A Modified Thermomechanical Root Canal Compaction Technique Using Synthetic Polymer-Based Root Canal Filling Material (Resilon)

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Leakage along root fillings (Marshall and Massler, 1961; Swanson and Madison, 1987; Torabinejad et al. 1990) can occur apically from the tooth crown, described as coronal leakage. If leakage occurs from the apicem upwards to the crown, it is defined as apical leakage.

"Microleakage of the root canal has been defined as the passage of bacterias, fluids, and chemical substances between the tooth and filling material of the root canal. Microleakage results in the presence of a fluid-filled space at the interface of the filling material and root canal wall."

There are two potential interfaces of leakage:
- between the gutta – percha and the sealer
- between the sealer and the canal.

Ray and Trope (1995) concluded, that the technical quality of the coronal restoration is more important for clinical success than the technical quality of the endodontic treatment. In contrast to this, Kirkevang et al. (2000) suggested that both the quality of the endodontic treatment and the coronal restoration may affect the treatment result in similar ways.

As cited by Galvan,[1] "Swanson and Madison[2] showed that in the absence of a coronal seal this contamination could occur in as little as three days. Hovland and Dumsha[3] observed that most of the leakage took place at the cement-canal wall interface or the gutta-percha/ cement interface, implicating the sealer as the weak link in long-term successful obturation of the root canal. Because no sealer-cement or

FIGURE 1—A master point (Resilon) with good apical fitting is selected.

FIGURE 2—Fitting of the manual pluggers (Buchanon pluggers, SybronEndo) into the root canal. The smallest manual plugger should reach within WL minus 5mm. The first wave of condensation will be accomplished using firm apical pressure.

FIGURE 3A—The TLC (Brasseler) rotary compactor files.

FIGURE 3B—The PacMac (SybronEndo) rotary condenser file, length adjusted to reach WL minus 5mm.

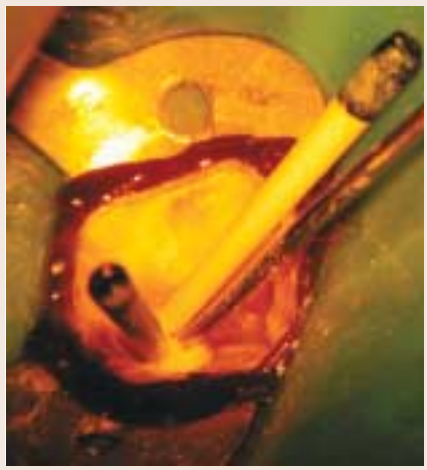

FIGURE 4—The point is shortened to the orfice cavum using System B.

FIGURE 5—The Resilon cones will be seared to orifice level.

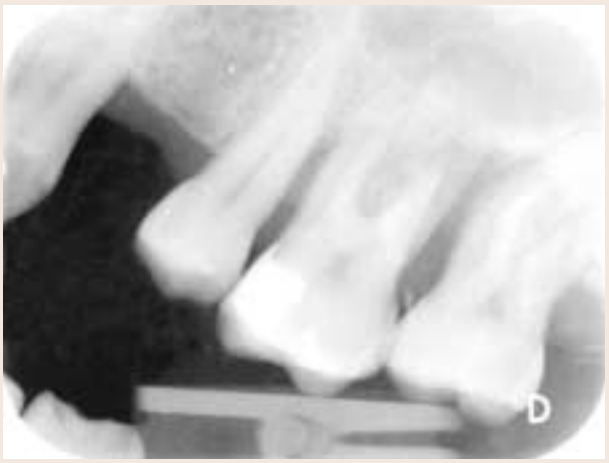

FIGURE 6—Preoperative view.

FIGURE 7—The straight canal orifices.

FIGURE 8—Sizing the root canal preparation with the Thermafill Verifiers.

FIGURE 9—The palatal canal needs a Resilon point one size larger.

obturation technique consistently prevent percolation through the canal,[4] it is crucial to maintain a coronal seal to prevent microleakage into the canal space."

Galwan's study proved that the use of resins to produce an intracoronal seal may prevent microleakage. The great disadvantage of gutta-percha use, as stated by Augustin & Schärer (1998) are:

- the lack of stiffness in narrow and curved canals;
- the lack of adhesion to the dentin;
- the danger of percolation and mobility.

From this point on, introducing adhesive resin cements, sixth generation bondings and replacing gutta-percha by bondable resins, was easy.

Gutta-percha is replaced in this technique by Resilon (Epiphany, Pentron Clinical Technologies; RealSeal, SybronEndo), a thermoplasticizable polymer of polyesters. Resilon is a semi-crystalline polymer with a melting temperature of +60° Celsius, which is bondable to the sealer used.

