G It Endo - vol. 19 - n. 1, pp. 11-18
Gennaio-Marzo 2005

Gary Glassman *
Rich Mounce **

Private endodontic practice in
* Toronto (Canada)
** Portland (Oregon - USA)

Correspondence to:
Dr. Gary Glassman
E-mail: gary@rootcanals.ca

Pervenuto in Redazione il 20 dicembre 2004
Accettato per la pubblicazione il 22 gennaio 2005

Root canal filling technique with a new obturation unit

ABSTRACT

Aim: To present a recent improvement of the continuous wave obturation technique

Summary
A recent improvement of the continuous wave obturation technique has been the development of the new Elements (SybronEndotm, Orange, CA) obturation unit. It combines both an electric heat source and backfilling injection system in a single state-of-the-art unit. The new obturation unit can work both with guttapercha and the novel, innovative, synthetic root canal filling materials. This clinical article will describe the new device and its features and the operative filling technique with the new obturating materials.

Key learning points:
- How to use the new obturation unit.
- The development of innovative filling materials.
- How the innovative filling materials can be used with the new obturation unit.

INTRODUCTION

Root canal obturation is defined and characterized by as the three-dimensional filling of the entire root canal system as close to the cemento-dentinal junction as possible. Historically a plethora of methods and materials have been advocated for root canal obturation, each with their own claim of case, efficiency and superiority. Although not the ideal filling material, gutta percha has been the best material clinicians have had up to this point in time. Among its disadvantages the lack of adhesiveness is considered to be the most important. It has been shown that gutta percha (with or without sealer) provides a relatively poor to non existent barrier to prevent the coronal to apical migration of bacteria after obturation as gutta percha (with and without sealer) does not bond to canal walls, it can only adapt (1-4). In addition, even if the standard of endodontic therapy is excellent, a lack of coronal seal or recurrent decay significantly diminish the possibilities for endodontic success over the long term as bacteria can migrate in a coronal to apical direction and initiate failure. (5,6) Recently, new synthetic obturating materials have been introduced in an attempt to achieve a more hermetic seal (RealSeal. ™, SybronEndo, Orange, CA. and Epiphany, Pentron, Wallingford, CT). By removal of the smear layer, produced during instrumentation, it is now possible to bond the obturating material into the dentinal tubules and create (as mentioned above) a "monoblock" of resin sealer and resin core filling material. The root canal system can now be sealed to some degree (technique and clinician dependent) along the entire length of the canal (from orifice to apex) preventing microbial migration (7, 8).
Schilder's warm vertical condensation technique has been traditionally considered one of the best root canal filling technique. The technique allowed predictable, good clinical results, even if the approach to heat softening and compaction of gutta percha was difficult to master. As a result, simplification and improvement were required, leading to development of new techniques and devices. These innovations have focused primarly on enhanced heating system for intracanal softening of gutta percha. A major improvement was the development of the System B™ heat source (9). This device can monitor temperature at the tip of its carrier device and deliver a precise amount of heat for an indefinite period of time. The heat carrier is designed as a plugger, allowing simultaneous heating and compaction. This combination creates a single wave of heating and compaction of the master cone throughout the movement of the heating-compacting plugger apically. Once the apical segment has been obturated, the coronal portion of the canal is backfilled. This can be done with the same system with modified temperatures or with injectable gutta percha techniques.
Many studies supported safety, efficacy and clinical success of this technique. However, incomplete softening of the apical gutta percha may sometimes occur, due to inadequate apical penetration of the plugger. As with all other techniques, canal shaping is, therefore, of outmost importance in achieving success, and in allowing proper penetration of pluggers. The search for simplification and increased proficiency has recently led to the development of a new obturation unit (Figs. 1 and 2), with the same continuous wave approach previously described.

OPERATIVE TECHNIQUE

Canal preparation
The canal is prepared with the protocol normally used. Canal preparation techniques do not need to be altered to facilitate the use of the material.

Smear layer removal
Throughout the entire instrumentation protocol an alternating sequence of 17% EDTA

Fig. 1 - *Overview of the Elements™ Obturation Unit.*
L'unità Elements™ Obturation.

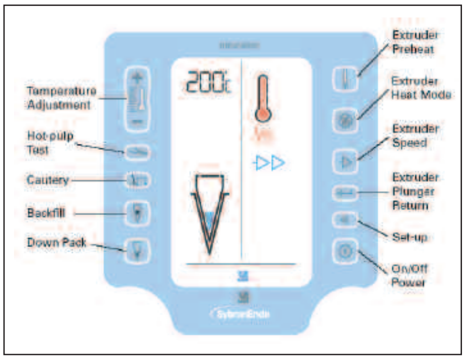


Fig. 2 - *The front panel of the Elements™ Obturation Unit illustrating the function of each button.*
Il display dell'Elements™ Obturation Unit con le funzioni associate ad ogni pulsante.

and sodium hypochlorite must be used to remove the smear layer. The smear layer is the layer of organic and inorganic debris that is created along the walls of the canals during instrumentation. While 17% liquid EDTA can be used as a final canal rinse, the Authors prefers to use EDTA and surfactants which enhance wetting of the canal walls and provide optimal smear layer removal. (SmearClear, Sybron-Endo, Orange, CA) as a final rinse. The irrigant is allowed to soak into the tubules throughout the entire canal system for 1-2 minutes. It is important not to use either sodium hypochlorite or absolute alcohol as the final rinse to dry the canal after the smear layer is removed. Sodium hypochlorite will disrupt the sealer bond and absolute alcohol will act as a drying agent. The walls need not be completely dry as the sealer is hydrophilic.

