Interfacial Adaptation of Adhesive Materials to Root Canal Dentin

Jorge Perdigão, DMD, MS, PhD, Maria M. Lopes, BS,† and George Gomes, DMD‡*

Abstract

Extracted single-rooted maxillary teeth were endodontically treated and filled with gutta-percha/AH-26 (GP), Resilon points/RealSeal (RS), AdheSE DC/Multicore Flow (ADH, self-etch control), or Excite DSC/Multicore Flow (EXC, total-etch control). Specimens were analyzed with electron microscopy using three methods: (a) field emission scanning electron microscopy (FESEM) of the interface; (b) transmission electron microscopy (TEM) of the interface; and (c) FESEM of the material fitting surface. The three adhesive materials (RS, ADH, and EXC) formed a dentin hybrid layer, which nonetheless resulted in interfacial separation. Gaps were more frequent for GP, which did not hybridize dentin. The fitting surfaces exhibited resin tags at all levels for EXC. Tags were less frequent with ADH, especially in the apical third. For RS, resin tags were rare and virtually absent from the apical half, whereas GP did not form tags. Despite the hybridization, a tight seal of the root canal is difficult to achieve because of the complexity and the mechanical challenge of the substrate. *(J Endod 2007;33:259–263)*

Key Words

Dental bonding, electron microscopy, Resilon, resin cements, root canal obturation

From the *Division of Operative Dentistry, Department of Restorative Sciences, University of Minnesota, Minneapolis, Minnesota; †School of Medicine and Dentistry, University of Santiago de Compostela, Santiago de Compostela, Spain; and the ‡School of Dentistry, University of Granada, Granada, Spain.

Address requests for reprints to Dr. Jorge Perdigão, University of Minnesota, Division of Operative Dentistry, Department of Restorative Sciences, 8-450 Moos Tower, 515 SE. Delaware St., Minneapolis, MN 55455. E-mail address: perdi001@umn.edu.

0099-2399/$0 - see front matter

doi:10.1016/j.joen.2006.10.002

The goal of root canal therapy is to eliminate intracanal bacteria and to seal the root canal system and crown access with materials that prevent reinfection (1, 2). Gutta-percha is considered the gold standard root canal filling material (3).

Adhesives have been used primarily to bond restorative materials to coronal enamel and dentin (4, 5). More recently, adhesives have been used in the root canal to bond posts and to strengthen endodontically treated teeth (6–11). However, most attempts to seal the root canal system with adhesives have proved unsuccessful (11–15).

A new root canal filling material has been recently developed (16). This material is composed of a thermoplastic polycaprolactone-based filled polymer (Resilon, Resilon Research LLC, Madison, CT) combined with proprietary self-etching adhesive and a dual-cured composite resin sealer (17). Controversy has recently emerged concerning the use of this material. According to one research group, the Resilon system forms a monoblock between the root canal dentin and the respective filling material (9, 18), resulting in a lower incidence of apical leakage but strengthening the tooth (9, 18). However, the findings of a different research group challenged both the sealing ability of the monoblock concept (17) and its potential for reinforcing the residual tooth structure (19).

