Predictable Endo 102: Why warm and soft is so good
System 'S' for injectable or carrier-based GP

By John J. Stropko, DDS

The author has been in private practice and a continuing education student for the past 50 years. The first half was spent providing conventional endodontics, and the second half in a specialty practice limited to endodontics. On the road to predictability, it became apparent there was a relationship between the root canal treatment, periodontal status, prosthodontic, and restorative procedures. Each operator has to decide what steps for a more predictable outcome they are willing to trust another to do. This article is an attempt to share some “secrets of success” and perhaps serve as a checklist for a system that works in the attempt to achieve predictability of endodontic treatment.

During the earlier years of the past century, several techniques were devised for the obturation of the canal system after removal of the diseased pulp, or necrotic tissue. Some of the most popular were silver points, lateral condensation of gutta-percha (GP), Sargent point and chloropercha. Currently there are seven techniques that utilize gutta-percha as the obturation material of choice:

1) Single cone
2) Lateral condensation
3) Chloropercha technique
4) Vertical compaction of warm material of choice: chloropercha. It is currently there are no reports, published research and clinical studies have confirmed the rational for an appropriate access and correct shaping.

The author believes that as long as the gutta-percha is introduced to the apical third of the canal system, pre-warmed and pre-hybridized, the decompaction and adaptation to the canal walls is more predictable, resulting in a better seal that is significantly less “sealer-dependent.” It has been shown that the pre-warmed techniques (Obtura and Thermafil) produce a better seal than lateral condensation.1 Due to the lack of deformity in a hermetic root temperature, the technique utilizing non-softerned GP are more “sealer-dependent.” The two most popular thermosplastic obturation techniques are the “carrier-based” (e.g., Thermafil) and “direct injection” (e.g., Calamus or Obtura) system. The pros and cons of each will be discussed, but regardless of the technique used, the shape of the prepared canal system is of utmost importance and must be discussed.

Access and shaping the canal system

In the early ‘70s, Schilder clearly stated the requirements for the proper shape using GP to achieve three-dimensional obturation of the canal system:

1) The root canal preparation should develop a continuously tapering cone shape.
2) It should have decreasing cross-sectional diameters at every point apically and increasing at each point as the access cavity is approached.
3) It should have multiple planes, which introduces the concept of “flow.”
4) The access should not be transported.
5) The apical opening should be kept as small as practical in all cases.

There were several other requirements that were clinically definitive. Following are a few of them: After placement of the rubber dam, the appropriate access is made. Unless the access is large enough for adequate visualization, appropriate instrumentatation may be compromised and canals missed. A perfect example is a maxillary first molar; if the access is made as though there was an MB2, it is amazing how many times an MB2 is found. A general rule of thumb is, if you access for it, you are more likely to find it. A proper access will also facilitate the creation of the continuously tapering shape of the canal, necessary for the warm GP technique. Occasionally after carries or old restorations are removed, a “pre-endodontic” restoration may be required to control and maintain a sterile environment until the endodontic treatment is complete. This can usually be accomplished using a bonded composite technique. Shaping should be confined to the anatomy of canal system, following the natural curvatures. Instrumentation beyond the apex is unnecessary and may needlessly enlarge and deform the apical foramen.4

Using the Schilder protocol to achieve the desired shape of the canal system was a time-consuming process. It involved the tedious use of pre-curved files and reamers to follow the anatomic curvatures of the canal. Other requirements that caused some controversy (and still does), besides the size of the access opening, was the need to keep the apical foramen as small as possible, and to maintain patency throughout the entire process. The majority of more recently published research and clinical studies have confirmed the rational for an appropriate access and correct shaping.

In the early 1990s, technology brought about the introduction of rotary instruments, relieving the operator of considerable time spent creating an acceptable shape. The ProFile rotary bur (Tulsa Dental) with 0.04 and 0.06 taper, was introduced to the profession. Creating the shape necessary for the success of the warm obturation techniques was made easier and faster.

