bioceramics currently in use in both dentistry and medicine, although more so in medicine. Alumina and zirconia are among the bioinert ceramics used for prosthetic devices. Bioactive glasses and glass ceramics are available for use in dentistry under various trade names. Additionally, porous ceramics such as calcium phosphate based materials have been used for filling bone defects. Also, some calcium silicates such as ProRoot MTA (Dentsply) have been used in dentistry as root repair materials and for apical retrofills.

However, we must ask ourselves again, “What are the advantages of bioceramics in dental applications?” Clearly the first answer is related to physical properties. Bioceramics are exceedingly biocompatible, non-toxic, do not shrink, and are chemically stable within the biological environment. Secondly (and this is very important in endodontics) bioceramics will not result in a significant inflammatory response if an over fill occurs during the obturation process or in a root repair. A further advantage of the material itself is its ability to form hydroxyapatite and a bond between dentin and filling materials.

While the properties associated with bioceramics make them very attractive to dentistry, in general, what would be their advantage if used as an endodontic sealer? From our perspective as clinicians, some of the advantages are: enhanced biocompatibility, possible increased strength of the root following obturation, high pH (12.9) during the setting process which is strongly anti-bacterial, sealing ability, and ease of use.¹⁸

The introduction of EndoSequence BC Sealer allows us, for the first time, to take advantage of all the benefits associated with bioceramics but to not limit its use to merely root repairs and apical retrofills. This is possible because of nanotechnology (the particle size of BC Sealer is so fine, it can actually be used with a capillary tip). When viewed in the overall context of obturation systems, EndoSequence BC Sealer is a game changer.

This material has been designed as a non-toxic hydraulic calcium silicate cement that is easy to use as an endodontic sealer. The purpose of BC Sealer is to improve the convenience and delivery method of an excellent root canal sealer while simultaneously utilizing the water inherent in the dentinal tubules to drive the hydration reaction (of the material, thereby shortening the setting time. Dentin is composed of approximately 20 % (by volume) water ¹⁹ and it is this water which initiates the setting of the material and ultimately results in the formation of hydroxyapatite.

For clinical purposes, the advantages of a premixed endodontic cement (sealer) should be obvious. In addition to a significant saving of time and convenience, one of the major issues associated with the mixing of any cement, or sealer, is an insufficient and non homogenous mix, which ultimately may compromise the benefits associated with
material. Keeping this in mind, BC Sealer has been designed as a premixed bioceramic sealer that hardens only when exposed to a moist environment (produced by dentinal tubules).

The technique with this material is straightforward. Simply remove the syringe cap from the EndoSequence BC Sealer syringe. Then attach an Intra Canal Tip of your choice to the hub of the syringe. The Intra Canal Tip is flexible and can be bent to facilitate access to the root canal.

Following this procedure, insert the tip of the syringe into the canal no deeper than the coronal one third (1/3). Gently and smoothly dispense a small amount (1-2 calibration markings) of EndoSequence BC Sealer into root canal by compressing the plunger of the syringe. Using a #15 hand file or something comparable, lightly coat the canal walls with the existing sealer in the canal. Then coat the master gutta percha cone with a thin layer of sealer and very slowly insert it into the canal. The synchronized master gutta percha cone will carry sufficient material to seal the apex.

The precise fit of the EndoSequence gutta percha master cone (in combination with a constant taper preparation) creates excellent hydraulics and, for that reason, it is recommended that the practitioner use only a small amount of sealer. Furthermore, as with all obturation techniques, it is important to insert the master cone slowly to its final working length. Finally, here’s more good news. The glass components in the bioceramic sealer bond to the Activ GP glass ionomer coated cones.

When we talk about a true single cone technique let’s think about what this really means. The easiest way to comprehend this is to compare it to carrier based techniques. In these techniques, you heat the obturator and then insert it into the tooth, delivering it to a point just shy of the working length. Basically, you are using a hard plastic carrier to deliver heated gutta percha, or resin, into the root canal system. The primary limitation associated with this technique is the concern of stripping (or denuding) the carrier of gutta percha (or resin) when it is inserted into the canal orifice. Additionally, there is the lack of apical control that is the result of using heated gutta percha or resin. However, the concept of filling a root canal with a device that you can “feel” is admirable. It is essentially the same with an Activ GP cone and BC Sealer, but with a few differences. Again think what you are doing. You are, in essence, using a stiff carrier (but one that is actually a stiffer gutta percha cone) to deliver a dimensionally stable bioceramic sealer into the root canal system. So while you get the “feel” of a carrier based technique, you have the advantage of using gutta percha as a carrier to deliver sealer. After all, it is the sealer that creates the seal in obturation, not heated gutta percha. Additionally, post preparation will be a lot easier because you are now removing gutta percha not cutting plastic.

