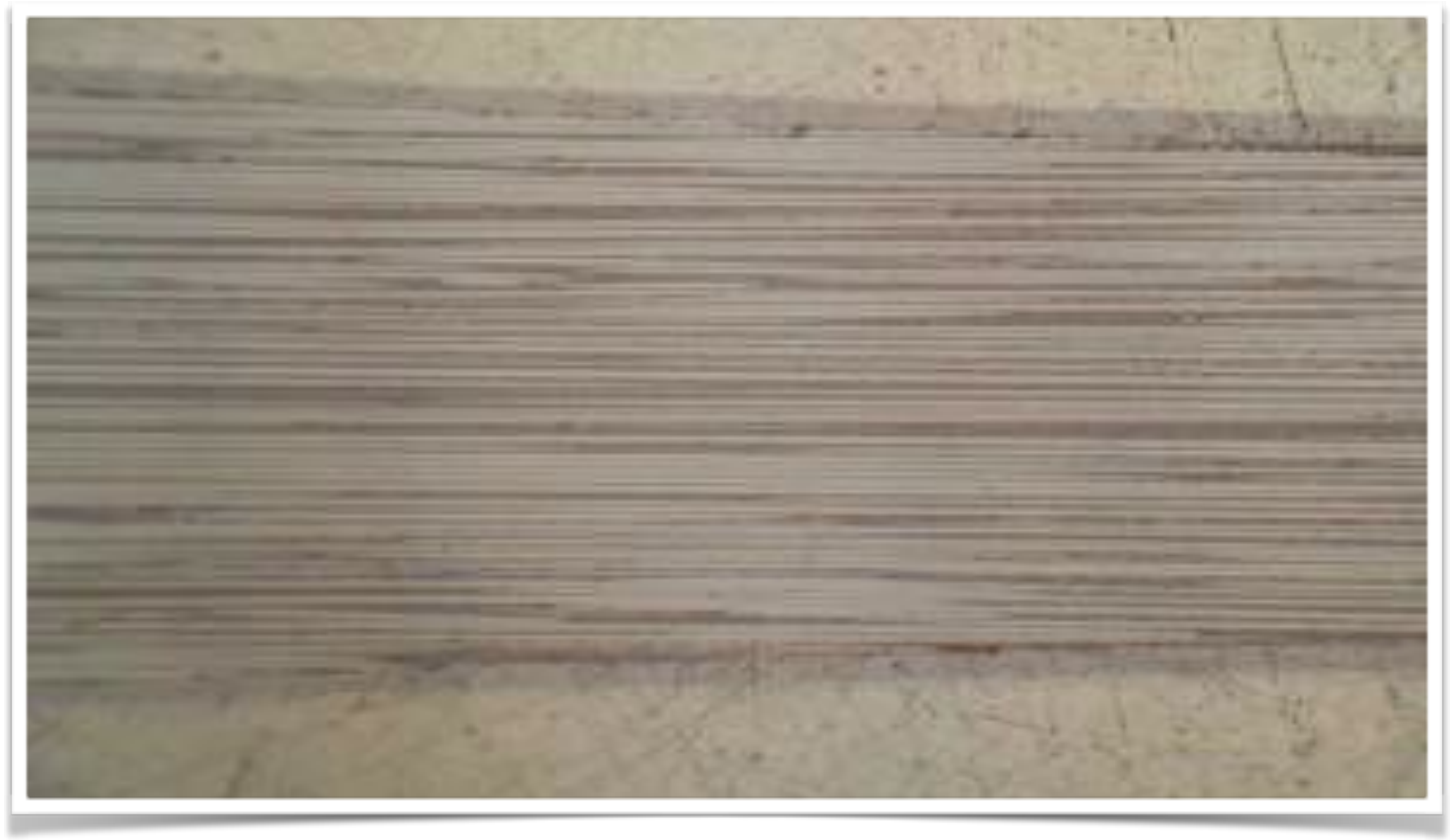
3 CONCEPTOS PRINCIPALES PARA NO OLVIDAR

2

Si se precisara un perno, considere que los pernos de fibra tienen un **comportamiento mecánico más similar a los tejidos dentarios y colaboran con la obtención de resultados estéticos**

Pernos de fibra
Generalidades



Una matriz de resina mantiene unidas distintos tipos de fibras
(vidrio y cuarzo son las más comunes)

Pernos de fibra
Ventajas

1. PERNO PREFORMADO
2. PERNO DE FIBRA

- **TRABAJO EN UNA SESIÓN CLÍNICA:** se ahorran tiempo y costos
- **NO HAY OBTURACIÓN PROVISORIA:** el conducto nunca queda sin sellado. El riesgo de contaminación se reduce o elimina
- **NO HAY IMPRESIONES**: no hay necesidad de sobreextender el lecho para facilitarlas. También ayuda a emplear el **dique de goma** lo que a su vez mejora el acceso, visibilidad, separa tejidos blandos, permite el uso de aparatología más compleja para el tratamiento y reduce riesgo de contaminación
- **MAYOR CONSERVACIÓN DE TEJIDOS**: el protocolo de instrumentación de un perno preformado conlleva a menor desgaste de tejidos, y así colabora con el mejor rendimiento mecánico del diente

POR SER UN PERNO PREFORMADO

- **NO HAY RELACIÓN DIRECTAMENTE PROPORCIONAL ENTRE EL CALIBRE Y LA RESISTENCIA:** se remueve menos dentina radicular porque no se sobreextiende el lecho.
- **COMPORTAMIENTO ELÁSTICO SIMILAR AL DE LA DENTINA:** se deforman en conjunto con el diente; no hay concentración de estrés sobre puntos específicos de la raíz. Mejor pronóstico mecánico para el diente en comparación a pernos metálicos o cerámicos.
- **ASPECTO ÓPTICO NATURAL**: La mayoría de los pernos de fibra no son oscuros u opacos. Mejor estética sobre el muñón, raíz y encía.
- **NO HAY CORROSIÓN:** mejoran aspectos estéticos y previenen inconvenientes mecánicos del perno y la raíz

POR SER UN PERNO DE FIBRA

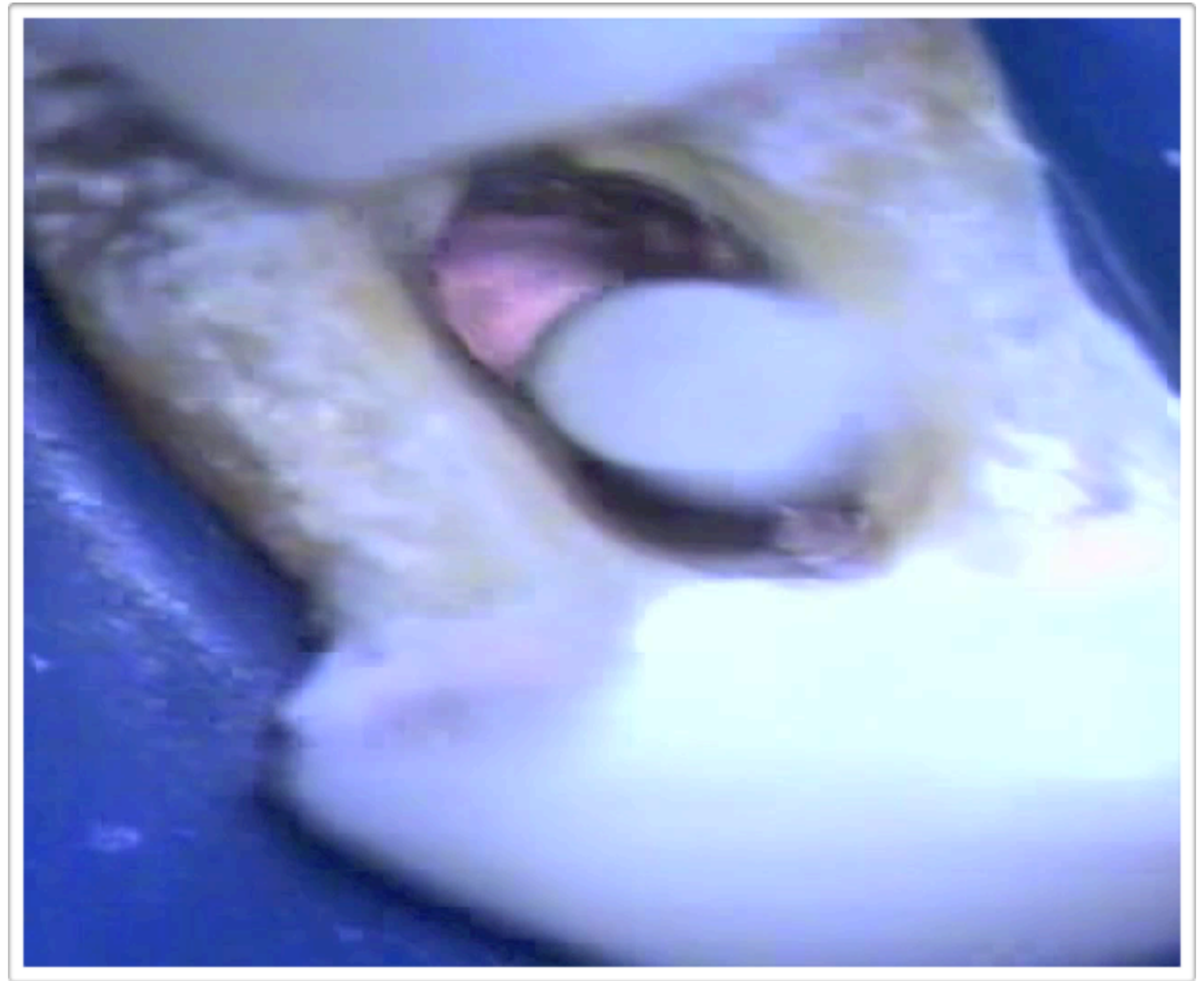
3 CONCEPTOS PRINCIPALES PARA NO OLVIDAR

3

Los pernos de fibra tienen limitaciones.

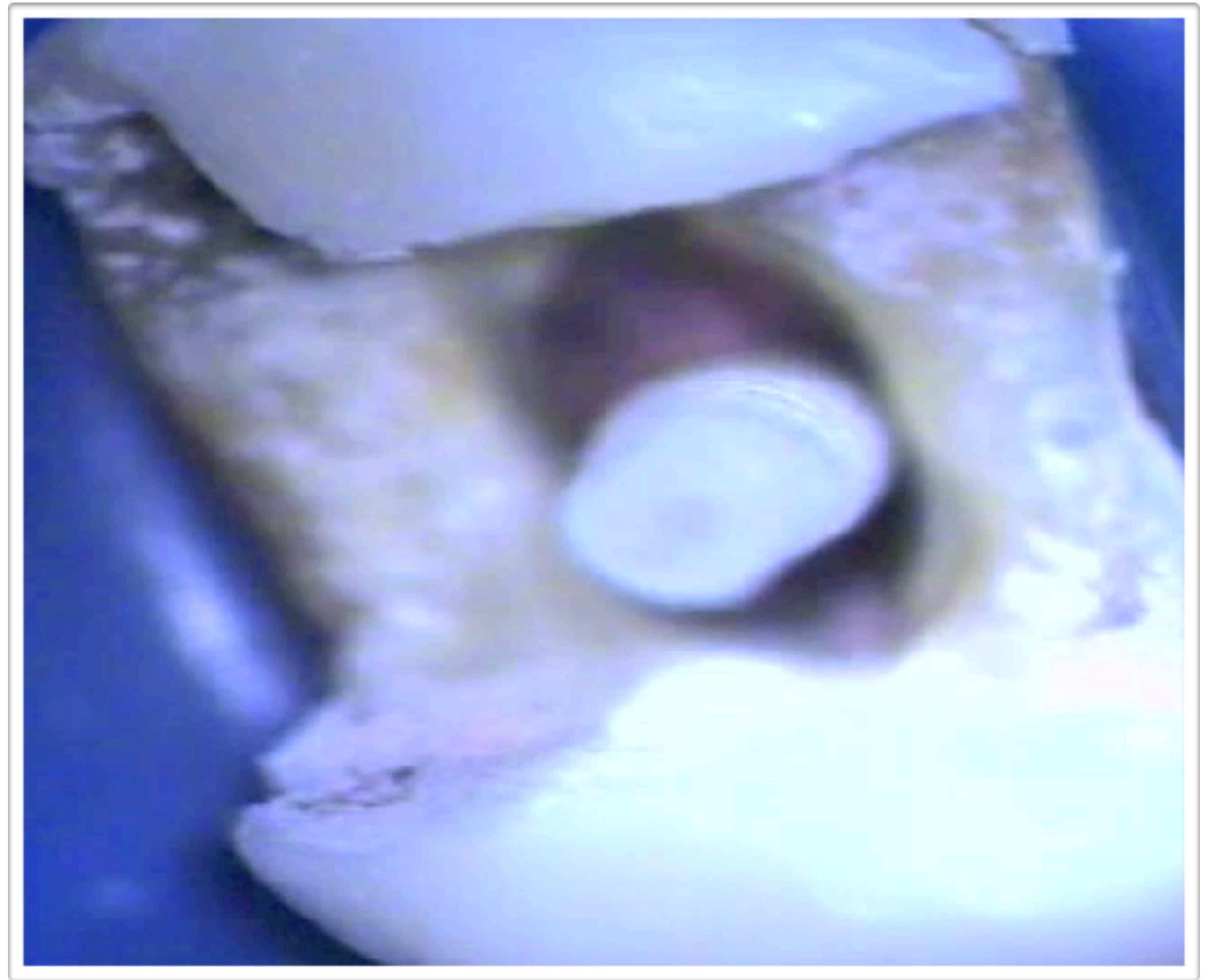
En gran medida, podrán ser superadas con (**A**) una **correcta selección del perno** acorde a ciertas propiedades y (**B**) con el **empleo de algunas técnicas clínicas**

DESPRENDIMIENTOS



Después de la preparación del lecho, **los pernos de fibra no suelen presentar retención por traba mecánica** (no hay adaptación íntima entre ambas superficies), y su **sección es redonda**.

Estos factores los predispone al desalojo



RECUERDE: Existen 3 MECANISMOS PARA LA RETENCIÓN

1

La **traba mecánica primaria** proviene de la **fricción superficial** que desarrollen el perno y las paredes del lecho.

Está condicionada por la **adaptación** del perno a las paredes del lecho y por su **extensión** en profundidad.