By the beginning of this century, numerous designs gradually evolved utilizing varying tapers, active or passive cutting blades, etc. (Fig. 1). At first, the biggest problem with the rotary files was breakage during use. But modern nickel titanium (NiTi) metallurgy technology has developed more, and more dependable, rotary files. As a result, today the separation of a rotary instrument during use is of virtually little or no concern. It has also been shown that proper shape permits more thorough irrigation and the removal of significantly more debris from the prepared canal system. Disinfecting irrigation should be used between each instrument during the entire shaping process and patency continually maintained with #10 file. Note: The quantity of irritants used is not as important as the frequencies of use. The irrigation protocol, instruments, fluids, etc., are in constant evolution and becoming more effective. However, a clean and sterile environment of the canal system prior to obturatiion is still the objective.

Irrigation for cleaning the canal system

After shaping is completed, final cleaning can be effectively accomplished by the alternative use of:
1) Warm 5- to 6-percent NaOCl
2) 17 percent aqueous EDTA for approximately 30 seconds (mechanical removal)
3) Warm 5- to 6-percent NaOCl and re-irrigation with the EDTA.

The NaOCl can be effectively warmed by placing the irrigating syringes in a beaker of water set on a small coffee warmer (Fig. 2). The canals are completely flooded with the desired solution; an Endo Activator (Dentsply) is appropriately set on a small coffee warmer. The NaOCl is then ef- fectively removed with a high-speed evacuator. Other CPD awarding programs for 2 CPD Credit Points.
Fig. 6. When drying canals with air, needles must be notched or sidervented (arrows).

solution (hydrogen peroxide, chlorhexidine, 17 percent aqueous EDTA, MTAD, etc.) can also be used alternatively, depending on operator preference. Close observation with an SOM will clearly indicate complete cleaning of the canal system when no debris is flushed out during the irrigation process. During the evacuation with the capillary tip, it becomes apparent if there is a joining of the canal systems within the root. For example, if using the SOM as the MB1 canal is being evacuated and it is noted that fluid is simultaneously being drawn from the MB2 canal, there is a good indication that the system is complicated and does join at some point (Figs. 4a,b).

There are occasions, especially in lower molars, where the mesial root canal system unexpectedly joins with the distal root canal system.

On occasion, the maxillary canal system will have the DB1 or MB canal system connected to the palatal system. These “surprises” are important to be aware of, both for obturation of the canal system, especially when using either carriers or injectable GP.

Drying canals with F4+H4E

The canals areãi washed with 95 percent ethyl alcohol (Everlux available at local liquor store), agitation of the fluids are initiat- ed with an activator for the tissue necrosis, then 1-irrigated with the 95/percent ethyl alcohol, and then evacu- ated with the capillary tip. The canal(s) are then heat dried by using a Stroho lip- rigator on a dedicated, air-only syringe (DCS), but if a three-way syringe is used, be sure to ex- press all water from the line first (Fig. 5). Next, with a 27- or 50-gauge needle or side-vented nee- dle (Monoject), fit- ten to the Stroho lip- rigator and heat at as neces- sary, to easily dry the canal system (Fig. 6). Important note: It is essen- tial to regulate the Syringe at 1 to 3 psi and use a side-vented or notched needle, to prevent any possibility of in- uniformly forcing air through the canal system, and it is noted that fluid is being achieved with an in-line regula- tor, the Chapman-Huffman reg- ulator, Gauge Part #17-490-00 (Fig. 7).

As dentists, we are accustomed to a “blast” of air while using the usual air/water syringe (or high air pressure to the A/V syr-inges). There is a regulated Stroho lip- rigator fitted with an appropriate small gauge needle, only 1-psi air is necessary to create the flow necessary for thorough air drying of the canal. On occasion, one has to direct the air to a sensitive area on oneself or herself to be sure the air is even flowing. Just watch- ing the evaporation that occurs within the canal, while using the SOM, is enough to convince any operator that there is indeed a flow of air.