Placement of the primer

After the canal is dried with paper points, a brush provided by the manufacturer can be used to bring the self etch primer (Fig 3) into the coronal third of the canal. Alternatively, a paper point of an appropriate taper can be super saturated with the adhesive that has been introduced into a plastic bonding well. The primer should be dispersed evenly on the canal walls yet not extrude apically. Under a surgical operating microscope, one may see if any primer remains in the canal or if the excess has been removed.

Mixing of the resin sealer

Next, the dual syringe (containing the sealer) is used to express the sealer onto the mixing pad. The dual syringe has tips which mix the sealer as it is expressed. As an aside, it is possible to forgo the use of the mixing tip provided in the kits and hand mix the sealer with a spatula (express a small amount of both sealer components onto the pad without the mixing tip) and save a significant amount of sealer from every dual syringe although the mixing tips eliminate one step relative to hand spatulation. Cone fit (Fig. 4) and placement of the sealer can be performed as per the clinician's present technique. While preferred methods for sealer placement vary widely, the Authors are not in favor of use of a lentulo spiral to introduce sealer of any type and this personal preference extends to the resin sealer used with RealSeal™ due to the unwarranted risk of apical extrusion as well as potential for lentulo separation.

OBTURATION TECHNIQUE

The Elements™ Obturation Unit

The current continuous wave of condensation techniques in the past required two separate devices: an electric heat source (such as the System-B™, or the Touch'n Heat™), for down packing, and a thermosoftened injection system for three-dimensional backfilling. Incorporating advanced technologies in software, metallurgy, and electronics in a compact industrial design, the Elements™ Obturation Unit (SybronEndo, Orange, CA) has combined both an electric heat source and backfilling injection system in a single state-of-the-art unit. It is a multifunctional,multitasking achievement of modern engineering. It

Fig. 3 - *RealSeal™ (R/S) (Sybron-Endo, Orange, CA).*
RealSeal™ (R/S) (Sybron-Endo, Orange, CA).

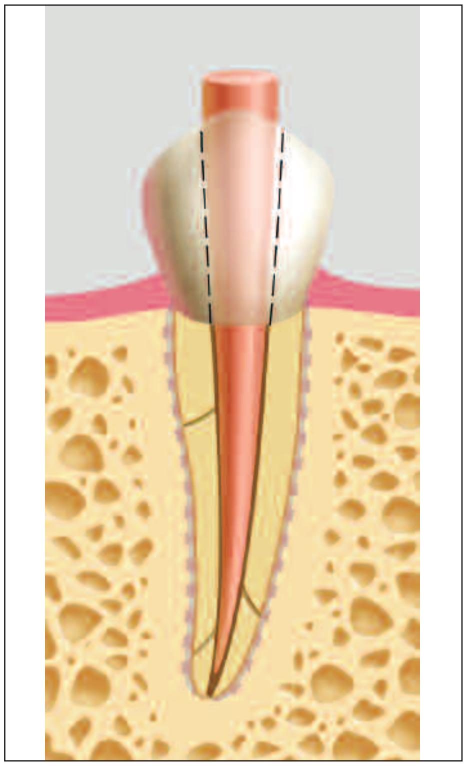


Fig. 4 - *Cone fit. An appropriate RealSeal cone is fit into the tapered root canal preparation making sure that "apical tug-back" has been achieved 1 mm to 2 mm short of the working length (distance from apical reference point will vary with canal curvature and size).*
Prova del cono. Un appropriato cono Realseal è inserito nel canale già preparato, assicurandosi che il *tug-back* si raggiunga a 1-2 mm dalla lunghezza di lavoro (la distanza può variare a seconda della curvatura canalare e della sua grandezza).

seamlessly integrates down packing, backfilling, hotpulp testing, and heat cauterization in a single dynamic unit that takes up only one third of the space of two separate machines.
The left side of the unit houses the System-B™ controls and handpiece while the right side houses the extruder system and its controls. Both the System-B™ and extruder handpieces have autoclavable aluminum sheaths with silicone coatings at the "active end" that prevent heat transfer to the clinician's fingertips and protect the patient's soft tissues. The sheaths are installed by lining up the index marking and sliding them into place until a click is felt and heard. The activation switches are easy to reach, smooth to the touch, and signal with an audible tone when deployed. Two sheaths are provided for each handpiece so that one can be in use while the other is being autoclaved.

The digital/graphical display for the controls incorporates four functions, each with its own preset default temperatures and durations. If a temperature setting other than the preset is desired for any of the functional modes, the temperature function can be used to change the temperature in 5-degree increments. Pressing and holding the "current mode" buttons for 4 seconds will set that temperature for that particular function. This new temperature preset is retained until manually changed or the defaults are renewed. The preset for the down-pack control function is 200ºC, the backfill function is 100ºC, the heat-cautery function is 600ºC, and the hot-pulp test function is 200ºC.

The handpiece is activated by depressing the button with a gloved finger. The tip will heat instantly and the LED indicator on the handpiece will illuminate. The tip will remain heated only as long as the button is depressed. A "time-out"feature assists the clinician by shutting off the energy to the tip after an appropriate amount of time for each of the four functions. This avoids overheating the tooth and/or tissue. The "time-outs" are 4 seconds for the down-pack function, 15 seconds for the backfill function, 60 seconds for the hot-pulp test function, and 5 seconds for the heat-cautery function. During activation, the tip temperature is continuously maintained and displayed. The handpiece will need to be reactivated to resume heating beyond the preset duration. During downpacking, the unit emits an automatic timer beep at 5 seconds and 10 seconds after the time-out to indicate readiness for the separation burst.