Es el factor más importante para la retención del perno

2

La **traba mecánica secundaria** es provista por el **medio cementante**: líquido que al solidificar aumenta el contacto entre el perno y las paredes de su lecho.

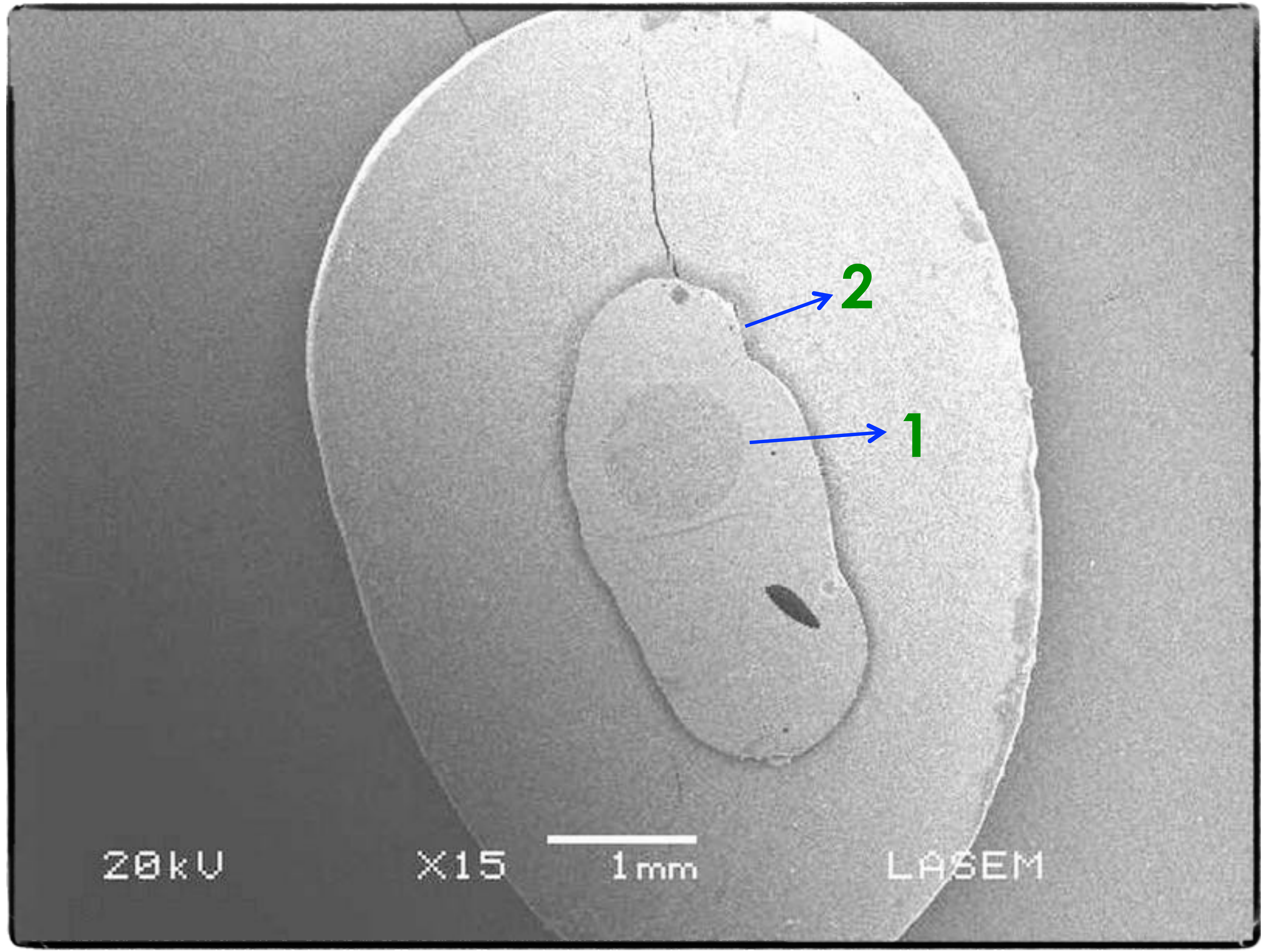
Está condicionada por la traba mecánica primaria y por las **propiedades físicas y mecánicas del medio cementante**

3

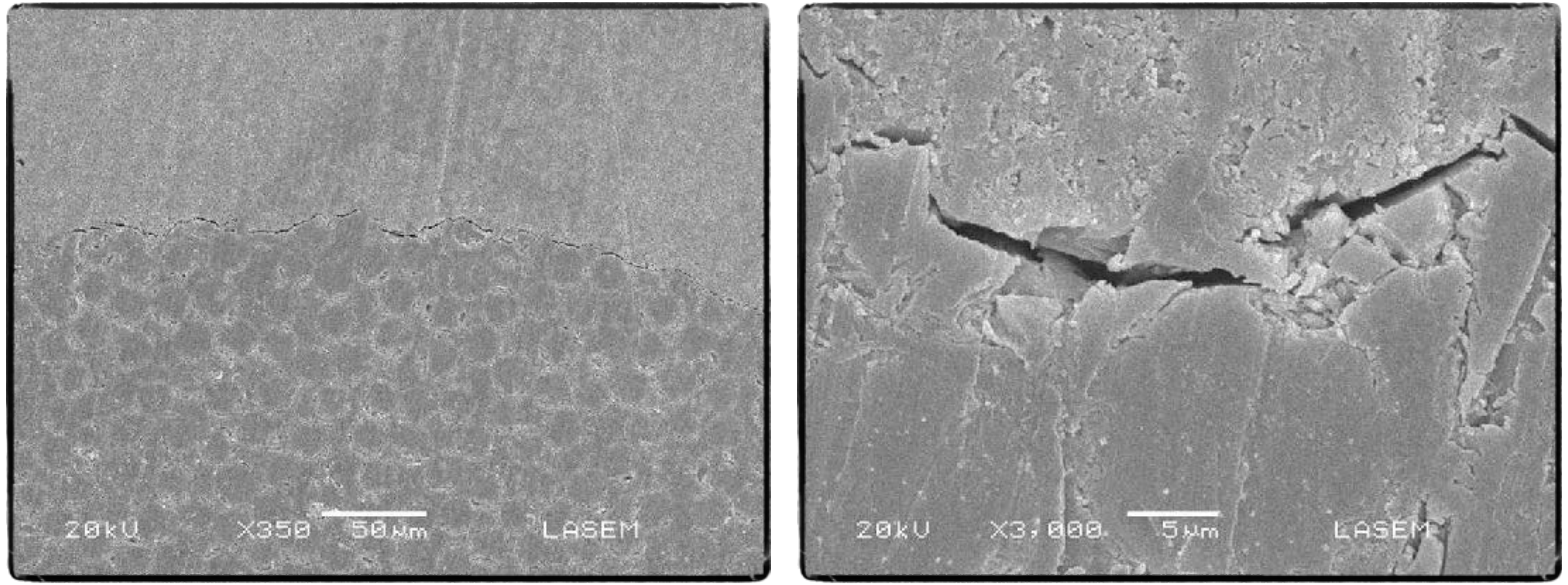
La **adhesión** es provista por un **cemento resinoso y su adhesivo**: uniones por trabas micromecánicas sobre el perno y la dentina radicular (capa híbrida y **tags de resina**).

Por distintas razones, es **complejo conseguirla sobre la dentina del lecho para el perno**.

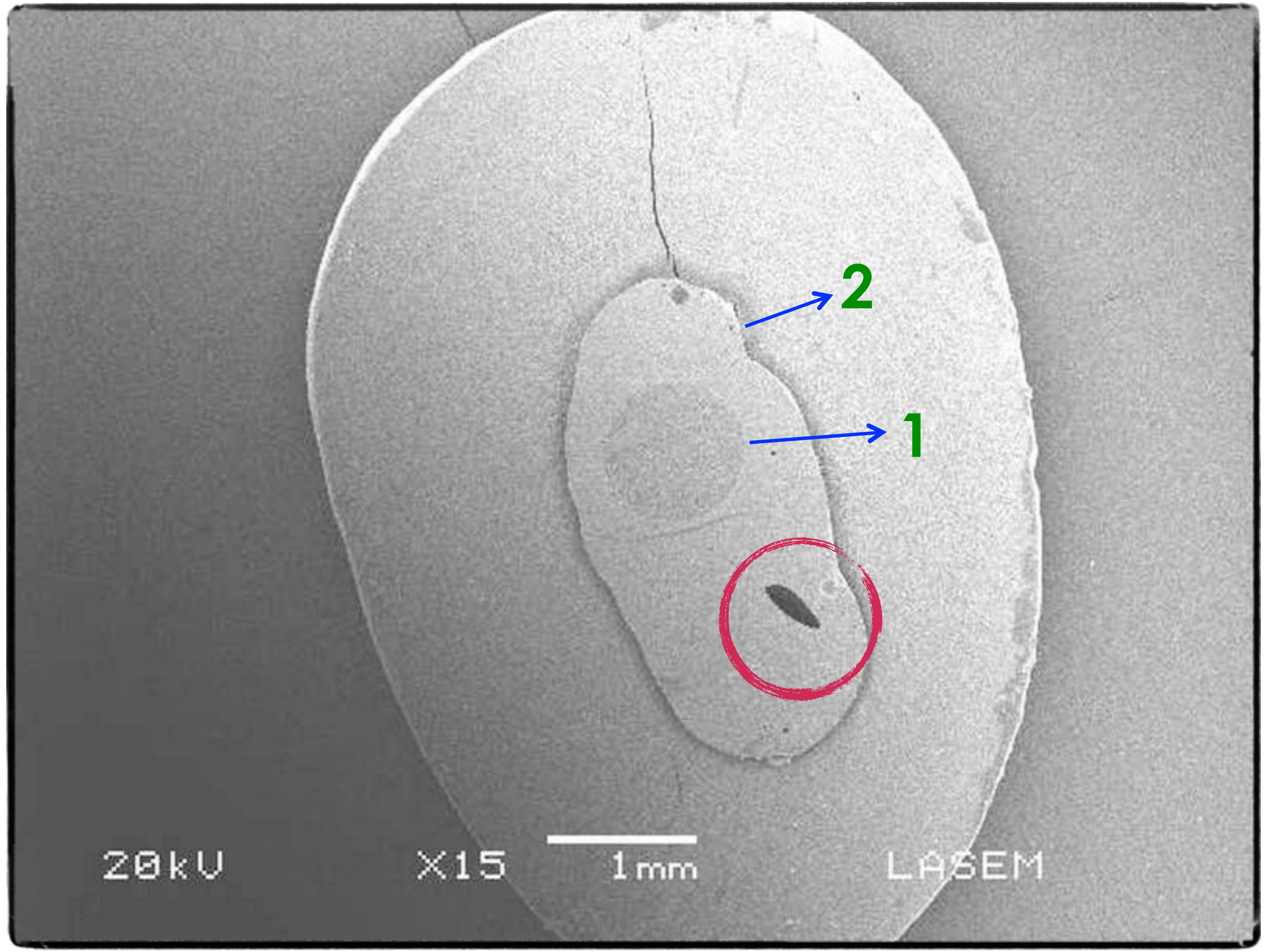
Su **importancia es relativa si se cuenta con traba mecánica primaria y secundaria.**



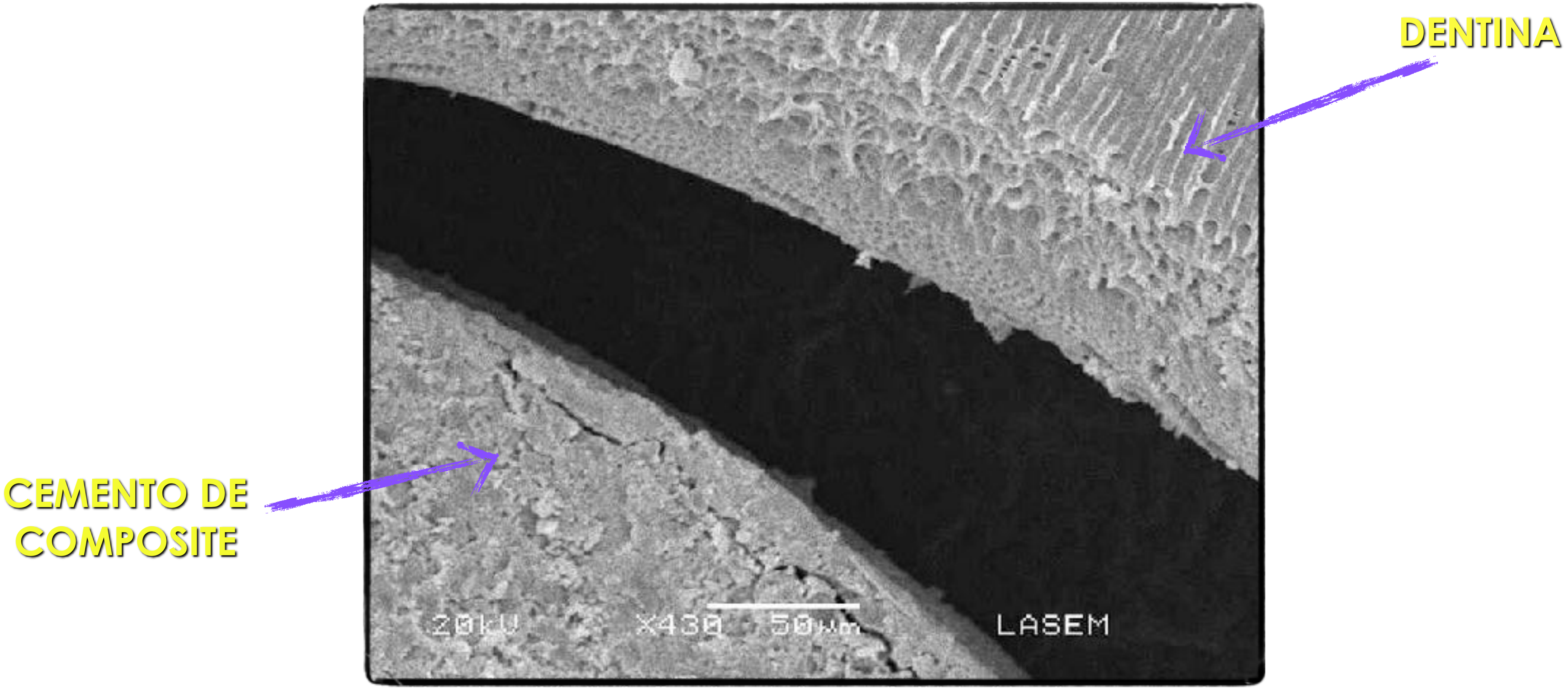
1



Cortesía Pablo Ensinas y Daniel Martucci (Argentina)