A final aspect of the Endo-Restorative Continuum and the one which ultimately melds restorative dentistry with endodontics, is the restoration of the endodontically treated tooth. It is well known and established that the ferrule effect (1.5 to 2.0 mm of vertical tooth structure at the gingival aspect of a crown preparation) is a key factor in the long
term success of these teeth. But let’s examine something more basic. This is the issue of posts.

It has been commonly accepted that all posts weaken teeth and it is generally recognized that the main purpose of a post is to retain the core. Yet, post design as it relates to endodontic shaping, has become a confusing issue. Years ago there was a mantra in restorative dentistry, “tapered posts split roots.” That was because all the specialists at the time were creating essentially parallel preparations with .02 taper hand files and if one inserted a tapered post into such a shape, you incurred the risk of splitting the tooth. Consequently, we used parallel posts. Then endodontic shaping evolved to the use of tapered preparations.

Today, while most practitioners are creating tapered endodontic preparations (constant or variable) many clinicians still are attempting to place parallel posts into these shapes. This likewise makes little sense and, as a result, clinicians are excessively enlarging their parallel post preps to gain some “bite” on the sides of the tapered canal walls. Unfortunately, the more coronal radicular dentin that has been removed, the less retentive is the final restoration. Additionally, this can also severely compromise the tooth and, as a result, we are witnessing many fractures emanating from the bottom of the posts. The net result is a diminished long term prognosis. The answer to this dilemma is straight forward. Use a post design that matches the shape of the endodontic preparation. When one thinks about it, this is what cast posts were attempting to create…..posts that precisely match the shape of the endodontic preparation!

A solution to this discrepancy between post size and canal shape has been achieved with the development and introduction by Real World Endo of the EndoSequence Post System (Brasseler USA, Savannah, Georgia). The EndoSequence rotary file creates a fully tapered preparation (.04 or .06) from orifice to apex. The corresponding paper points and gutta percha cones are laser verified to precisely match the shape created in the canal. The EndoSequence post goes one step further and is likewise tapered (.04 or .06) to match the exact shape of the instrumented canal. Because of the synchronicity that has been established, there is no need to alter the shape of the root canal preparation to match the post. In a sense, the last rotary file taken to length is acting as a post drill. This concept has also been addressed in a recent article by Dr. Richard Trushkowsky when he wrote, “The ideal post should have the same shape as the endodontic preparation, and should be non-corrosive, readily adjusted, and able to be removed without difficulty.” Furthermore, since the dual cure resin cement that is used to bond the post to the canal wall is also the same material used to create the buildup (EndoSequence Build-up), one can think of this technique as an intra-radicular
core buildup with a rebar. Not only is this “post technique” easy to replicate, it is kinder to the tooth and, most importantly, it is safer.

In this article, a case has been made for the importance of maintaining endodontics as part of the treatment planning process and for performing endodontics in a more conservative fashion. When talking about doing “conservative endo,” everyone thinks of coronal tooth structure, but it is the preservation of the radicular dentin (particularly in the coronal third of the root) that will enhance the long term retention of the endodontically treated tooth. Additionally, it has been emphasized in this article that we need to think in terms of an Endo-Restorative Continuum rather than just endodontics. Furthermore, an endodontic system (EndoSequence) has been introduced that bridges the gap between root canal therapy and restorative dentistry. This is significant because this melding of endodontics with restorative dentistry now gives you the ability to offer your patients endodontic therapy that will stand the test of time.

Real World Endo will continue to “Stand up for Endodontics” and all the benefits that well done root canal therapy can offer your patients.

References:
2. Brave D, Koch K. Excessive Coronal Shaping Adversely Affects the Long-Term Prognosis of Endodontically Treated Teeth Dentaltown Feb. 2007: 10-12


11. Schafer E, Oitzinger M. Cutting Efficiency of Five Different Types of Rotary Nickel-Titanium Instruments Journal of Endodontics February 2008 Vol.34, No.2 Pg.198-200

12. Realworldendo.com


17. Hichman K., Bioceramics, April 1990
http://www.csa.com/doscoveryguides/archives/bceramics.php#editor

18. Koch, K., Brave D., A New Day has Dawned: The Increased Use of Bioceramics in Endodontics Dentaltown, March 2009