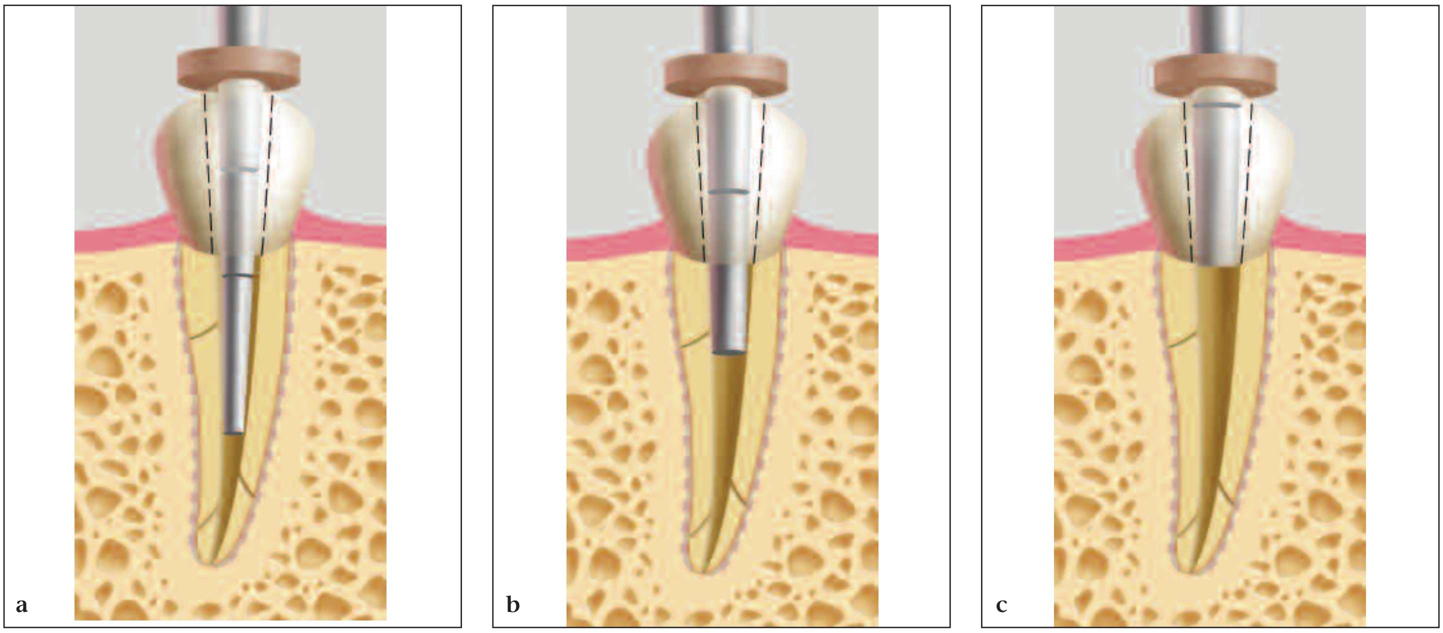
The pluggers are available in 0.04 (0.3-mm round end), 0.06, 0.08, 0.10, and 0.12 (all 0.5 mm round) They replicate the canal shape and maximize condensation forces to move the filling material and sealer into all areas of the root canal system, including lateral and accessory canals, to ensure a complete and homogeneous fill. They have a new "hex-nut" attachment that allows quick insert and release, thereby eliminating the need for a pinvise nut that is found in both the original System-B™ and the Touch'n Heat™. The new 0.04 taper has a 40% smaller tip diameter that allows access into smaller canals and provides the same thermo-feedback as the other System-B™ pluggers, but it is closer to the size of a Touch 'n Heat™ tip.

The extruder system is micromotor driven and automates the backfill process, eliminating the fatiguing manual action required by other thermosoftening injection units. Its advanced insulation technology allows the extruder to stay dramatically cooler than other units throughout treatment. The extruder handpiece has a mechanical indicator on the opposite side of the activation buttons that shows the amount of material remaining in the cartridge. If the extruder is deactivated before the cartridge is empty, the plugger will retract slightly to prevent excess filling material from discharging. When the heat-select and heat-activated buttons are deployed, the preset temperature is reached in approximately 45 seconds and shuts off automatically to prevent overheating of the filling material. There are two activation buttons on the extruder handpiece that allow the clinician to choose between two speeds for the extrusion of filling material.

The new obturation unit can work both with guttapercha and the novel, innovative, synthetic root canal filling materials. One remarkable feature about RealSeal™ (RS) is that in virtually all handling characteristics, it handles and feels like gutta percha. In other words, it can be used with all the common present forms of endodontic obturation (vertical compaction of warm gutta percha, cold lateral condensation, lateral/vertical combinations) and there is virtually no learning curve to its use. This allows the clinician to use this new technology with only two added steps relative to common endodontic treatment regimens, clearing the smear layer and placing the self etch primer (to be described).
Proprietary disposable cartridges of gutta percha or RS, are available, and the needles are extra long (by 4 mm), facilitating access to posterior teeth with unprecedented visibility and greater control and accuracy. The cartridges are offered in 20-, 23-, and 25-gauge sizes that have plastic locknuts color-coded gray for RS and black for gutta percha. Made of silver for excellent heat conductivity, the cartridges load and disengage easily from the handpiece with the specialized tool provided with the unit.