2



Cortesía Pablo Ensinas y Daniel Martucci (Argentina)

De la A a la Z…

a. Falta de visión
b. Restos de cemento sellador y gutapercha sobre las paredes del lecho
c. Colágeno con alteración propia de un diente sin vitalidad pulpar
d. Colágeno dañado por el calor de la instrumentación para el lecho
e. Alteración estructural de la dentina luego del tratamiento endodóntico: colágeno dañado por efectos del hipoclorito de sodio que no permite adecuada hibridización
f. Obstrucción de túbulos dentinarios por sellador endodóntico o barro dentinario secundario
g. Factor de configuración del lecho muy alto: tensiones de contracción de polimerización del cemento de resina que pueden llegar hasta 20 MPa
h. Influencia de líquidos irrigantes, selladores y otras sustancias sobre la activación o polimerización del MCR
i. Dificultad para lograr adecuada activación física de la polimerización del cemento de resina (no hay acceso para la luz de activación)

De la A a la Z...

j. Polimerización incompleta del cemento de resina cuando activa químicamente: no genera propiedades físicas apropiadas y promueve el desalojo (pobre traba mecánica 2a.)

k. Agua puede afectar la polimerización y propiedades del cemento de resina esp. cuando activa químicamente: relación con adhesivos simplificados (capas adhesivas más ácidas e hidrófilas permiten el pasaje de agua)

l. Bajo pH de algunos adhesivos alteran la activación química del cemento de resina

m. Dificultad y falta de certeza para mojar las superficies con micropinceles

n. Inadecuada inserción del cemento de resina dentro del lecho (mala distribución)

o. Posible polimerización anticipada del cemento de resina por anaerobiosis y/o acción del léntulo: no permite correcta inserción del perno

p. Espesores importantes de cemento: problemas mecánicos en el cemento (*cracks*)

q. Espesores imporantes de cemento: presencia de defectos (burbujas)

r. Espesores importantes de cemento resinoso: mayor generación de tensiones

s. Etc....

The Contribution of Friction to the Dislocation Resistance of Bonded Fiber Posts

Cecilia Goracci, Andrea Fabianelli, Fernanda T. Sadek,* Federica Papacchini,* Franklin R. Tay,† and Marco Ferrari**

Abstract

This study tested the null hypothesis that the use of dentin adhesives produces no improvement on the fixation of fiber posts with resin cements in endodontically treated teeth. Post spaces were prepared in 36 single-rooted root-filled teeth. Silanized glass fiber posts were cemented to the post spaces using a self-etch (ED primer/Panavia 21) and a total etch resin cement (Excite DSC/Variolink II), with or without the accompanying dentin adhesives. Fixation strengths and interfacial ultrastructure were evaluated using a "thin slice" push-out test and transmission electron microscopy. For both resin cements, the fixation strengths obtained from specimens luted with resin cement only did not differ significantly from those in which the intraradicular dentin was first bonded with a dentin adhesive. In the presence of incomplete smear layer removal and interfacial gaps, the dislocation resistance of bonded fiber posts was contributed largely by sliding friction.

Key Words

Dislocation resistance, fiber post, adhesive resin cement, sliding friction

From the Department of Dental Materials, University of Siena, Policlinico "Le Scotte," viale Bracci, Siena, Italy; and Faculty of Dentistry, University of Hong Kong, Prince Philip Dental Hospital, Pokfulam, Hong Kong SAR, China.

Address request for reprints to Dr. Cecilia Goracci, Department of Dental Materials, University of Siena, Policlinico "Le Scotte," viale Bracci, Siena 53100, Italy. E-mail address: cecilia.goracci@tin.it.

Improvements in dentin adhesive technology in the past decade have fostered attempts to reduce microleakage (1) and improve retention (2) by bonding to root canals in the restoration of endodontically treated teeth. Because of the unfavorable cavity configuration factors (3) encountered within post spaces (4, 5), and the high wall-to-wall contraction experienced in thin resin films (6), bonding of posts presents challenges in relieving shrinkage stresses that are generated along canal walls during the polymerization of resin cements (5, 7). Recent studies indicated that restorations bonded with fiber posts fail via the dislodging of the posts from root canals (8, 9). These results were supported by frequent observations of premature bond failures when root sections containing fiber posts bonded to root canals were prepared for microtensile bond testing (10).

To prevent superimposing disruptive stresses (11, 12) during specimen trimming, the "thin slice" push-out test (13) has been advocated as a more forgiving test for evaluating the fixation strengths of fiber posts bonded to root canals (10). It is known that sliding friction derived from interfacial roughness (14) contributes substantially to the results derived from push-out tests of composite materials (15–17). The discrepancy in experiences with the microtensile and push-out tests (10) strongly suggests the dislocation resistance of bonded fiber posts may be largely derived from sliding friction. Thus, the objective of this study was to examine, with the use of a push-out test, the fixation strengths of fiber posts that were cemented with either resin cements only, or in conjunction with a self-etch and a total-etch dentin adhesive. The null hypothesis tested was that the use of dentin adhesives produces no additional improvement on the fixation of fiber posts with resin cements in endodontically treated teeth.

Materials and Methods

Thirty-six single-rooted teeth were mechanically cleaned with a curette to remove soft tissue remnants from the root surfaces. The crown of each tooth was removed at 2-mm beneath the cementoenamel junction using a high-speed diamond saw (Isomet, Buehler, Lake Bluff, IL) under water cooling. The working length was established 1-mm short of the apex. Instrumentation of the root canals was performed with a crown-down technique, using Profile nickel-titanium rotary instruments (Dentsply TulsaDental, Tulsa, OK). All canals were prepared to ISO size 35, 0.06 taper. Each canal was irrigated with 17% EDTA and 5% sodium hypochlorite, dried with paper points and obturated with gutta-percha and AH26 (Dentsply DeTrey, Konstanz, Germany). Downpacking was performed using the continuous wave warm vertical compaction technique (System B, SybronEndo, Orange, CA), and backfilling was performed with Obtura II (Spartan, Fenton, MO).

After 24 hr, the gutta-percha was removed from the coronal and middle thirds of each root. At least 5 mm of intact gutta-percha was left behind to preserve the apical seal. A dowel space was then prepared with increasing sizes of post-hole drills (FRC Postec, Ivoclar-Vivadent, Schaan, Liechtenstein). A size #3 drill was used as the largest drill, corresponding to the same size of a tapered FRC Postec glass fiber post (1 mm in diameter apically). Each post was silanized with Monobond-S (Ivoclar-Vivadent) before cementation.

The teeth were randomly divided into two experimental groups, depending on the type of resin cement system (self-etch versus total etch) employed for post cementation. Each group was further divided into two subgroups ($n = 6$), according to whether the

Goracci C, Tay F, Ferrari M. The contribution of friction to the dislocation resistance of bonded fiber posts. JOE 2005. Vol 31(8): 608-612

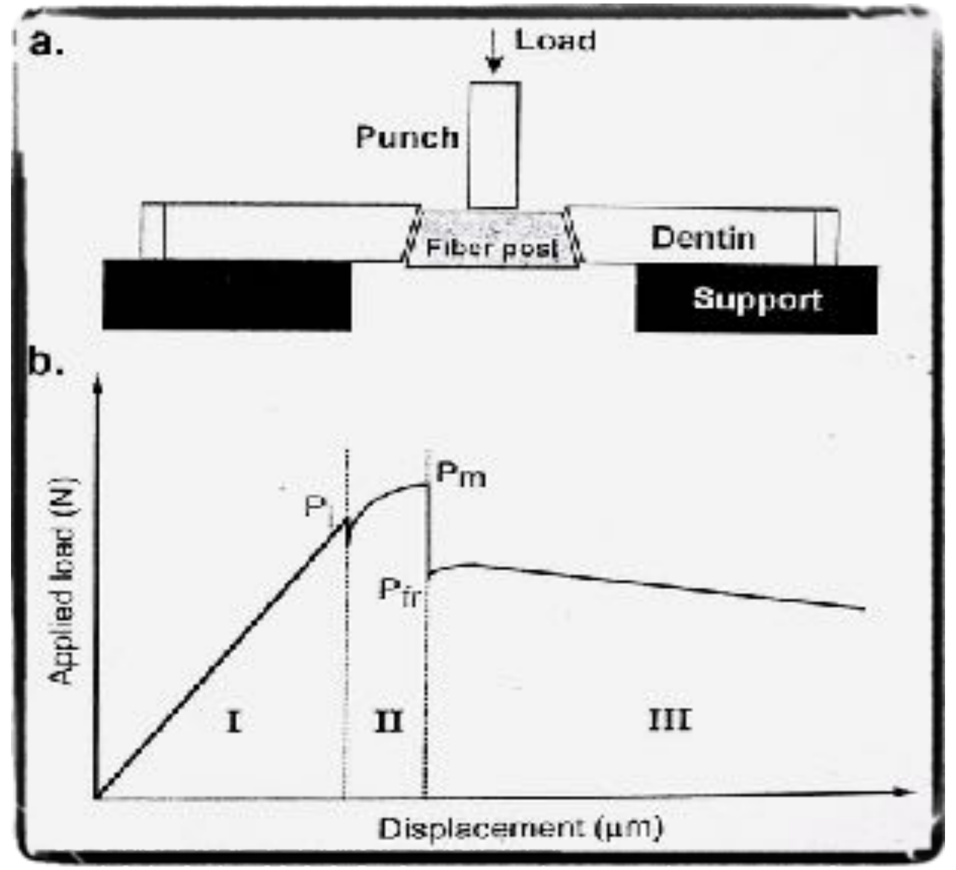


TABLE 1. Push-out strengths of fiber posts coupled with the self-etch and total-etch resin cement systems to post holes created in root-treated teeth, with or without the use of proprietary dentin adhesives

Group	Subgroup	Number of Slices	Push-out strength (MPa)*
(I) Panavia 21	(A) Without adhesive	32	3.37 ± 2.89[A]
	(B) Self-etch adhesive ED primer	36	5.04 ± 2.81[A]
(II) Variolink II	(A) Without adhesive	32	8.57 ± 2.50[B]
	(B) Total-etch adhesive Excite DSC	37	10.18 ± 2.68[B]

* Values are means ± SD. Subgroups with the same letter superscripts are not statistically significant ($p > 0.05$).

The Contribution of Friction to the Dislocation Resistance of Bonded Fiber Posts

Cecilia Goracci, Andrea Fabianelli, Fernanda T. Sadek,* Federica Papacchini,* Franklin R. Tay,† and Marco Ferrari**

Abstract

This study tested the null hypothesis that the use of dentin adhesives produces no improvement on the fixation of fiber posts with resin cements in endodontically treated teeth. Post spaces were prepared in 36 single-rooted root-filled teeth. Silanized glass fiber posts were cemented to the post spaces using a self-etch (ED primer/Panavia 21) and a total etch resin cement (Excite DSC/Variolink II), with or without the accompanying dentin adhesives. Fixation strengths and interfacial ultrastructure were evaluated using a "thin slice" push-out test and transmission electron microscopy. For both resin cements, the fixation strengths obtained from specimens luted with resin cement only did not differ significantly from those in which the intraradicular dentin was first bonded with a dentin adhesive. In the presence of incomplete smear layer removal and interfacial gaps, the dislocation resistance of bonded fiber posts was contributed largely by sliding friction.

Key Words

Dislocation resistance, fiber post, adhesive resin cement, sliding friction

From the Department of Dental Materials, University of Siena, Policlinico "Le Scotte," viale Bracci, Siena, Italy; and Faculty of Dentistry, University of Hong Kong, Prince Philip Dental Hospital, Pokfulam, Hong Kong SAR, China.

Address request for reprints to Dr. Cecilia Goracci, Department of Dental Materials, University of Siena, Policlinico "Le Scotte," viale Bracci, Siena 53100, Italy. E-mail address: cecilia.goracci@tin.it.

Improvements in dentin adhesive technology in the past decade have fostered attempts to reduce microleakage (1) and improve retention (2) by bonding to root canals in the restoration of endodontically treated teeth. Because of the unfavorable cavity configuration factors (3) encountered within post spaces (4, 5), and the high wall-to-wall contraction experienced in thin resin films (6), bonding of posts presents challenges in relieving shrinkage stresses that are generated along canal walls during the polymerization of resin cements (5, 7). Recent studies indicated that restorations bonded with fiber posts fail via the dislodging of the posts from root canals (8, 9). These results were supported by frequent observations of premature bond failures when root sections containing fiber posts bonded to root canals were prepared for microtensile bond testing (10).

To prevent superimposing disruptive stresses (11, 12) during specimen trimming, the "thin slice" push-out test (13) has been advocated as a more forgiving test for evaluating the fixation strengths of fiber posts bonded to root canals (10). It is known that sliding friction derived from interfacial roughness (14) contributes substantially to the results derived from push-out tests of composite materials (15–17). The discrepancy in experiences with the microtensile and push-out tests (10) strongly suggests the dislocation resistance of bonded fiber posts may be largely derived from sliding friction. Thus, the objective of this study was to examine, with the use of a push-out test, the fixation strengths of fiber posts that were cemented with either resin cements only, or in conjunction with a self-etch and a total-etch dentin adhesive. The null hypothesis tested was that the use of dentin adhesives produces no additional improvement on the fixation of fiber posts with resin cements in endodontically treated teeth.