THERMOMECHANICAL COMPACTION

Thermomechanical compaction was introduced to Endodontics in 1980 by MacSpadden. The initially described procedure was performed with a rotary file

FIGURE 10—Picture showing the backfill control.

FIGURE 11—The final x-ray confirm the perfect root canal obturation.

very similar to a Hedström instrument, just presenting the edges apically called PacMac (Sybron Endo).

In the meantime, modifications have been added to this file by Brasseler (USA), launching a rotary file for thermo-lateral compaction. The design differences can be described as follows:

- The extensions of the cutting edges of the reversed Hedstrom file are eliminated.
- The distance between the edges is raised.
- The file is used at lower rpm and the resulting compaction can be described as lateral condensation because of the material dispersion towards the lateral walls of the root canals. The TLC file maintains a balanced opening and closing force by its interrupted spins. This allows the flowing and, at the same time, the compression of the polymer towards the root canal walls. At the same time the frictional heat of the file helps plasticizing the solid core at temperatures 60 – 70° Celsius. The result can be explained by the hydrostatic seal theory.

Mccullagh[5] states the technique's advantage as follows:

"The principle of its use relies on the frictional heat of the instrument initially plasticizing the gutta-percha at a temperature of between 30°C and 60°C and then the thread pattern of the instrument propels the gutta-percha laterally and towards the apical region" (See Table 1).

This is the mean maximum temperature measured during obturation at three different drill speeds as registred by McCullagh et al. (1997)[6]

Description of a modfied hybrid thermomechanical procedure

The thermomechanical compaction can be split into two distinct treatment sequences:
- Downpack phase
- Backpack phase.

These phases were first used to describe the vertical compaction procedure.

Downpack phase:
The ready prepared root canal is sized using Thermafill Verifiers (Dentsply Tulsa Dental, Tulsa) to select the proper Master cone (Resilon).

Gauging the apical capture zone guarantees a good tug back by allowing the perfect adjustment of the master cone.

Resilon Bonding Material is applied into the

Table 1

r.p.m.	Mean max. temperature (°C)	SD	Range
8,000	76.90	15.78	40.2–97.1
12,000	77.32	15.06	52.4–97.4
16,000	80.96	13.54	52.6–97.7

canal. The excess is removed with paper points.

The Resilon master cone, coated with Resilon Sealer, is placed in the root canal in a pumping motion. The cone excess is seared off at the orifice level.

The TLC rotary file is inserted into the canal in modification to the initial McSpadden procedure,in a motion of about 6000 rpm and apically advanced to WL minus 5mm (this length is preset using rubber stops). An action time of five seconds is sufficient to compact the core. The removal of the TLC file is affected in motion using a circular movement on the outerl limit of the root canal. To finish the "first wave of condensation" firm pressure is applied when using the manual plugger to condense the root canal obturation in the apical zone.

Backpack phase:
Resilon Sealer is coated onto the root walls using paper points. Resilon pellets, which are heated in the Obtura II gun (Obtura Spartan, Fenton, MO), are now injected into the root canal. The plasticized Resilon will fill a depth of 4-5mm of the root canal. The reheatable Resilon is condensed in to the middle part of the root canal using the PacMac files at a motion of about 20000 – 30000 rpm, Firm pressure is applied when using the next bigger sized manual plugger to compact apically representing the "second wave of condensation."

A final "wave of condensation" (Resilon application and compaction) might be necessary but is not mandatory if the root canal is already filled to the orifice level minus 3mm.

To control and confirm the excellent root canal filling, x-rays in different angles (orthoradial, mesioexcentric, distoexcentric) need to be taken. If the result is satisfactory, the most coronally 2mm of sealer can be light-cured achieving a coronal seal. The rest of the sealer will self cure in the following 30 to 60 minutes.

CONCLUSION

Choice of material:
In 1998, Spagenberg stated the new adhesive properties of the root canal sealer:

"A desirable property of the root canal sealer is to have adhesive strength both to the dentin and to the core material, which is usually gutta-percha. The sealer also must have cohesive strength to hold the obturation together".[7]

"The ability of root canal sealers to adhere to dentin and gutta-percha may be expected to result in superior sealing ability, which should reduce leakage in clinical situations. Adhesion also should improve the stability of the root filling, e.g. during preparation for post space." Saleh[8] et al..

Choice of procedure:
1. Thermomechanical compaction results in a lower heat development.

2. Thermomechanical compaction is a simple and fast obturation procedure.

3. Thermomechanical compaction ends in a very homogenous root filling preventing the formation of voids.

Using thermomechnical compaction techniques combined with adhesive sealers, and solid core, helps prevent voids and avoids microleakage (Beer 1986, Isley & El Deeb 1983). **OH**

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Oral Health welcomes this original article.

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