Down pack

Stainless steel Schilder™ pluggers (Tulsa/-Dentsply, Tulsa, OK), Obtura™ pluggers (Obtura/Spartan, Fenton, MO), or Buchanan™ hand pluggers (SybronEndo, Orange, CA) are prefit into the canals to their binding point. Rubber stoppers are adjusted on these pluggers to the occlusal reference point corresponding to 2 mm short of the apical binding point. These pluggers are placed aside to be used later in the back fill phase of canal obturation (Figs. 5a, b and c). The The System-B™ Buchanan™ plugger is prefit to its binding point in the canal, and the rubber stop is adjusted adjacent to the appropriate reference point (Fig. 6). The canal is dried and measured one last time with feather-tipped paper points, and the master RS cone is cemented in the canal with sealer (Fig. 7). The trigger switch on the System B™ handpiece is made active. The plugger is driven through the center of the RS cone in a single motion (about one second), to a point about 3-4 mm shy of its apical binding point (Figs. 8a and b). While maintaining pressure on the plugger, the trigger switch is released and the plugger slows its apical movement as the plugger tip cools (about one second) to within 2 mm from its apical binding point. After the plugger stops, short of its binding point apical pressure on the plugger is sustained until the apical mass of RS has set (five to ten seconds), taking up any shrinkage that occurs upon cooling (Fig. 9). After the apical mass has set, the touch switch is made active again, for a one-second surge of heat. Pause for one-second after this separation burst, and then remove the heated plugger and the surplus RS (Figs. 10a and b). Because these pluggers heat from their tips, this separation burst of heat allows for quick, sure severance of the plug-



Figs. 5 a-c - *Hand pluggers fit. Stainless steel Schilder™ pluggers (Tulsa/Dentsply), Obtura™ pluggers (Obtura/Spartan, Fenton, MO), or Buchanan™ hand pluggers (SybronEndo, Orange, CA) are prefit into the canals to their binding point. Rubber stoppers are adjusted on these pluggers to the occlusal reference point corresponding to 2 mm short of the apical binding point. The reason the rubber stoppers are adjusted short of the apical binding point is to provide the clinician a marker to prevent direct engagement of the plugger on the canal walls.*
Prova dei plugger manuali. I condensatori, sia che si usino quelli in acciaio di Schilder™ (Tulsa/Dentsply,Tulsa, OK), i plugger Obtura™ (Obtura/Spartan, Fenton, MO), o i plugger manuali di Buchanan™ (SybronEndo, Orange, CA) vanno posizionati nei canali fino a raggiungere il punto di impegno. Gli stop di gomma vanno posizionati sui condensatori a 2 mm da questo punto di impegno apicale, per evitare un impegno diretto del condensatore sulle pareti canalari.

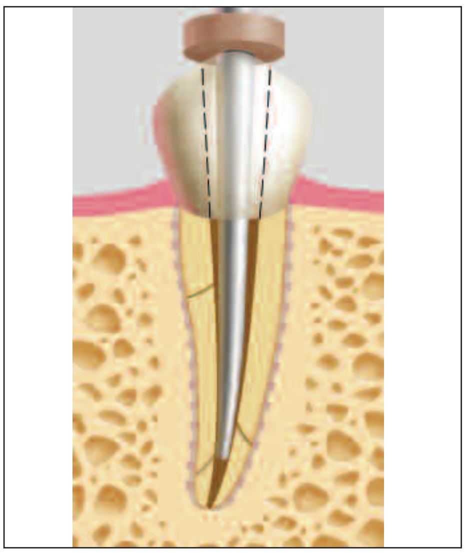


Fig. 6 - *System-B™ Buchanan plugger fit. It is essential that the plugger is prefit into each canal to its binding point. A rubber stop must be placed and adjusted to the appropriate coronal reference point for each canal.*
Prova del plugger del System-B. è importante che il plugger sia provato, e lo stop di gomma conseguentemente aggiustato, per ogni canale fino al proprio punto di impegno.

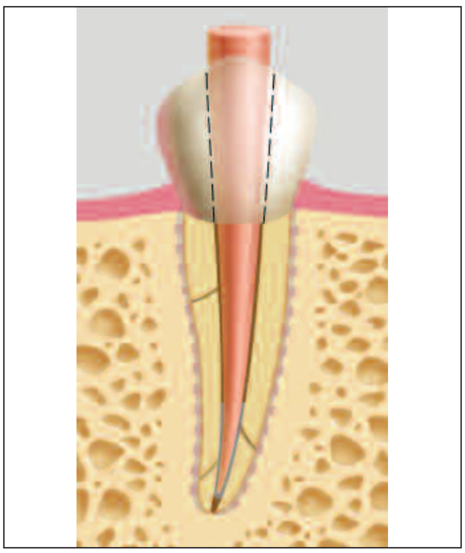
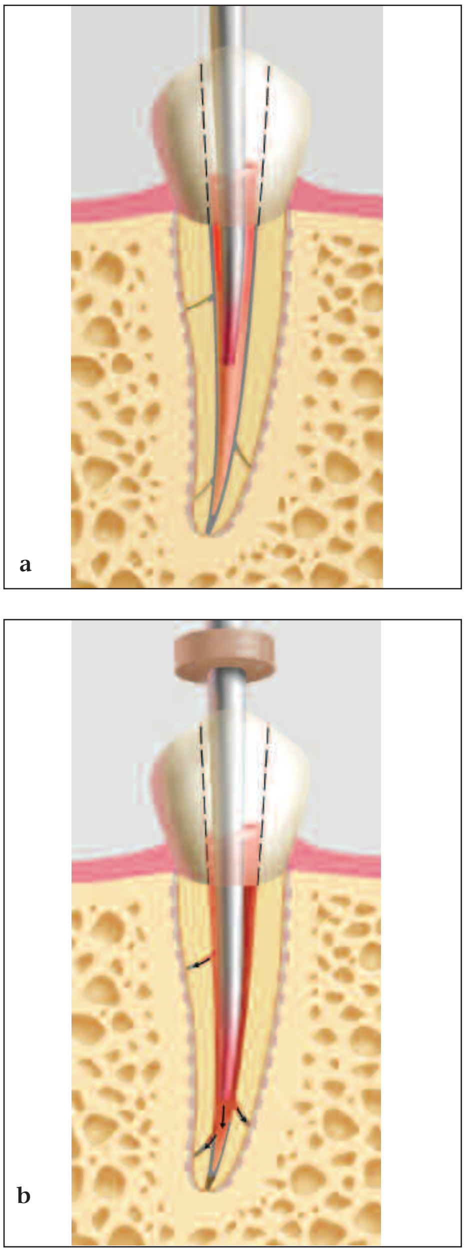