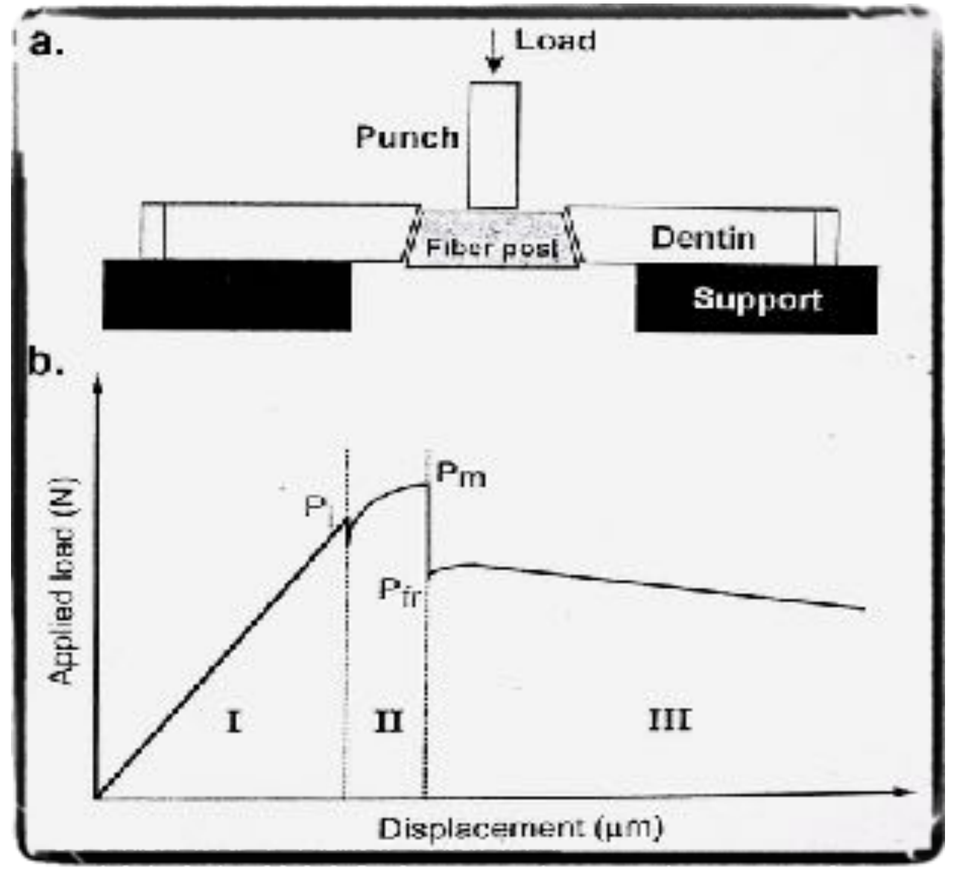
Materials and Methods

Thirty-six single-rooted teeth were mechanically cleaned with a curette to remove soft tissue remnants from the root surfaces. The crown of each tooth was removed at 2-mm beneath the cementoenamel junction using a high-speed diamond saw (Isomet, Buehler, Lake Bluff, IL) under water cooling. The working length was established 1-mm short of the apex. Instrumentation of the root canals was performed with a crown-down technique, using Profile nickel-titanium rotary instruments (Dentsply TulsaDental, Tulsa, OK). All canals were prepared to ISO size 35, 0.06 taper. Each canal was irrigated with 17% EDTA and 5% sodium hypochlorite, dried with paper points and obturated with gutta-percha and AH26 (Dentsply DeTrey, Konstanz, Germany). Downpacking was performed using the continuous wave warm vertical compaction technique (System B, SybronEndo, Orange, CA), and backfilling was performed with Obtura II (Spartan, Fenton, MO).

After 24 hr, the gutta-percha was removed from the coronal and middle thirds of each root. At least 5 mm of intact gutta-percha was left behind to preserve the apical seal. A dowel space was then prepared with increasing sizes of post-hole drills (FRC Postec, Ivoclar-Vivadent, Schaan, Liechtenstein). A size #3 drill was used as the largest drill, corresponding to the same size of a tapered FRC Postec glass fiber post (1 mm in diameter apically). Each post was silanized with Monobond-S (Ivoclar-Vivadent) before cementation.

The teeth were randomly divided into two experimental groups, depending on the type of resin cement system (self-etch versus total etch) employed for post cementation. Each group was further divided into two subgroups ($n = 6$), according to whether the

Goracci C, Tay F, Ferrari M. The contribution of friction to the dislocation resistance of bonded fiber posts. JOE 2005. Vol 31(8): 608-612



El uso de adhesivos previo al cemento resinoso **<u>no</u>** produce mejoras significativas en la resistencia a la remoción del poste; **<u>la traba mecánica es el factor de retención más importante</u>**

Basic Research—Technology

Influence of Filling Materials on the Bonding Interface of Thin-walled Roots Reinforced with Resin and Quartz Fiber Posts

Cid Alonso Manicardi, PhD, Marco Aurélio Versiani, MS, Paulo César Saquy, PhD, Jesus Djalma Pécora, PhD, and Manoel Damião de Sousa-Neto, PhD

Abstract

Introduction: A common complication during the restoration of severely destroyed teeth is the loss of coronal root dentine. The aim of this study was to evaluate the influence of different sealers on the bonding interface of weakened roots reinforced with resin and fiber posts. **Methods:** Sixty extracted maxillary canines were used. The crowns were removed, and the thickness of root dentine was reduced in the experimental (n = 40) and positive control (n = 10) groups. The specimens of experimental group were assigned to four subgroups (n = 10) according to the filling material: gutta-percha + Grossmann's sealer, gutta-percha + AH Plus (Dentsply De Trey Gmbh, Konstanz, Germany), gutta-percha + Epiphany (Pentron Clinical Technologies, Wallingford, CT), and Resilon (Resilon Research LLC, Madison, CT) + Epiphany. In the negative control group (n = 10), canals were not filled. After post space preparation, the roots were restored with composite resin light-activated through a translucent fiber post. After 24 hours, specimens were transversally sectioned into 1-mm-thick slices. Push-out test and scanning electron microscopic (SEM) analyses of different regions were performed. Data from push-out test were analyzed by using Tukey post hoc multiple comparison tests. The percentage of failure type was calculated. Data from SEM analysis were compared by Friedman and Kruskal-Wallis tests ($\alpha = 0.05$). **Results:** The mean bond strength was significantly higher in the negative control group as compared with the other groups ($P < .05$). In all groups, the most frequent type of failure was adhesive. Overall, apical and middle regions presented a lower density of resin tags than the coronal region ($P < .05$). **Conclusions:** The push-out bond strength was not affected by sealer or region. The canal region affected significantly the resin tag morphology and density at the bonding interface. *(J Endod 2011;37:531–537)*

Key Words

Bond strength, endodontic sealer, fiber post, push-out bond testing

From the Department of Restorative Dentistry, Faculty of Dentistry, University of São Paulo, Ribeirão Preto, São Paulo, Brazil.

Address requests for reprints to Dr Manoel Damião de Sousa-Neto, Rua Célia de Oliveira Meirelles 350, 14024-070 Ribeirão Preto, SP, Brasil. E-mail address: sousanet@forp.usp.br

0099-2399/$ - see front matter

Copyright © 2011 American Association of Endodontists.

doi:10.1016/j.joen.2010.12.009

A common complication encountered during the restoration of severely destroyed teeth is the loss of coronal root dentine that results in a funnel-shaped canal with thin walls (1). These teeth very often need to be restored with a post and core as a foundation for the final restoration (2, 3). Traditionally, posts were either prefabricated or cast in metal (4). Prefabricated posts are classified according to their structural composition as metal, ceramic, or resin reinforced with fibers. The introduction of fiber posts has further extended the applications of adhesive dentistry in endodontics and has been advocated because of their advantages of corrosion resistance, nonhypersensitivity, aesthetic appeal, easier removal for endodontic retreatment, and single-visit office placement (4–8).

Adhesive techniques for luting fiber posts have increased in popularity, and resin cement materials have been proposed for use in combination with an acid etching technique (2, 9–12). It involves the removal of the smear layer, demineralization of the dentine, and exposure of a fine network of collagen fibrils. Infiltration of this network with resin permits the formation of a hybrid layer, resin tags, and adhesive lateral branches, thus creating a micromechanical retention of the resin to the demineralized substrate (4, 13). Despite improvements of the adhesive systems, optimal intraradicular bonding must be considered as a real challenge because of the anatomic factors linked to the well-known limitations of the current materials (13). As a consequence, the most frequent cause of adhesive failure is debonding of post restoration at the resin cement/dentin interface (7, 10, 14–19). Thus, concerns have been expressed that residual filling materials could prevent effective bonding in some areas (1, 20–23).

The effect of eugenol on the retention of resin-cemented posts has been studied with conflicting results. Its presence on the canal walls appeared to have an adverse effect on post retention (20, 23–28). To avoid this problem, resin-based root canal sealers have been recommended (29). Resilon (Resilon Research LLC, Madison, CT), a polymer-based thermoplastic root-filling material, has been introduced with claims to be bondable to a variety of dentin adhesives and resin cement-type sealers such as Epiphany (Pentron Clinical Technologies, Wallingford, CT). The Epiphany system contains a self-etching primer and a dual-curable resin composite sealer whose adjunctive use with Resilon purportedly creates a monoblock between root canal dentin and the root-filling material (30–34). AH Plus (Dentsply De Trey Gmbh, Konstanz, Germany) is an epoxy resin-based sealer that is frequently used as a control material in research because of its physic-chemical properties (31, 32, 34). Despite the fact that Epiphany has shown a penetration into dentinal tubules similar to AH Plus (30), previous studies verified that the adhesion of the former to radicular dentin was not superior when compared with other resinous sealers (32, 33). It has been stated that AH Plus was based on the creation of a covalent bond by an open epoxide ring to exposed amino groups in the collagen network (31). Thus, the removal of the sealer-impregnated dentin from the canal walls during post space preparation seems

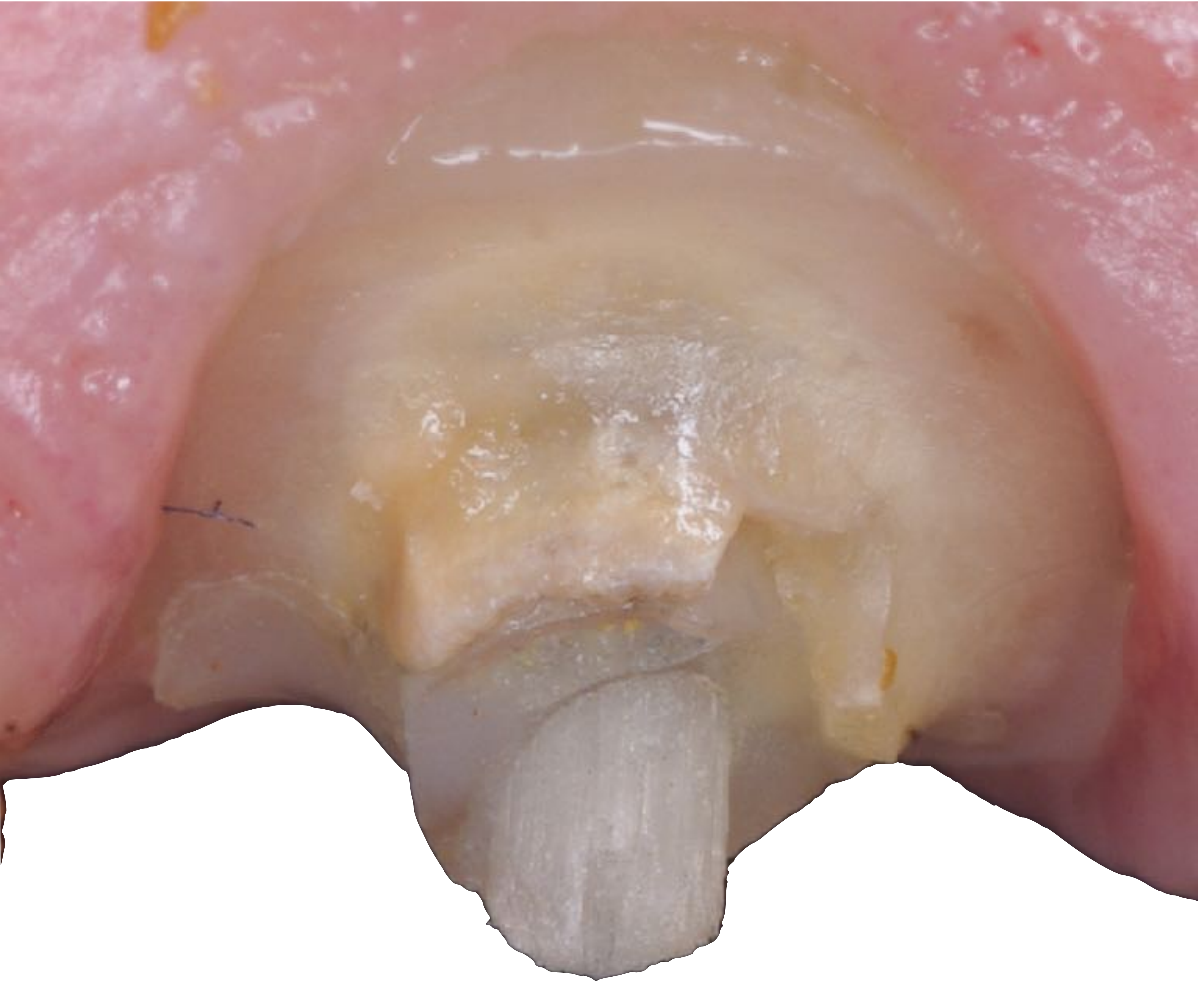
JOE — Volume 37, Number 4, April 2011 Adhesion of Fiber Posts to Weakened/Resin-restored Root Dentin 531

Manicardi CA et al. Influence of Filling Materials on the Bonding Interface of Thin-walled Roots Reinforced with Resin and Quartz Fiber Posts. JOE 2011. Vol 37 (4) 531-37