There is enough physiologic back pressure of the air on the envi- ronment (1.5 mm Hg) to prevent movement of the air past the terminus in the correctly shaped canal. In almost 20 years, with many different doctors using the Stroho lip- rigator to “air dry” ca- nals, the author has only heard of one unfavorable incident. In that one case, the doctor did not use the air/dry syringe and did not regulate the air pressure to the air syringe.

To repeat, when the Stroho lip- rigator is used with the properly regulated air pressure (1 to 3 psi) and the appropriate 27- to 50-gauge, side-vented/notched needle is used, there is no air movement or forcing into air into apical tissues. Sealer application

To the SOM user, the ineffective- ness of drying the canal with a paper point is soon realized. It is also easy to observe how differ- ently the Kerr Pulp Canal Sealer EWT (SybronEndo) acts when the canal is in fact not just blotted. After blotting with a pa- per point, the sealer tends to act like a drop of oil placed on the canal wall. But when the sur- face is dried, using alcohol and air as described previously, the sealer readily spreads onto the canal wall, much like a coat of paint. The complete dryness of the ca- nal to the desired working length is checked with a clean absorb- ent tip that points to that length. This also gives the operator an excellent chance to recheck the working length and dryness of the canal. Any sealer (Kerr EWT, Roth, AH Plus, etc.) can be used as long as the heat of the warm GP does not cause an “flash set.” The end 5 mm of a sterile paper point is coated with the sealer of choice and placed into the canal to the working length.

The user keeps Pulp Canal Sealer EWT, mixed per usual di- tectics, but a little “on the thin- side.” Using short, rapid apica- lal movements, the walls of the canal are completely coated with sealer. The use of the SOM is a great aid for observing when the coating of the canal wall by the sealer is complete. In this way, a sterile absorbent point is used, in the same manner, to remove any excess sealer that may remain.

Depending on the amount of sealer placed at the beginning, more than one absorbent point may be necessary to get the “blotchy appearance” on the final point (Fig. 8). Only a thin coat of sealer is necessary for la- curation, so very little remains on the walls of the canal (Fig. 9). One of the most common mis- takes, made at first, is using too much sealer. When this happens, the excess sealer will be extruded back into the cham- ber, or apically when the warm GP is placed. In some cases, the GP may be prevented from completing the desired “bath.” Typically, only one or two points are normally needed once the operator achieves pro- ficacy at applying the correct amount of sealer to begin with. Thermoplastic GP techniques are very consistent and depend more on the operator that there is indeed a flow of the thermoplastic GP.

Important consideration be- tween using injection or carrier- based obturation Essentially, there is one very significant dif- ference between the two tech- niques. The injection technique fills the canal system from the apical to the coronal, whereas the carrier-based techniques fill from coronal to the apical. This is important to take into account, especially in cases in which the operator does not want to fill the canal to the orifice or needs to control the “depths” of the fill. A good example would be in the case of treatment of a per- foration repair. Using injection, the “fill” can be accomplished rather easily, and both the sealer and GP can be confined to the perforation. MTA can then be added to the repair in a very controlled manner (Figs. 10a-c). When a post space is required, the GP can be injected to any level in the canal, but it is bet- ter to obturate the entire canal first, so unknown anatomy more coronally in the canal won’t be missed.

Injection of thermo-plasti- cized GP with a Calamus or Obtura

After using the Obtura for more than a decade and the thermo-plasti- cized GP obturation, the author switched to the Calamus when it was introduced 10 years ago. After thousands of canals were obturated using the 95 percent, several advantages were noted when comparing the two units (Table 1).

Both units are available as a sin- gle unit, or a dual configuration, with a thermal handpiece for convenience (Figs. 11a,b). The consistent flow of the Calamus unit does make the learning curve quicker and the working time is signifi- cantly less, and the restorative flow of the GP can be pre-set for consistency.

The size of the needle used in the Calamus or Obtura (20 vs. 25 gauge) is generally a matter of preference and can also de- pend on what the canals want. It does not make any difference,apically and corona- lly into the canal the nee- dle is placed, as long as it is non-bitting.