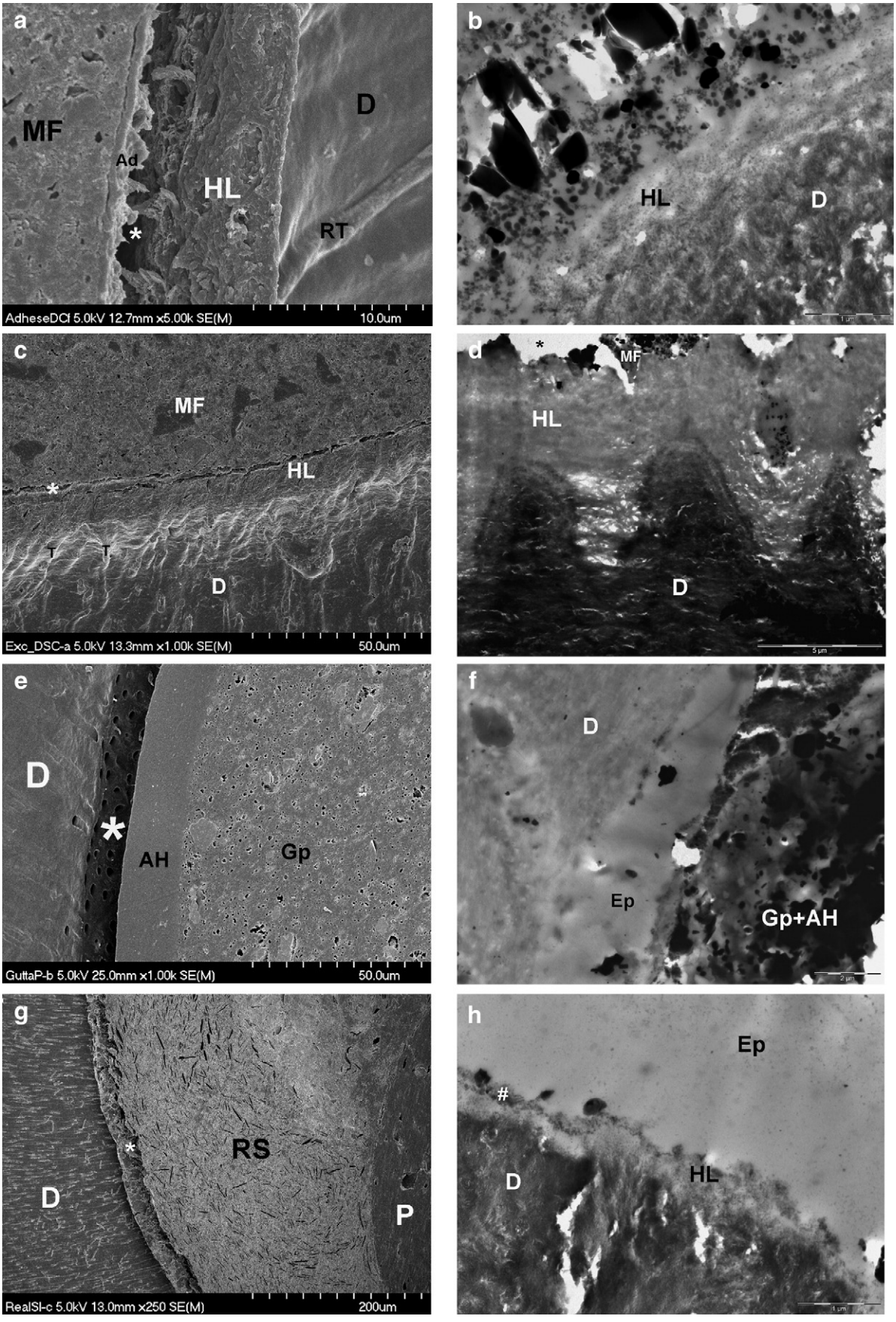
Self-etching and total-etching dual-cured adhesive systems have been extensively tested; therefore, they serve as appropriate controls to test the new polycaprolactone-based filled polymer. The purpose of this study is to compare the interfacial ultramorphology and sealing ability of RealSeal sealer/Resilon points with that obtained with gutta-percha/AH-26 sealer, using two resin adhesive systems as controls. The null hypothesis tested is that the dentin penetration and sealing ability of the new root canal filling material is not superior to that of existing materials.

Materials and Methods

We used 36 single-rooted human maxillary teeth stored in 0.2% chloramine at 4°C. Access was made with a tapered round end bur (Brasseler USA, Savannah, GA) with a high-speed handpiece and water spray. For working length calculation, 1 mm was subtracted from the total length of the file inside the root canal. A crown-down technique was used for instrumentation with Gates Glidden (Moyco Union Broach, York, PA) #2 to #4 drills and then rotary files (Profile .06 Taper Series 29, Dentsply Maillefer, Tulsa, OK) were used incrementally up to a #35 file/.06 taper. The teeth were irrigated between each instrument, and the canal space was filled with irrigant during the instrumentation phase. For each tooth, 2 ml of 5.25% sodium hypochlorite (NaOCl) (The Clorox Co, Oakland, CA) was delivered with a Monoject syringe (Sherwood Medical Co., St. Louis, MO) and a 27-gauge needle. The final rinse was done with 5.25% NaOCl followed by 2 ml of distilled water. The canal spaces were dried with absorbent paper points (Dentsply Maillefer, Tulsa, OK) and randomly divided into four groups.

Group 1: Gutta-Percha and AH-26 (GP)

The canals were coated with AH-26 (Dentsply Maillefer) using paper points dipped into the sealer. The warm vertical condensation technique was accomplished with Obtura II (Obtura Spartan, Fenton, MO) warm gutta-percha and Obtura warm gutta-percha condensers (S-Kondensers, Obtura Spartan).


a
MF
Ad
HL
D
RT
*
AdheseDCf 5.0kV 12.7mm x5.00k SE(M)
10.0um
b
HL
D
c
MF
HL
*
T
T
D
Exc_DSC-a 5.0kV 13.3mm x1.00k SE(M)
50.0um
d
*
MF
HL
D
e
D
*
AH
Gp
GuttaP-b 5.0kV 25.0mm x1.00k SE(M)
50.0um
f
D
Ep
Gp+AH
g
*
RS
D
P
RealSl-c 5.0kV 13.0mm x250 SE(M)
200um
h
Ep
#
D
HL