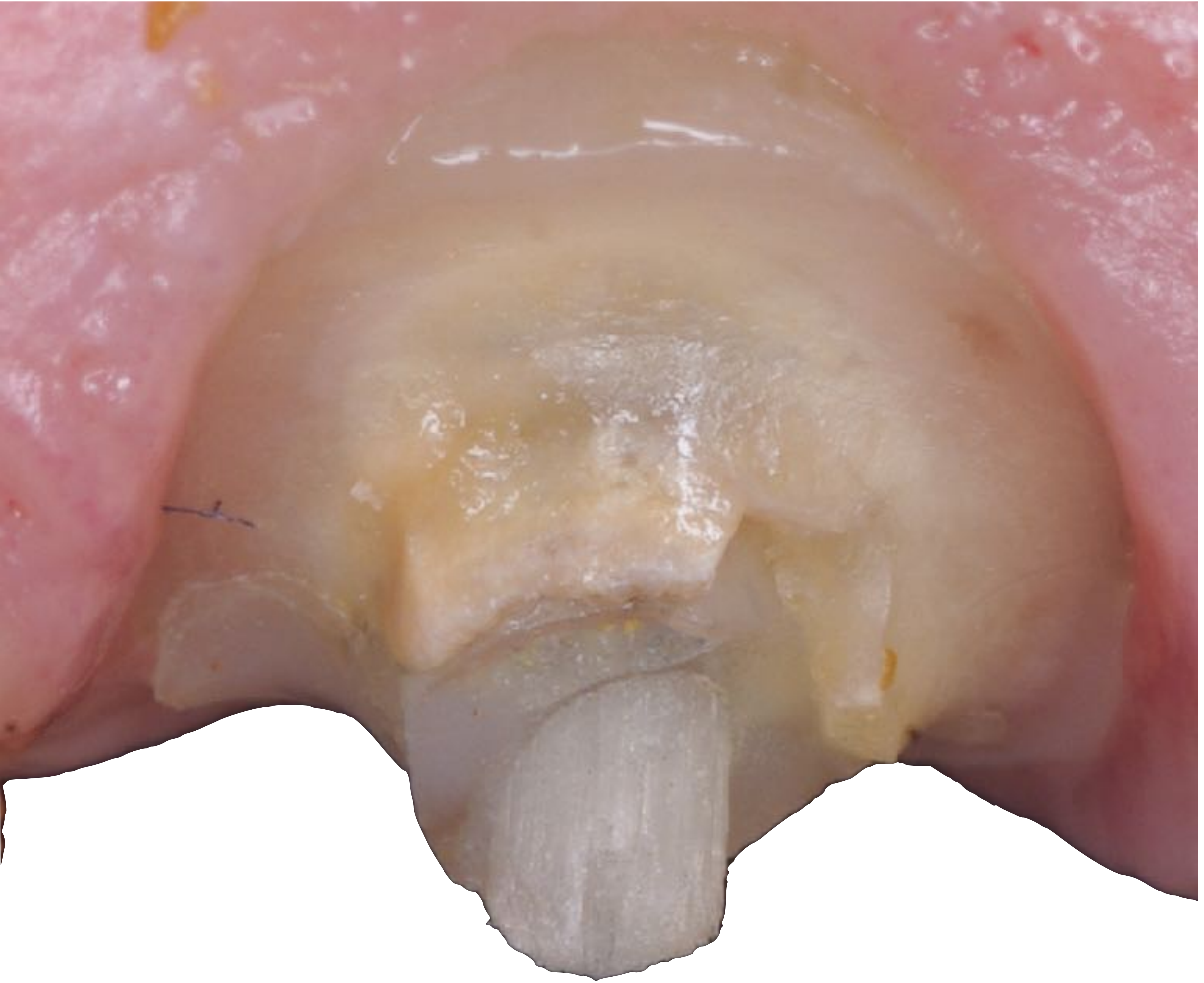
... the dislocation resistance of bonded fiber posts may be largely derived from sliding friction. As a result, **the retentive strength of a bonded post to root canal dentin may depend largely on frictional sliding resistance to dislodgement rather than on the relatively low micromechanical and chemical adhesion** achieved by resin-based dentin bonding agents.

Conclusions:

...nonweakened roots showed the highest retentive strength in all thirds, the most frequent type of failure was adhesive between dentin and cement...

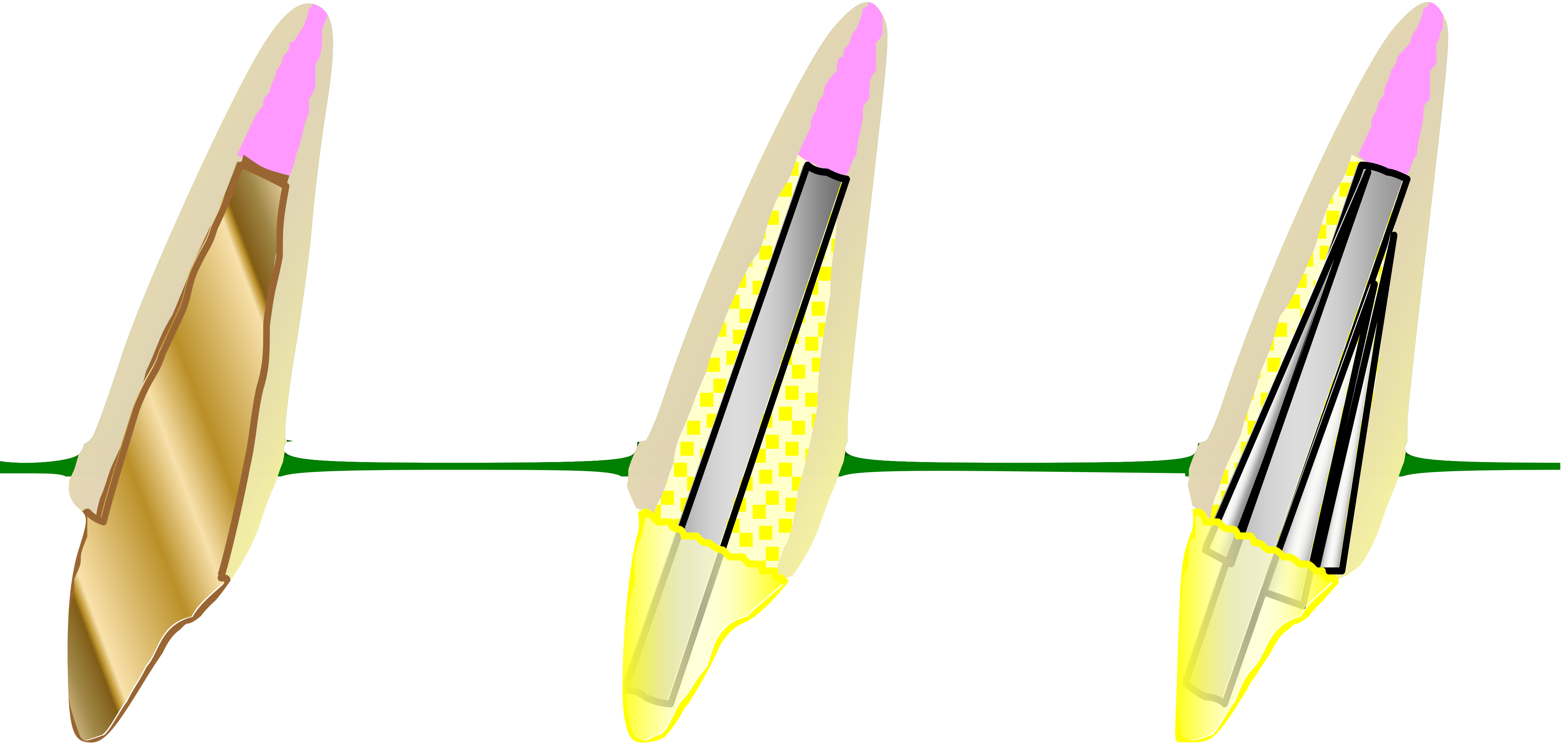


FRACTURAS



Ante exigencias mecánicas que superen la resistencia del complejo raíz-anclaje intraradicular, podrían colapsar:

1. La raíz
2. El perno
3. La raíz y el perno



Una fractura es catastrófica o irrecuperable cuando se produce apicalmente al tercio cervical de la raíz dentaria

En cambio, una fractura se considera **favorable** o recuperable cuando sólo se fractura el perno, cuando se genera sobre la porción coronaria del diente con mínima invasión del espacio biológico o bien cuando se produce sobre la ráiz sin superar su tercio cervical

Adaptado de Heydecke (2001)

A ring or cap, typically a metal one, that strengthens the end of a handle, stick, or tube and prevents it from splitting or wearing.

Efecto “ferrule” (zuncho) : dentina coronal con 2 mm de altura y 1 mm de espesor

SEGURIDAD

In vitro fracture resistance of endodontically treated central incisors with varying ferrule heights and configurations. Philip LB, Aquilino SA, Gratton DG, Stanford CM, Chian S, Johnson WT. Journal of Prosthetic Dentistry. Vol 93 (4). April 2005. 331-336

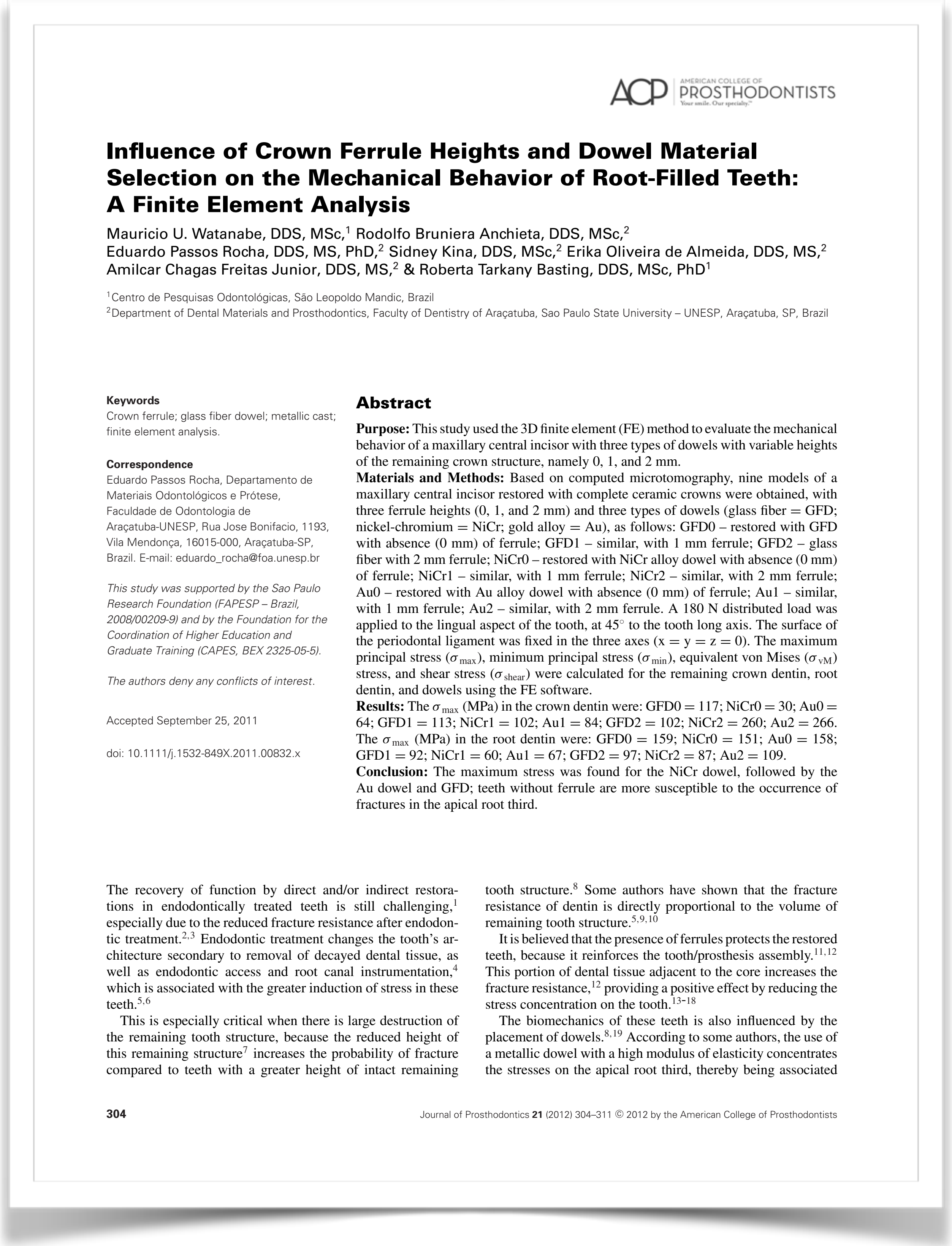
NO efecto “ferrule”: dentina coronal con menos de 2 mm de altura o 1 mm de espesor

RIESGO: mayor demanda mecánica para el perno y la raíz

In vitro fracture resistance of endodontically treated central incisors with varying ferrule heights and configurations. Philip LB, Aquilino SA, Gratton DG, Stanford CM, Chian S, Johnson WT. Journal of Prosthetic Dentistry. Vol 93 (4). April 2005. 331-336

Ante escaso remanente coronario y falta de "efecto ferrule", muchos clínicos indican pernos resistentes pero a la vez muy rígidos (por ej.; Ni-Cr) y contraindican el empleo de pernos más flexibles por su menor resistencia...

SH... T!



AMERICAN COLLEGE OF PROSTHODONTISTS

Influence of Crown Ferrule Heights and Dowel Material Selection on the Mechanical Behavior of Root-Filled Teeth: A Finite Element Analysis

Mauricio U. Watanabe, DDS, MSc,[1] Rodolfo Bruniera Anchieta, DDS, MSc,[2] Eduardo Passos Rocha, DDS, MS, PhD,[2] Sidney Kina, DDS, MSc,[2] Erika Oliveira de Almeida, DDS, MS,[2] Amilcar Chagas Freitas Junior, DDS, MS,[2] & Roberta Tarkany Basting, DDS, MSc, PhD[1]

[1]Centro de Pesquisas Odontológicas, São Leopoldo Mandic, Brazil
[2]Department of Dental Materials and Prosthodontics, Faculty of Dentistry of Araçatuba, Sao Paulo State University – UNESP, Araçatuba, SP, Brazil

Keywords
Crown ferrule; glass fiber dowel; metallic cast; finite element analysis.

Correspondence
Eduardo Passos Rocha, Departamento de Materiais Odontológicos e Prótese, Faculdade de Odontologia de Araçatuba-UNESP, Rua Jose Bonifacio, 1193, Vila Mendonça, 16015-000, Araçatuba-SP, Brazil. E-mail: eduardo_rocha@foa.unesp.br

This study was supported by the Sao Paulo Research Foundation (FAPESP – Brazil, 2008/00209-9) and by the Foundation for the Coordination of Higher Education and Graduate Training (CAPES, BEX 2325-05-5).

The authors deny any conflicts of interest.