For example, a straighter and larger canal will take a larger needle. On some occasions, the 20-gauge needle will not be far enough apical to the orifice of the canal before binding. If the canal is parallel, this is an indication to use the smaller, 25-gauge needle. As long as it is not too apically, the canal has the correct shape, the smaller needle is acceptable. If the canal is parallel in shape, the smaller needle is acceptable. If the canal is parallel, the canal then becomes an ex- tremely difficult canal to obturate and control is severely handicapped.

Shape is of the utmost impor- tance, especially in these tech- niques.

The settings on the Calamus are checked to assure the de- sired level in the canal, but it has been achieved (the author uses 160 C), and the flow rate is set cor- rectly (the author prefers 100 percent). When the unit reaches the desired setting, the man- ual plunger will not initiate, and GP is not ejected. When all is ready, the collar is pressed un- til the initial GP is extruded and then the collar is released. The slight amount of GP at the tip is removed.

The needle is then placed into the canal apically, parallel to the canal, and the collar is pressed to reactivating the plunger and initiating the flow of GP. It is good practice to barely move the tip, in a very slight apical-coronal direction until the GP is initiated. The moment there is a sensa-
Table 1. A comparison of thermo-plasticized GP obturation with Calamus vs. Obtura.

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<th>Obtura</th>
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<tbody>
<tr>
<td>CALAMUS</td>
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<tr>
<td>1) Flow is consistent and can be preset</td>
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<tr>
<td>2) GP is cross-linked in package</td>
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<tr>
<td>3) Carrier for carrier-based GP is used</td>
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<td>4) Barrier protection very easy to use, especially if you have to use it unilaterally</td>
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<td>5) Proper “squeeze” required, and the time setting for the larger carrier is not critical, as long as they are held for at least 40 seconds</td>
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<tr>
<td>6) Proper “squeeze” a longer learning curve</td>
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<tr>
<td>7) Proper “squeeze” a longer learning curve</td>
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<tr>
<td>8) Hand fatigue can occur</td>
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<thead>
<tr>
<th>Obtura</th>
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<tbody>
<tr>
<td>1) Flow dependent on operator’s “squeeze”</td>
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<tr>
<td>2) Patients delivered several in a box</td>
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<tr>
<td>3) M’s needed to use the norm</td>
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<tr>
<td>4) Variable pitch, can vary distance</td>
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<tr>
<td>5) Patients often feel a “flash of warmth”</td>
</tr>
<tr>
<td>6) Proper “squeeze” a longer learning curve</td>
</tr>
<tr>
<td>7) Patients often feel a pulse</td>
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<td>8) More time consumption</td>
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Insertion of the heated carrier is slow and deliberate; you need to allow the excess material to be vented coronally. Insertion rates are 2 to 5 mm per second, which would translate to an average time of seven to 10 seconds for most canals from orifice to working length. With the larger carriers, you may experience a “rebound” effect after the carrier is inserted a few millimeters into the canal. Release the carrier and it will “rise” slightly from the canal space.

This is the GP pushing and pushing the carrier back out of the orifice level using either a Prepi bur or a thermal tip (Figs. 14a,b). Removal of the handle is essential when placing more than one carrier in the access, as it is the only safe way to prevent access will obscure the view for the succeeding placements. A radiograph is taken to confirm placement, and any adjustments are easily made using a hand-packed core with a file and removing the core. Using a high-speed round bur, the remaining carrier “stubs” are trimmed to the desired level. If a post space is desired, it can be prepared immediately with an end-cutting ProPrest drill (Dentsply) that will not displace the carrier.

Compaction of warm GP using Thermafil for carrier-based obturation is slightly different. A simple technique is to segment a GP cone into approximately 5 mm sections prior to the obturation process. Immediately after the Thermafil carrier is seated with a Prepi bur (Dentsply) the GP cone is soft and can be read-ily compacted. To facilitate thorough compaction of the small and lubricated plugger (about a size 9 to 9.5 Schell), it is best to use a apically compact the warm GP alongside the carrier. Push apically against the predetermined distance, hold briefly and remove the plugger. Then, using one of the pre-cut segments of GP, place it into the void created by the plugger, and compact it into place.