Fig. 7 - *Master cone cementation. The master cone is cemented in the canal with sealer.*
Cementazione del cono master. Il cono master RealSeal™ è cementato nel canale.

ger from the already condensed and set apical mass of RS, minimizing the possibility of pulling the master cone out. Be certain to limit the length of this heat burst, as the goal is separation from the apical mass of RS without reheating it. Clinicians must be very alert during the first second of the downpack so that the binding point is not reached before completion of the downpack. If heat is held for too long, the plugger drops to its binding point in the canal and then cannot maintain condensation pressure on the apical mass of gutta-percha during cooling, possibly allowing it to pull away from the canal walls. If binding length is reached by mistake, the heat plugger should be removed immediately and the small end of the nickel-titanium Buchanan hand plugger (Sybron Endo, Orange, CA), or Obtura pluggers (Obtura/Spartan, Fenton, MO) should be used to condense the apical mass of gutta-percha until set. A final downpacking nuance is required for ovoid or canals that join into a common apical foramen (apically contiguous). These two canal forms can allow for venting of condensation backpressures during a continuous wave downpack and less then ideal filling of canal irregularities. In both canals, a sec-



Figs. 8 a-b - *Down pack. With the omni directional "trigger" switch activated, the prefit, preheated plugger is smoothly driven through the mass of RealSeal™ to within 4-6 mm of the binding point.*
Downpacking. Attivando il pulsante omnidirezionale, il condensatore viene uniformemente spinto attraverso la massa del cono RealSeal™ fino a 4-6 mm dal punto di impegno.

ondary RS cone is first to butt into the master cone short of the canal terminus and the fat end of the hand plugger is used to hold it in place during the downpack. For ovoid canals, the hand plugger is placed at the orifice alongside the heat plugger. For apically contiguous canals, the hand plugger is held at the orifice of the other canal.

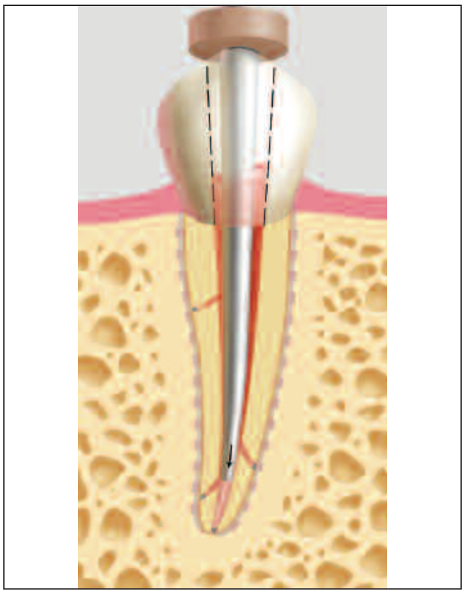
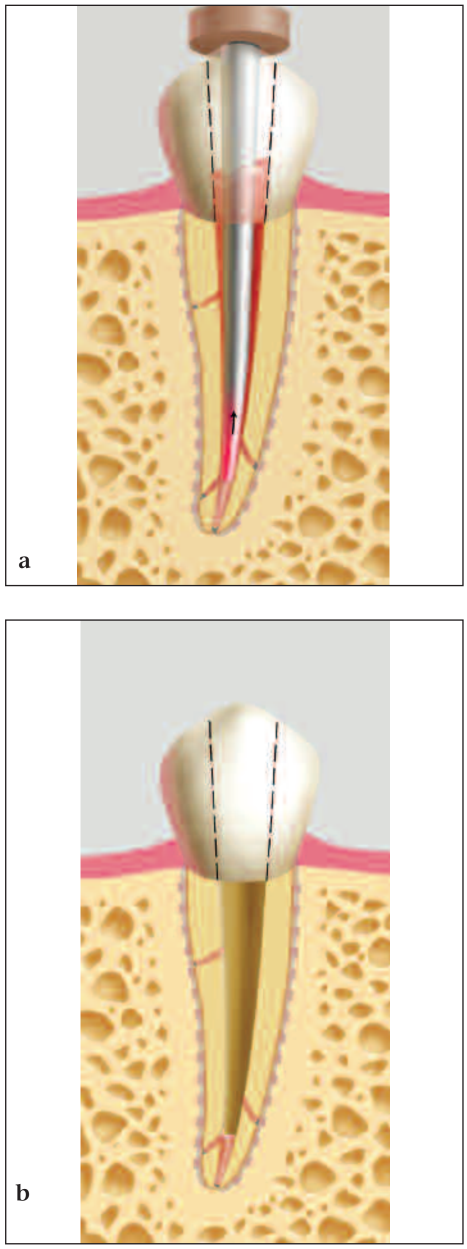