Accepted September 25, 2011

doi: 10.1111/j.1532-849X.2011.00832.x

Abstract

Purpose: This study used the 3D finite element (FE) method to evaluate the mechanical behavior of a maxillary central incisor with three types of dowels with variable heights of the remaining crown structure, namely 0, 1, and 2 mm.
Materials and Methods: Based on computed microtomography, nine models of a maxillary central incisor restored with complete ceramic crowns were obtained, with three ferrule heights (0, 1, and 2 mm) and three types of dowels (glass fiber = GFD; nickel-chromium = NiCr; gold alloy = Au), as follows: GFD0 – restored with GFD with absence (0 mm) of ferrule; GFD1 – similar, with 1 mm ferrule; GFD2 – glass fiber with 2 mm ferrule; NiCr0 – restored with NiCr alloy dowel with absence (0 mm) of ferrule; NiCr1 – similar, with 1 mm ferrule; NiCr2 – similar, with 2 mm ferrule; Au0 – restored with Au alloy dowel with absence (0 mm) of ferrule; Au1 – similar, with 1 mm ferrule; Au2 – similar, with 2 mm ferrule. A 180 N distributed load was applied to the lingual aspect of the tooth, at 45° to the tooth long axis. The surface of the periodontal ligament was fixed in the three axes ($x = y = z = 0$). The maximum principal stress (σ_{max}), minimum principal stress (σ_{min}), equivalent von Mises (σ_{vM}) stress, and shear stress (σ_{shear}) were calculated for the remaining crown dentin, root dentin, and dowels using the FE software.
Results: The σ_{max} (MPa) in the crown dentin were: GFD0 = 117; NiCr0 = 30; Au0 = 64; GFD1 = 113; NiCr1 = 102; Au1 = 84; GFD2 = 102; NiCr2 = 260; Au2 = 266. The σ_{max} (MPa) in the root dentin were: GFD0 = 159; NiCr0 = 151; Au0 = 158; GFD1 = 92; NiCr1 = 60; Au1 = 67; GFD2 = 97; NiCr2 = 87; Au2 = 109.
Conclusion: The maximum stress was found for the NiCr dowel, followed by the Au dowel and GFD; teeth without ferrule are more susceptible to the occurrence of fractures in the apical root third.

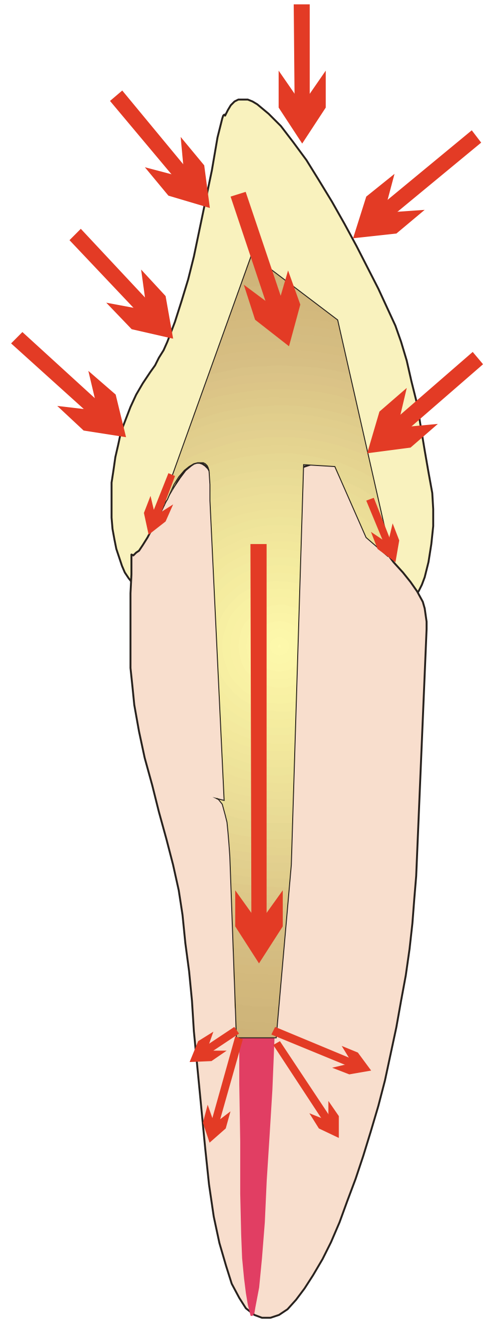
The recovery of function by direct and/or indirect restorations in endodontically treated teeth is still challenging,[1] especially due to the reduced fracture resistance after endodontic treatment.[2,3] Endodontic treatment changes the tooth's architecture secondary to removal of decayed dental tissue, as well as endodontic access and root canal instrumentation,[4] which is associated with the greater induction of stress in these teeth.[5,6]

This is especially critical when there is large destruction of the remaining tooth structure, because the reduced height of this remaining structure[7] increases the probability of fracture compared to teeth with a greater height of intact remaining tooth structure.[8] Some authors have shown that the fracture resistance of dentin is directly proportional to the volume of remaining tooth structure.[5,9,10]

It is believed that the presence of ferrules protects the restored teeth, because it reinforces the tooth/prosthesis assembly.[11,12] This portion of dental tissue adjacent to the core increases the fracture resistance,[12] providing a positive effect by reducing the stress concentration on the tooth.[13–18]

The biomechanics of these teeth is also influenced by the placement of dowels.[8,19] According to some authors, the use of a metallic dowel with a high modulus of elasticity concentrates the stresses on the apical root third, thereby being associated

En situaciones de pobre "efecto ferrule", el riesgo de fractura radicular es <u>mayor</u> con <u>pernos rígidos</u>...



Watanabe M et al (2011)

International Endodontic Journal
doi:10.1111/j.1365-2591.2010.01807.x

Influence of post system and remaining coronal tooth tissue on biomechanical behaviour of root filled molar teeth

F. R. Santana[1], C. G. Castro[1], P. C. Simamoto-Júnior[2], P. V. Soares[1], P. S. Quagliatto[1], C. Estrela[3] & C. J. Soares[1]
[1]Operative Dentistry and Dental Materials Department, School of Dentistry, Federal University of Uberlândia, Uberlândia, Brazil; [2]Technical Course in Dental Prosthesis, Technical School of Health, Federal University of Uberlândia, Uberlândia, Brazil; and [3]Endodontic Department, School of Dentistry, Federal University of Goiás, Goiás, Brazil

Abstract

Santana FR, Castro CG, Simamoto-Júnior PC, Soares PV, Quagliatto PS, Estrela C, Soares CJ. Influence of post system and remaining coronal tooth tissue on biomechanical behaviour of root filled molar teeth. *International Endodontic Journal*, **44**, 386–394, 2011.

Aim To investigate *ex vivo* the influence of post system and amount of remaining coronal tooth tissue on the fracture resistance, fracture mode and strain of root filled molar teeth.

Methodology Seventy mandibular human molar teeth were divided into seven groups (n = 10), one control (sound teeth) and six experimental groups resulting from the interaction between the two study factors: post system (Pa, post absence; Gfp, glass fibre post; Cmp, cast Ni–Cr alloy post and core) and amount of remaining coronal tooth tissue (Fe, 2 mm of ferrule; NFe, no ferrule). Teeth in the experimental groups were restored with metal crowns. For the strain gauge test, two strain gauges per sample were attached on the buccal and proximal root surfaces, and the samples of each group ($n = 5$) were submitted to a load of 0–100 N. Fracture resistance (N) was assessed in a mechanical testing device ($n = 10$). Strain gauge and fracture resistance data were analysed by two-way ANOVA (3×2) followed by the Tukey's HSD and Duncan's test ($\alpha = 0.05$). The failure mode was evaluated using an optical stereomicroscope and classified according to the location of the failure.

Results The absence of ferrule was associated with lower fracture resistance regardless of the post system. Groups restored with glass fibre post and cast Ni–Cr alloy post and core had similar fracture resistance and higher values than groups without posts, regardless of the remaining coronal tooth tissue. Teeth with no ferrule and cast Ni–Cr alloy post and core resulted in catastrophic fractures and those with no ferrule and glass fibre post or no ferrule and post absence resulted in restorable failures. Buccal strain was higher in sound teeth and lower in teeth without posts. Glass fibre post insertion decreased the buccal strain compared to the teeth with ferrule and absence of post.

Conclusions Two millimetre of ferrule had a significant influence on cusp strain, fracture resistance and failure mode. The glass fibre post was as effective as the cast Ni–Cr alloy post and core in the restoration of root filled molars regardless of the remaining tooth tissue. Absence of a post decreased the fracture resistance and increased the cusp strain.

Keywords: cast post and core, fracture resistance, glass fibre post, root filled molar, strain gauge test.

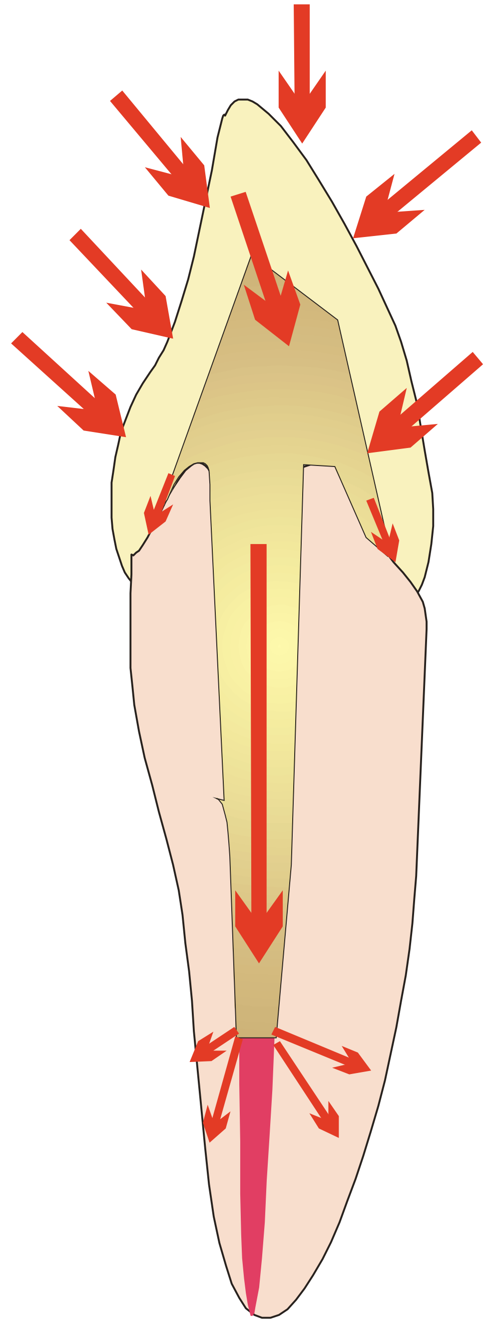
Received 3 April 2010; accepted 11 September 2010

Correspondence: Prof. Dr. Carlos José Soares, Biomechanical Research Group, Federal University of Uberlândia, School of Dentistry, Avenida Pará, 1720, Bloco 2B, Sala 24, Campus Umuarama, Uberlândia, MG, Brazil CEP. 38400-902 (Tel.: +55 34 3218 2255; fax: +55 34 3218 2279; e-mail: carlosjsoares@umuarama.ufu.br).

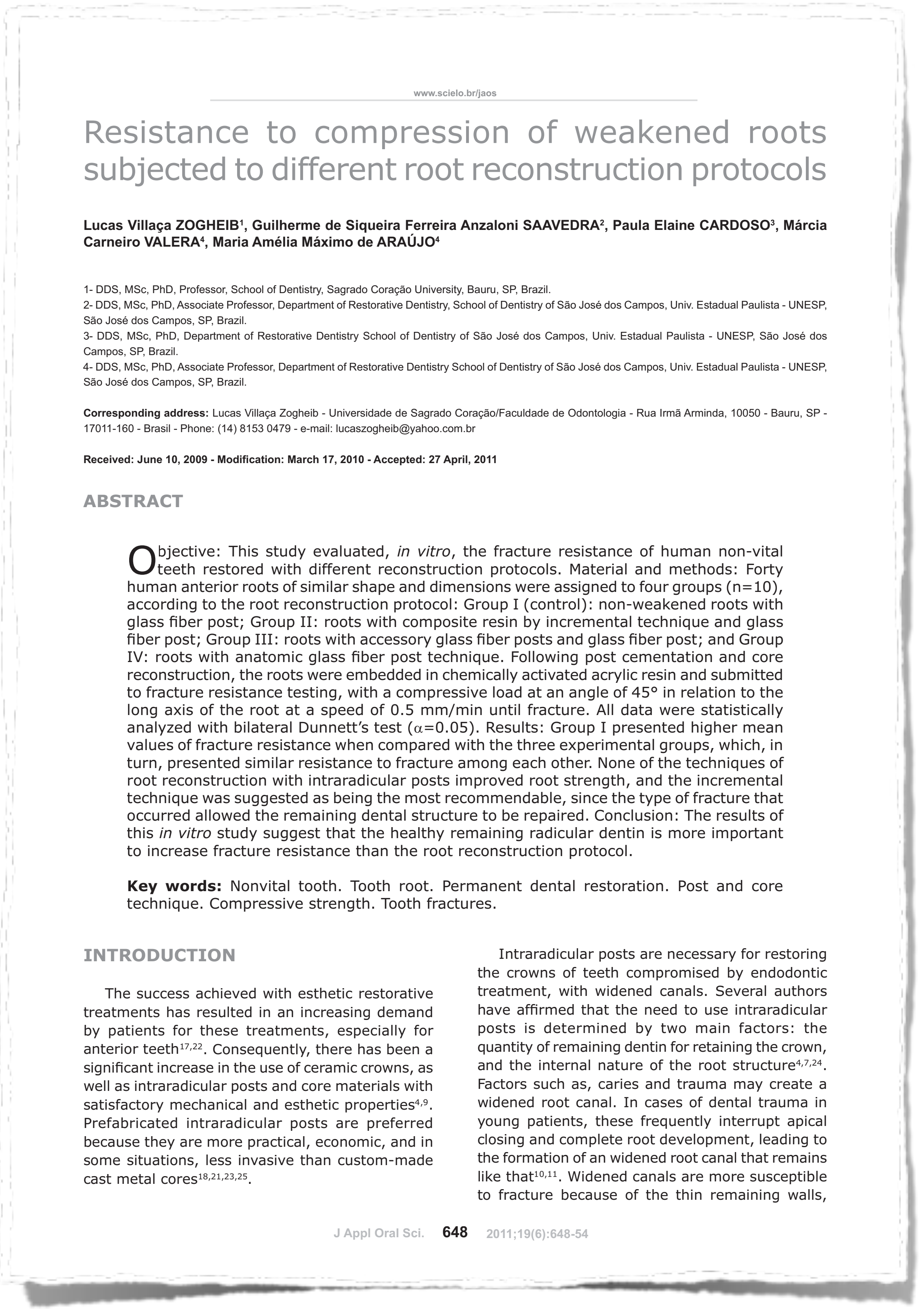
Introduction

Root filled teeth are considered to have a higher prevalence of fracture because of their inherently poor structural integrity as a result of pre-existing caries or tooth preparation (Burke 1992, Assif & Gorfil 1994,

Teeth with <u>no ferrule and cast Ni–Cr alloy post</u> and core resulted in <u>catastrophic fractures</u> and those with <u>no ferrule and glass fibre post</u> resulted in restorable failures



Santana FR et al (2010)



Resistance to compression of weakened roots subjected to different root reconstruction protocols

Lucas Villaça ZOGHEIB[1], Guilherme de Siqueira Ferreira Anzaloni SAAVEDRA[2], Paula Elaine CARDOSO[3], Márcia Carneiro VALERA[4], Maria Amélia Máximo de ARAÚJO[4]

1- DDS, MSc, PhD, Professor, School of Dentistry, Sagrado Coração University, Bauru, SP, Brazil.
2- DDS, MSc, PhD, Associate Professor, Department of Restorative Dentistry, School of Dentistry of São José dos Campos, Univ. Estadual Paulista - UNESP, São José dos Campos, SP, Brazil.
3- DDS, MSc, PhD, Department of Restorative Dentistry School of Dentistry of São José dos Campos, Univ. Estadual Paulista - UNESP, São José dos Campos, SP, Brazil.
4- DDS, MSc, PhD, Associate Professor, Department of Restorative Dentistry School of Dentistry of São José dos Campos, Univ. Estadual Paulista - UNESP, São José dos Campos, SP, Brazil.