More segments of GP may be necessary depending on the size of the canal. In cases when the carrier may be ribbed-shaped and large in the M-D or B1 direction, the apical third of the canal should be obturated in the conventional manner. Then an accessory carrier can be inserted alongside the initial carrier (Fig. 15).

Excess filling material
Historically, any time a case was obturated, there was much concern when anything was extruded beyond the apical terminus. Many endodontic failures were historically attributed to lack of extension, but in reality the culprits have been “under-filled” canal system.

As Schilder stated, “You only can fill a canal 100 percent. If the canal is filled 100 percent, any excess material extruded cannot be of no consequence.

In fact, if the authors obturated a canal system and there was no excess filling material, the GP would acumultantly be reb-ought and re-obtured until there was. The point was, “How else could you be sure the canal system was obturated 100 percent un-less there was an excess of filling material present at the apex?”

Cases that have a significant amount of excess filling material but are properly shaped, cleaned and packed do heal. Over time, the excess material will slowly be absorbed and the apex will close. The biggest fear of the new user of injection or carrier-based GP is, “There will be a great amount of excess filling material at the apical terminus.” The opposite is utterly true. At first, the most common problem for the new user was the inability to get to the terminus and completely fill/obturate the canal system.

The usual reason for this was either an improper shape, the absence of the warm GP from the first and second carriers fuse together so any voids are elimi-nated.

A good way to imagine what is happening, while using ther-mo-plasticized GP in a properly shaped and cleaned canal is to envision everyone in a theater rushing to get out the same door was big. Everyone will get out, but the audience is relatively large and warm, so not everyone will get out. The operator is in the same situation. The operator is in the same situation.

The apical terminus of the

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are generally concerned with obturation. As endodontists, we are responsible for the canal system and turn the treatment into a success. The final step of the system is the obturation and compaction.

A good example of an easy-to-use temporary is auto-cure Tempure USA-inlay and Core Poste (Demet). CaOH (Ulbrich by Ulbrich) is injected into the canal system and covered with a sterile cotton pellet (Fig. 19a). Then Tempure USA-inlay is used to condition the access opening (Fig. 19b). After a few minutes, the auto-cure Core Poste is set completely, the occlusion is ready for any adjustments, and to make sure there are no interferences left to irritate the tooth between visits.

On occasion, a patient is unable to keep the adjusted return visit. The post may have to be delayed or her return visit for weeks or even months (Fig. 19c). There may be an important change of events in his or her life, or the doctor may have also changed the scheduled visit. If a temporary is placed, such as Cavite, IRM or Tempfill, all control of the bacterial environment in the canal is lost. The post is inserted into the canal system and covered with Tempfill (Fig. 20a). The temporary may have a very high degree of success when the coronal seal has been created.

When the tooth is ready for the final restoration, the doctor must be responsible for the quality of the final restoration at the same time for the following reasons:

1. Patient is “in the chair.”
2. Patient is anesthetized.
3. Rubber dam is in place.
4. Access is sterile for placement of the foundation restoration.
5. The access opening is easy to remove.
6. The “endo-doer” has microscopically enhanced vision.
7. The “endo-doer” knows core preparations from the anesthetics of the canal system.
8. There is no chance of contamination of the canal system.
9. Inadvertent perforations are eliminated.
10. The tooth can be “roughed” prepped with dam in place.
11. The patient has more time to plan for the final restoration.
12. After RCT, doctor knows, within two minutes, the time to schedule for crown prep.
13. Any anterior teeth, appointment management has been fixed in place for placement of a provisional.

It has been shown that coronal leakage is a main cause for root canal treatment failure. Therefore, all dentists should try to do all that is possible to prevent it. If any multiple visits are required, the doctor should inform the patient on the “cotton and Cavit” to maintain sterility. For the temporary, handling and composite technology, the temporary placed between visits should be a bonded composite.