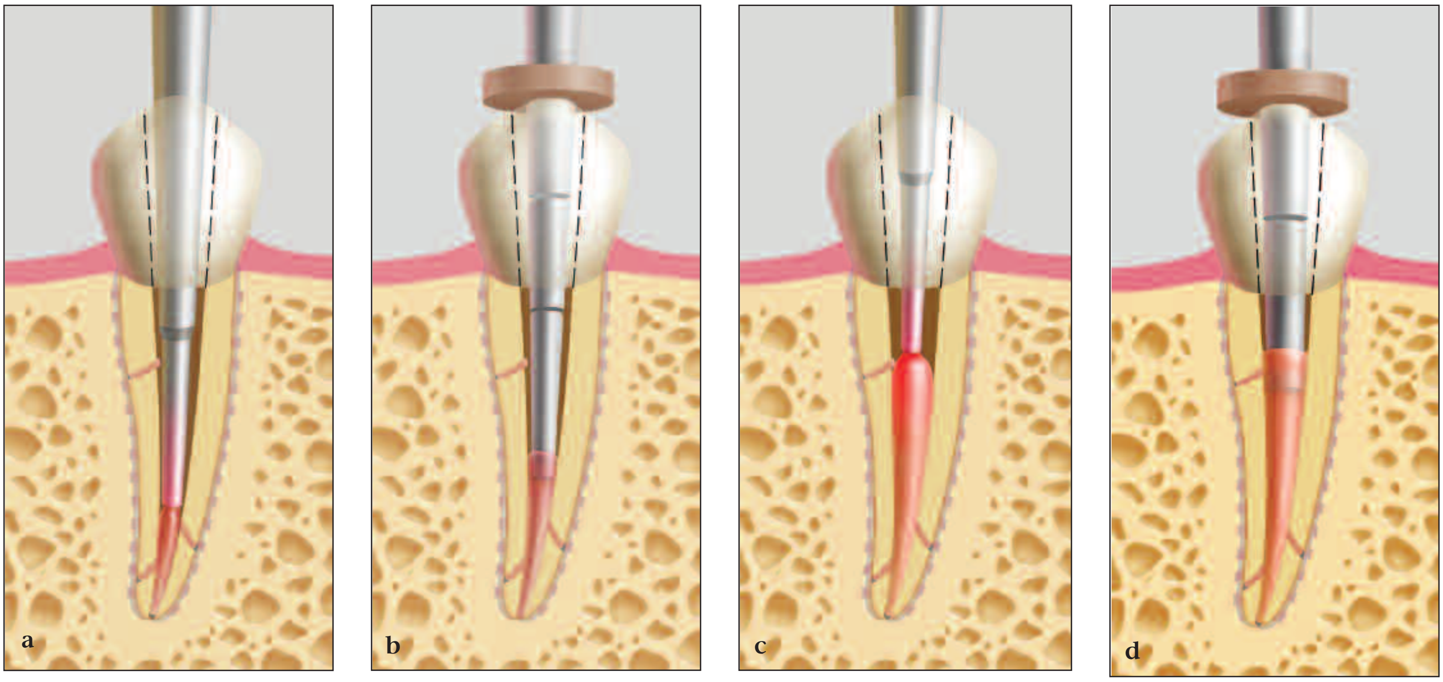
Fig. 9 - *Sustained apical condensation. The omni directional "trigger" switch should be released once within 3-4 mm of the apical binding point. The plugger should slow and stop within 2 mm short of the binding point. Apical pressure is maintained for a full 10 second "sustained" push to prevent the cooling RealSeal™ mass from shrinking.*
Mantenimento della condensazione apicale. Una volta a 3-4 mm dal punto di impegno, il pulsante omnidirezionale viene rilasciato; il condensatore rallenta e si ferma a 2 mm dal punto di impegno. La pressione apicale è mantenuta per 10 secondi per prevenire la contrazione del RealSeal™ durante il raffreddamento.