Corresponding address: Lucas Villaça Zogheib - Universidade de Sagrado Coração/Faculdade de Odontologia - Rua Irmã Arminda, 10050 - Bauru, SP - 17011-160 - Brasil - Phone: (14) 8153 0479 - e-mail: lucaszogheib@yahoo.com.br

Received: June 10, 2009 - Modification: March 17, 2010 - Accepted: 27 April, 2011

ABSTRACT

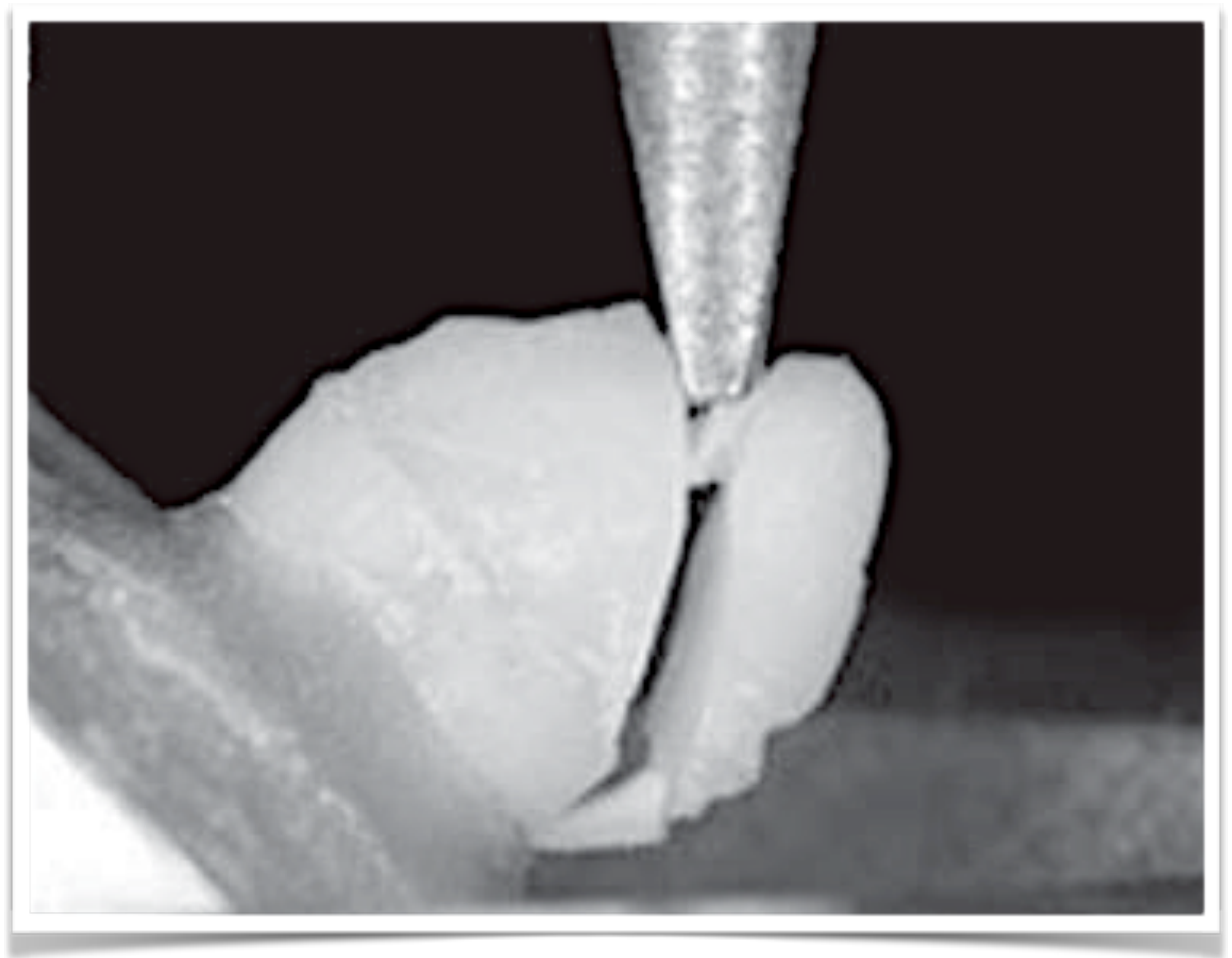
Objective: This study evaluated, *in vitro*, the fracture resistance of human non-vital teeth restored with different reconstruction protocols. Material and methods: Forty human anterior roots of similar shape and dimensions were assigned to four groups (n=10), according to the root reconstruction protocol: Group I (control): non-weakened roots with glass fiber post; Group II: roots with composite resin by incremental technique and glass fiber post; Group III: roots with accessory glass fiber posts and glass fiber post; and Group IV: roots with anatomic glass fiber post technique. Following post cementation and core reconstruction, the roots were embedded in chemically activated acrylic resin and submitted to fracture resistance testing, with a compressive load at an angle of 45° in relation to the long axis of the root at a speed of 0.5 mm/min until fracture. All data were statistically analyzed with bilateral Dunnett's test (α=0.05). Results: Group I presented higher mean values of fracture resistance when compared with the three experimental groups, which, in turn, presented similar resistance to fracture among each other. None of the techniques of root reconstruction with intraradicular posts improved root strength, and the incremental technique was suggested as being the most recommendable, since the type of fracture that occurred allowed the remaining dental structure to be repaired. Conclusion: The results of this *in vitro* study suggest that the healthy remaining radicular dentin is more important to increase fracture resistance than the root reconstruction protocol.

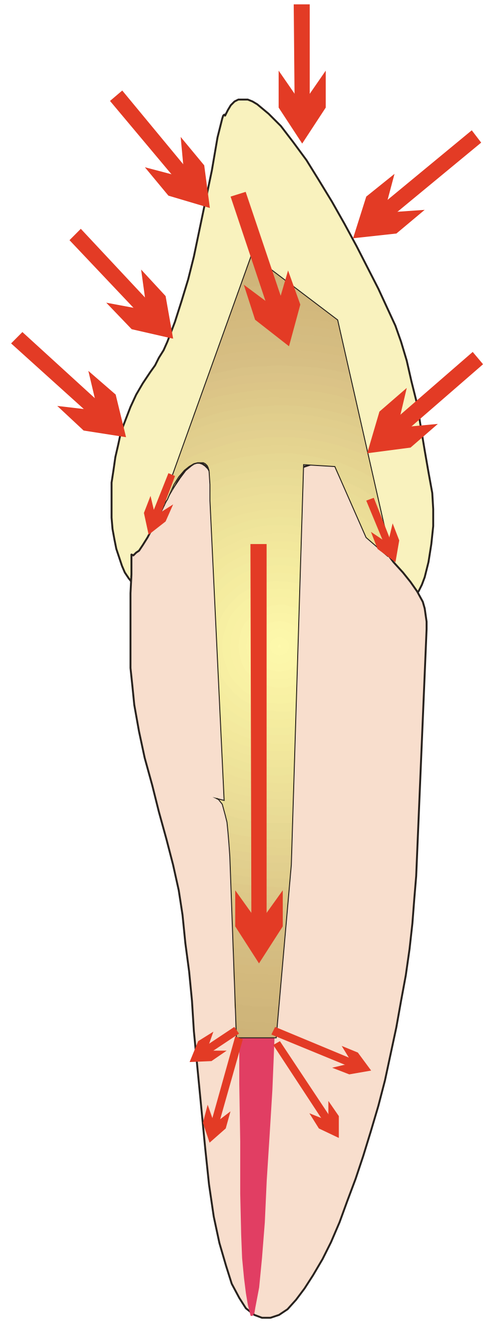
Key words: Nonvital tooth. Tooth root. Permanent dental restoration. Post and core technique. Compressive strength. Tooth fractures.

INTRODUCTION

The success achieved with esthetic restorative treatments has resulted in an increasing demand by patients for these treatments, especially for anterior teeth[17,22]. Consequently, there has been a significant increase in the use of ceramic crowns, as well as intraradicular posts and core materials with satisfactory mechanical and esthetic properties[4,9]. Prefabricated intraradicular posts are preferred because they are more practical, economic, and in some situations, less invasive than custom-made cast metal cores[18,21,23,25].

Intraradicular posts are necessary for restoring the crowns of teeth compromised by endodontic treatment, with widened canals. Several authors have affirmed that the need to use intraradicular posts is determined by two main factors: the quantity of remaining dentin for retaining the crown, and the internal nature of the root structure[4,7,24]. Factors such as, caries and trauma may create a widened root canal. In cases of dental trauma in young patients, these frequently interrupt apical closing and complete root development, leading to the formation of an widened root canal that remains like that[10,11]. Widened canals are more susceptible to fracture because of the thin remaining walls,





Resistance to compression of weakned roots subjected to different root reconstruction protocols. Zogheib L et al (2011). J Appl Oral Sci;19(6):648-54

JOURNAL OF APPLIED ORAL SCIENCE
J Appl Oral Sci. 2009;17(6):574-8
www.fob.usp.br/jaos or www.scielo.br/jaos

FRACTURE STRENGTH OF FLARED BOVINE ROOTS RESTORED WITH DIFFERENT INTRARADICULAR POSTS

Victor Grover Rene CLAVIJO[1], José Maurício dos Santos Nunes REIS[2], William KABBACH[1], André Luis Faria e SILVA[3], Osmir Batista de OLIVEIRA JUNIOR[4], Marcelo Ferrarezi de ANDRADE[4]

1- DDS, MSc PhD student, Department of Restorative Dentistry, Araraquara Dental School, São Paulo State University, Araraquara, SP, Brazil.
2- DDS, MSc, PhD, Substitute Professor, Department of Dental Materials and Prosthodontics, Araraquara Dental School, São Paulo State University, Araraquara, SP, Brazil.
3- DDS, MSc, PhD student, Department of Restorative Dentistry, Piracicaba Dental School, State University of Campinas, Piracicaba, SP, Brazil.
4- DDS, MSc, PhD, Associate Professor, Department of Restorative Dentistry, Araraquara Dental School, São Paulo State University, Araraquara, SP, Brazil.

Corresponding address: Prof. José Maurício dos Santos Nunes Reis - Faculdade de Odontologia de Araraquara - UNESP - Departamento de Materiais Odontológicos e Prótese -Rua Humaitá, nº. 1680 - 14801-903 - Araraquara, SP - Brasil - Phone: +55 016 3301-6408 - Fax: +55 016 3301-6406 - e-mail: reisunesp@hotmail.com / josemsnreis@foar.unesp.br

Received: August 19, 2008 - Modification: May 18, 2009 - Accepted: July 21, 2009

ABSTRACT

Objective: The aim of this study was to evaluate the fracture strength and failure mode of flared bovine roots restored with different intraradicular posts. Material and Methods: Fifty bovine incisors with similar dimensions were selected and their roots were flared until 1.0 mm of dentin wall remained. Next, the roots were allocated into five groups (n=10): GI- cast metal post-and-core; GII- fiber posts plus accessory fiber posts; GIII- direct anatomic post; GIV- indirect anatomic post and GV- control (specimens without intraradicular post). A polyether impression material was used to simulate the periodontal ligament. After periodontal ligament simulation, the specimens were subjected to a compressive load at a crosshead speed of 0.5 mm/min in a servo-hydraulic testing machine (MTS 810) applied at 135º to the long axis of the tooth until failure. The data (N) were subjected to ANOVA and Tukey's post-hoc test ($\alpha=0.05$). Results: GI and GIV presented higher fracture strength ($p<0.05$) than GII. GIII presented intermediate values without statistically significant differences ($p>0.05$) from GI, GII and GIV. Control specimens (GV) produced the lowest fracture strength mean values ($p<0.05$). Despite obtaining the highest mean value, GI presented 100% of unfavorable failures. GII presented 20% of unfavorable failures. GIII, GIV and GV presented only favorable failures. Conclusions: Although further *in vitro* and *in vivo* studies are necessary, the results of this study showed that the use of direct and indirect anatomic posts in flared roots could be an alternative to cast metal post-and-core.

Key words: Post and core technique. Compressive strength. Prosthodontics.