Another important consideration for success restore the tooth. Posts neu-
tooth is lost to disease? Once the referring doctors are made aware of the favorable benefits that will be derived, it behooves all of us to do everything humanly possible to give our patients dental treat- ment that will create the health they expect from our profession.

In general, our current endodon- tic vision has been directed to treatment of the apical half of the root canal system. It should not be a problem in degrading the basic principles of bonding technology, restorative prin- ciples and post core placement into our normal endodontic treatment protocol. We, as a specialty, should be thinking in terms of being responsible for improving every- thing humanly possible to increase the predictability of our treatment. When endodon- tic failure occurs, it seems like everyone “stands around in a circle and points at one another.” Adhering to proven prin- ciples eliminates the probability of contamination of the canal sys- tem by providing a solid founda- tion for the restorative aspect of the patient treatment.

Obviously, those days are over and the endodontic lack of respect for radial structure have not witnessed what often happens to that same tooth when preparing it for a crown. It is im- perative for the endodontic and restorative to be a team, work- ing together for predictability, in the interest of the patient.

Our job as “endo-doers” is to learn, become teachers and educate the patients, staff and doctors we work with, so we can achieve dental health as a team. Let’s not “cave into” the demands of public convenience or political pressure, but rather be governed by proven dental principles, so we can achieve predictable endodontic success, saving the teeth our patients are born with, but isn’t that what endo- dontics is all about?

References

Beverly Hills Formula - Over 20 Years Perfecting the Business of Smiling

By Chris Dodd, CEO Beverly Hills Formula

Manufactured in fre- s entering, the Beverly Hills Formula ranges are rapidly becoming the go-to whitening products, with many people opting to use these safe at-home whitening toothpastes over harsh and abrasive treat- ments. The company is con- stantly expanding its range and endeavors to be a whitening toothpaste to suit all pref- erences. With over 20 years’ experience, the company, based in Ireland, has grown considerably in the past few years. In 2015 Nelson Check- out Magazine named Beverly Hills Formula as one of the top five oral care brands. This is an appreciable achievement when one takes into consideration the vast number of whitening toothpastesc available on the market today.

The success of Beverly Hills Formula comes down to a num- ber of factors:
• The company’s range of whitening products are safe to use at home.
• The company has ensured that their products are as ef- fective as possible, and have proved themselves as leaders in expert stain removal.

Launched in 2012, the Perfect White Range has been viewed as a revolutionary way of al- lowing patients to whiten their teeth without opting for prod- ucts containing high percent- age of peroxide, potentially devastating to teeth in the long term. The company responded to the need for quality and ef- fective whitening products in the market. New product develop- ment has always been some- thing that Beverly Hills For- mula held in great importance, and owes much of its success to the fact that they have brought some of the most innovative and effective products to the market. Launching in 2015, Perfect White Black was the first of its kind on the market. The toothpaste, containing activated charcoal, took the market by storm. Charcoal is a centuries old method of clean- ing teeth, and this cutting-edge product was well received by consumers. Although a num- ber of copy-cat products have emerged in the market, none have seen the same success as Beverly Hills Formula’s very own Perfect White Black, with qualified dentist and cosmetic doctor Dr Martin Kinsella say- ing: ‘I’ve tried the Beverly Hills Perfect White toothpaste and found it to be effective in removing stains and helping to achieve a white, brighter smile.’ Following on from this, the company introduced Per- fect White Black Moutlwash in 2015, also the first of its kind. The ‘shake to activate’ charcoal mouthwash keeps breath fresh for up to 12 hours, whilst removing stains. Perfect White Gold toothpaste, contain- ing real gold particles was launched later that year. Both of these products have seen considerable success in the market.

2016 will be a huge year for Beverly Hills Formula, with the company planning on in- troducing an expert whitening product. Perfect White Expert toothpaste, containing effective and safe levels of peroxide, will offer a high performance whit- ening boost. As well as this, the company also launched Perfect White Black Sensitive, the first charcoal toothpaste for sensi- tive teeth. The brand also added a charcoal dental floss and...