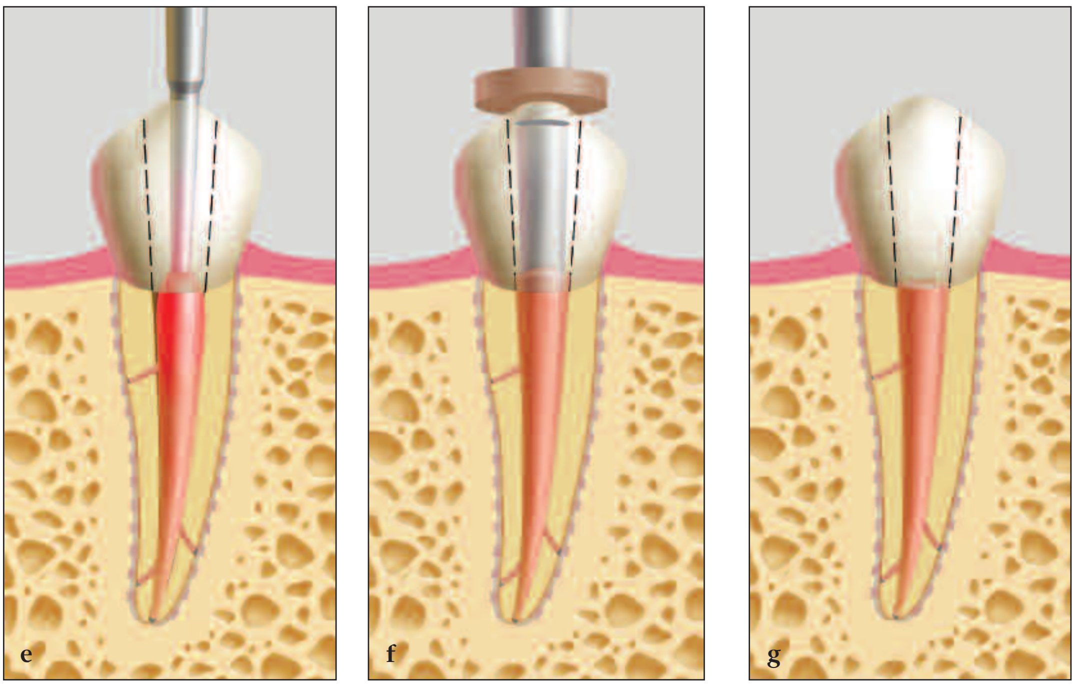
Backfilling

The Elements ™ Obturation System extruder handpiece is used to backfill the canal space at a temperature of between 150-175 °C. A 23 gauge applicator tip is suitable for most root canals. A thin layer of sealer is applied to the root canal walls with a paper point before backfilling. The applicator tip is placed into the root canal space until it penetrates the coronal aspect of the apical plug of RS. A bolus of 5 to 6 mm of RS is then



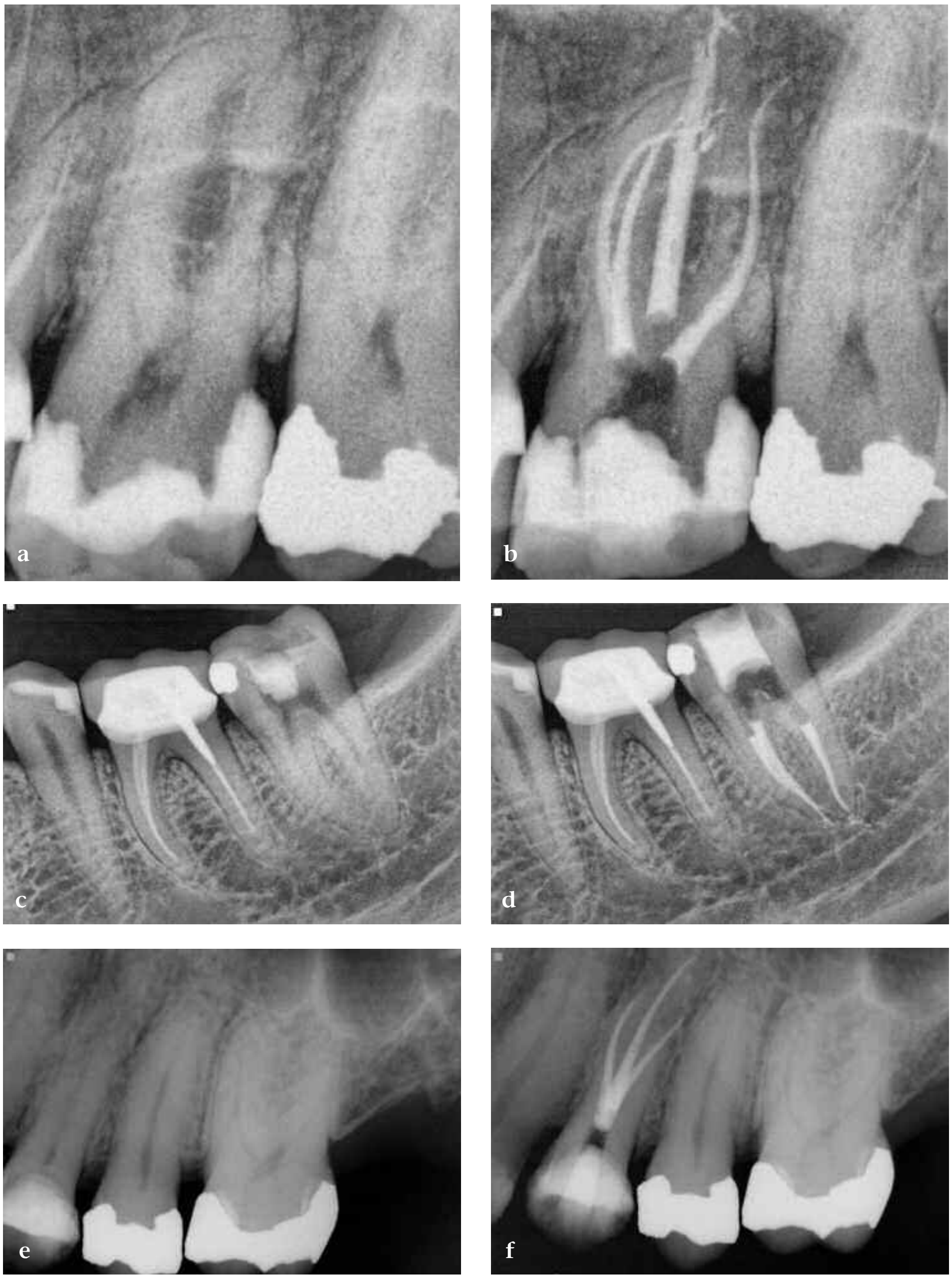
Figs. 10 a-b - *Separation burst. The heat source is activated for one second then the omni directional "trigger" switch is released. The plugger is held in position for one second after the switch is released, and the plugger is removed with the down pack surplus of RealSeal, leaving the apical seal intact. All portals of exit may be sealed, primarily with RealSeal or a combination of RealSeal™ and resin sealer, and the canal is ready for backfilling.*
Separazione. La sorgente di calore è attivata per un secondo; il condensatore è mantenuto in posizione per un ulteriore secondo, e poi ritirato con il surplus di RealSeal™, lasciando la porzione apicale intatta. Tutte le porte di uscita dovrebbero essere sigillate, con il RealSeal™ o con una combinazione di RealSeal™ e cemento resinoso, e il canale è pronto per il *backfilling*.





Figs. 11 a-g - *Backfilling. Applicator tips for the injection system are available in sizes #20, #23, and #25 gauges. Additional root canal sealer may be placed in the coronal aspect of the root canal with a hand file prior to back filling. 4-6 mm aliquots of RealSeal™ are injected into the canal space then immediately condensed with the pre-fitted Schilder™ or Buchanan™ hand pluggers in sequence using the sequentially larger pluggers as the coronal aspect of the canal is approached. As thermosoftened RealSeal™ is deposited in the canal, backpressure is produced and the applicator is forcibly extruded from the canal space. It is essential that the operator continue injecting as the applicator tip is retrieved from the canal in order to avoid inadvertent removal of the newly deposited RealSeal™ mass prior to condensation.*

Backfilling. Le punte applicatrici per il sistema di termoiniezione sono disponibili nelle misure 20G, 23G, e 25G. Con un file manuale si può depositare uno strato addizionale di cemento nella porzione coronale del canale. Porzioni di 4-6 mm di RealSeal™ sono iniettati nello spazio canalare e immediatamente compattati con i plugger precedentemente provati in sequenza crescente man mano che si procede coronalmente. Mentre il RealSeal™ termoplasticizzato viene depositato nel canale, la pressione provocata spinge la punta applicatrice coronalmente. È essenziale che l'operatore continui a depositare il materiale mentre la punta viene ritratta, per evitare di rimuovere il RealSeal™ appena depositato.



Figs. 12 a-f - *Clinical RealSeal™ cases. Compaction and handling characteristics of RealSeal™ are virtually identical to guttapercha.*
Casi clinici effettuati con RealSeal™. Le caratteristiche di manegevolezza e compattazione del RealSeal™ sono praticamente identiche a quelle della guttaperca.

deposited. As thermosoftened RS is extruded from the applicator tip, the viscosity gradient of the back pressure produced will push the tip coronally from the root canal space. The technique sensitivity requires that when this sensation occurs, the operator must sustain pressure on the trigger mechanism as the applicator tip moves from the canal. The prefit hand condensers are then used in sequence to maximize the density and homogeneity of the compressed gutta percha mass. This sequence of thermosoftened guttapercha injection and progressive compaction is continued until the obturation of the entire root canal space is achieved (Figs. 11 a-g).

Post preparation/curing of the coronal third

If required, a post space may be prepared at the time of obturation only after the canals are first filled to the level of the orifices. If any lateral/accessory canals and/or dentinal tubules have not been sealed during the down pack, perhaps they may be sealed on the back fill. If post space needs to be prepared after the material has set up and the monoblock created, ideally, a small amount of chloroform can be introduced and the RS dissolved to the desired depth in the canal and post preparation accomplished.
A curing light can also be used to help cure several mm of the material in the coronal third and the material will self cure within one hour. Empirically, the authors have found the transition from A gutta percha to RS to be virtually seamless and without a learning curve and are using this material exclusively (Figs. 12 a-f). The added step of placing the primer is virtually negligible with regard to the amount of time it takes in the context of the entire procedure and the benefits derived.

CONCLUSION

With certainty, this RS material will be extensively studied, tested and reported in the literature in the years to come. Technique nuances with regard to its handling and creation of the greatest possible efficiency in its use may emerge. This said, in the Authors' opinion, over the next decade, as studies in all probability will continue to validate this material, it is very possible that gutta percha will become obsolete until another material can be found which will give greater clinical benefit with less patient risk than RS In the Authors' opinion, this material truly is a quantum leap forward in the modern era of endodontics and worthy of consideration for use as an obturating material in place of guttapercha.

REFERENCES

1. Barrieshi KM, Walton RE, Johnson WT, Drake DR. Coronal leakage of mixed anaerobic bacteria after obturation and post space preparation. *Oral Surg 1997;84:310-4.*
2. Torabinejad M, Ung B, Kettering JD. In vitro bacterial penetration of coronally unsealed Endodontically treated teeth, *J Endod. 1990 Dec; 16(12):566-9.*
3. Saunders WP, Saunders EM Assessment of leakage in the restored pulp chamber of Endodontically treated multirooted teeth *Int. Endod J 1990;23(1):28-33.*
4. Chailertvanitkul P, Saunders WP, Saunders EM, MacKenzie D. An evaluation of microbial coronal leakage in the restored pulp chamber of root canal treated multirooted teeth *Int Endod. J 1997;30(5):318-22.*
5. Swartz DB, Skidmore AE, Griffin JA. Twenty years of Endodontic success and failure. *J Endod. 1983;9: 198-202.*
6. Ray HA, Trope M. Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and the coronal restoration. *Int Endod J 1995;28:12-18.*
7. Shipper G, Orstavik D, Teixeira FB, Trope M, An evaluation of microbial leakage in roots filled with a thermoplastic synthetic polymer based root canal filling material (Resilon), *J Endod, 2004 May; 30(5):342-7.*
8. F.B. Teixeira, E.C. Teixeira, J. Y. Thompson, M. Trope. IADR/AADR/CADR 82nd General Session, *March 10-13, 2004.*
9. Buchanan LS. Vertical condensation of warm gutta-percha: observations regarding a classic technique. *Dentistry Today 1994; Sept:1-7*