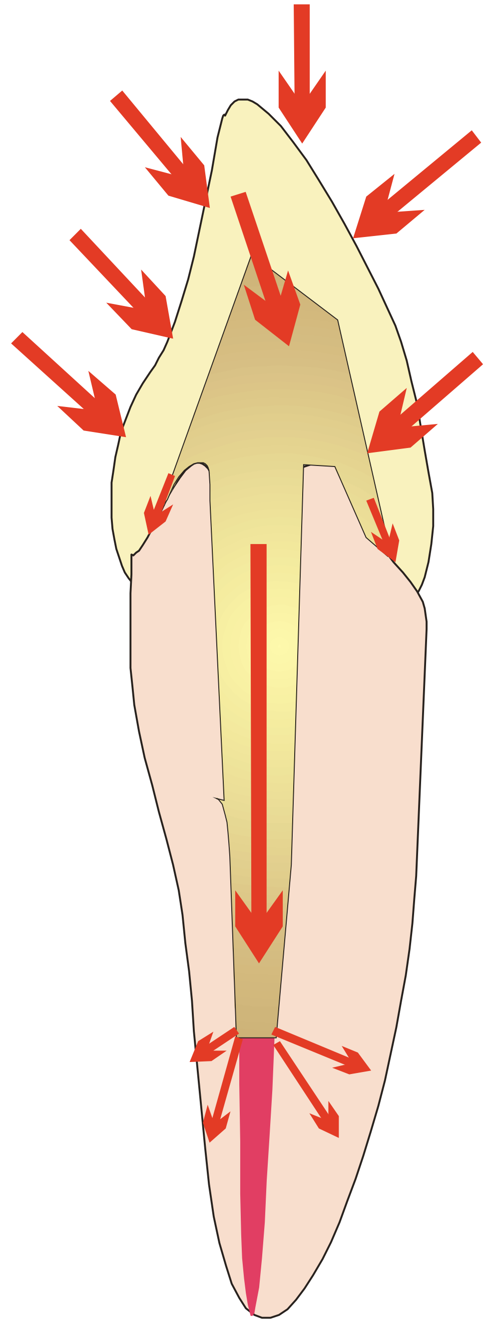
INTRODUCTION

Intraradicular posts are commonly used to restore endodontically treated teeth when their remaining coronal tissue can no longer provide adequate support and retention for the restoration material. However, flared canal restoration continues to be a challenge to clinicians. The flared canal may result from carious extension, trauma, pulpal pathosis and iatrogenic misadventure[20].

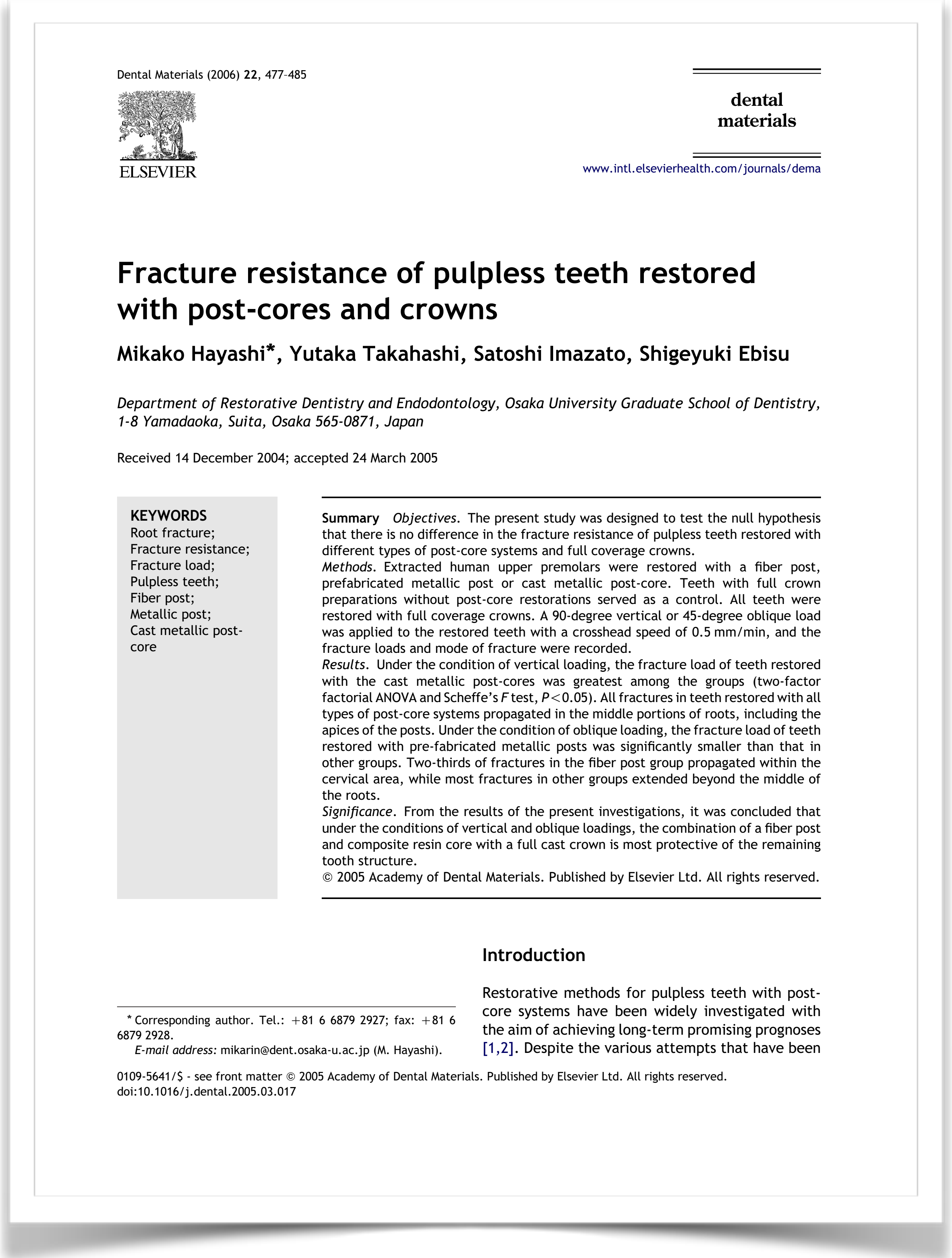
Endodontically treated teeth have been restored using cast metal post-and-core for decades. Instead the high retention and thin cement layer, these conventional posts present high elastic modulus and can lead to root fracture[13,16,19,24,26]. Another option is to use fiber posts[1,16,26]. The similarity in elastic modulus of the fiber post, resin cement and dentin was perceived to be advantageous for improving the performance of restorations[1,15,19,22,23,29]. However, the use of fiber posts in flared root canals is compromised. In this case, if the post does not fit well, especially at the coronal level, the resin cement layer would be excessively thick, and bubbles are likely to form within it, predisposing to debonding[14].

One solution to overcome this problem is the use of dentin-bonded composite resin. This technique increases the internal thickness of dentin on root walls and reduces the resin cement thickness[5,15]. However, light-activation of composite resin in more apical regions of the root canal is difficult and may compromise this technique. Another solution is to reline the fiber post with composite resin. This individual post system increases the adaptation of the post to root walls and reduces the resin cement thickness[5,15]. However, this technique presents another interface (fiber post-composite resin) that may lead to failure. Thus, fabricating an individual fiber post-resin composite may

1. **The use of intraradicular posts increased the fracture strength of the flared roots**
2. Direct and indirect anatomic posts could be an alternative to cast metal post-and-core during the treatment of flared roots
3. The fracture strength of teeth restored with cast metal post and core and anatomic fiber posts, fabricated by both direct and indirect techniques, presented similar values
4. **As opposed to the cast metal post-and-core, all fractures presented by the anatomic fiber posts were favorable**



Clavijo V et al (2009)



Dental Materials (2006) **22**, 477–485

dental materials

www.intl.elsevierhealth.com/journals/dema

Fracture resistance of pulpless teeth restored with post-cores and crowns

Mikako Hayashi*, Yutaka Takahashi, Satoshi Imazato, Shigeyuki Ebisu

Department of Restorative Dentistry and Endodontology, Osaka University Graduate School of Dentistry, 1-8 Yamadaoka, Suita, Osaka 565-0871, Japan

Received 14 December 2004; accepted 24 March 2005

KEYWORDS
Root fracture;
Fracture resistance;
Fracture load;
Pulpless teeth;
Fiber post;
Metallic post;
Cast metallic post-core

Summary *Objectives.* The present study was designed to test the null hypothesis that there is no difference in the fracture resistance of pulpless teeth restored with different types of post-core systems and full coverage crowns.
Methods. Extracted human upper premolars were restored with a fiber post, prefabricated metallic post or cast metallic post-core. Teeth with full crown preparations without post-core restorations served as a control. All teeth were restored with full coverage crowns. A 90-degree vertical or 45-degree oblique load was applied to the restored teeth with a crosshead speed of 0.5 mm/min, and the fracture loads and mode of fracture were recorded.
Results. Under the condition of vertical loading, the fracture load of teeth restored with the cast metallic post-cores was greatest among the groups (two-factor factorial ANOVA and Scheffe's F test, $P<0.05$). All fractures in teeth restored with all types of post-core systems propagated in the middle portions of roots, including the apices of the posts. Under the condition of oblique loading, the fracture load of teeth restored with pre-fabricated metallic posts was significantly smaller than that in other groups. Two-thirds of fractures in the fiber post group propagated within the cervical area, while most fractures in other groups extended beyond the middle of the roots.
Significance. From the results of the present investigations, it was concluded that under the conditions of vertical and oblique loadings, the combination of a fiber post and composite resin core with a full cast crown is most protective of the remaining tooth structure.

Introduction

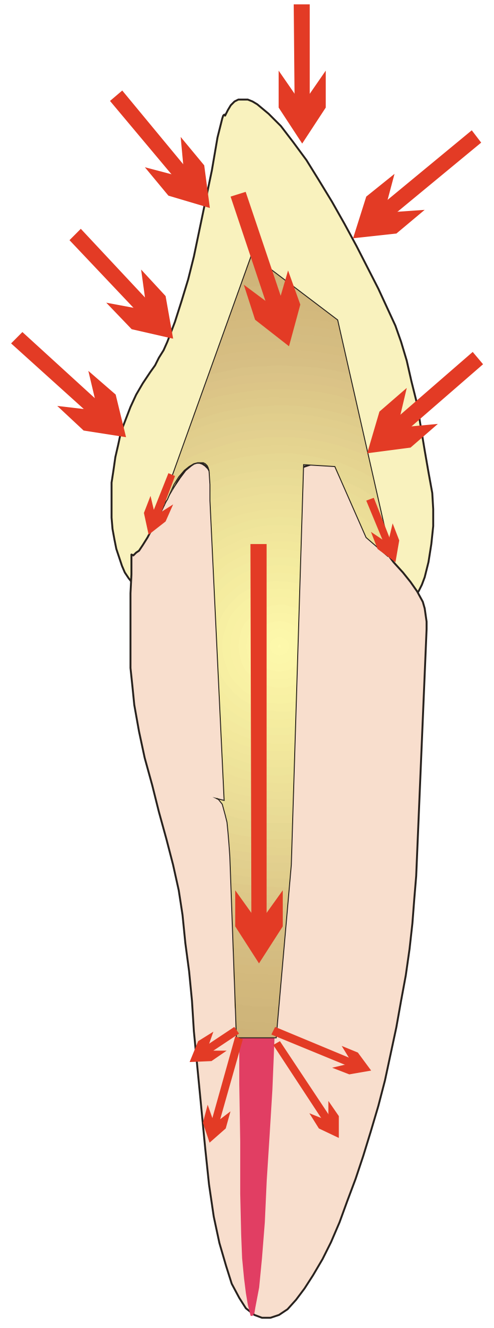
Restorative methods for pulpless teeth with post-core systems have been widely investigated with the aim of achieving long-term promising prognoses [1,2]. Despite the various attempts that have been

* Corresponding author. Tel.: +81 6 6879 2927; fax: +81 6 6879 2928.
E-mail address: mikarin@dent.osaka-u.ac.jp (M. Hayashi).

0109-5641/$ - see front matter
doi:10.1016/j.dental.2005.03.017

Most of the fractured teeth restored with c**ast metallic post-cores were not reparable**.

In contrast, the majority of fractures in the **fiber post group were limited to the cervical portion of the root including the core-dentin interface**, since the stress was concentrated in the cervical area and the outer root surface. This type of fracture is **easier to repair**.



Hayashi M et al (2005)

En casos de **gran pérdida vertical de tejidos y socavamiento del lecho**, el rendimiento de cualquier rehabilitación con perno es crítico. Pero los patrones de fracaso son más favorables cuando se emplean pernos de fibra: fracturas del perno, o bien de la raíz afectando al tercio cervical

La incidencia de fracturas radiculares es menor al trabajar con pernos de fibra

Los patrones de fractura suelen ser más favorables con pernos de fibra que con pernos rígidos (como los metálicos colados) ya que los pernos de fibra generan una distribución de cargas uniforme a lo largo de la raíz

A Randomized Controlled Trial of Endodontically Treated and Restored Premolars. Ferrari M, Vichi A, Fadda GM, Cagidiaco MC, Tay FR, Breschi L, Polimeni A, Goracci C (2012). J Dent Res. Vol 91. Supl 1: 72-78


El perno debe ofrecer un comportamiento elástico similar a
la dentina, pero al mismo tiempo ser RESISTENTE

2

A - **Resistencia a la fractura (resistencia flexural):** static strength; one single load is applied over the post until fracture

B - **Resistencia a la fatiga**: dynamic strength; cyclic loads lead to a slow crack initiation and propagation till fracture

Variables que condicionan la resistencia la fractura por flexión y a la fatiga


DENTAL MATERIALS 23 (2007) 265–271
available at www.sciencedirect.com
journal homepage: www.intl.elsevierhealth.com/journals/dema

Resistance to fracture and structural characteristics of different fiber reinforced post systems

Frank Seefeld, Hans-Jürgen Wenz, Klaus Ludwig, Matthias Kern*

Department of Prosthodontics, Propaedeutics and Dental Materials, University Hospital Schleswig-Holstein, Campus Kiel, Germany

ARTICLE INFO

Article history:
Received 30 September 2005
Accepted 18 January 2006

Keywords:
FRC-post
Fiber/matrix Ratio
Structural characteristics
Interface
SEM-evaluation

ABSTRACT

Objectives. The aim of this study was to investigate the ultrastructure and resistance to fracture of eight different types of fiber post, and to verify the existence of a correlation between structural characteristics and flexural strength.
Methods. Eight types of fiber post were selected for this study. Fiber Kor (Jeneric-Pentron), Para Post Fiber White (Colténe), Luscent Anchor (Dentatus), Twin-Luscent Anchor (Dentatus), Style Post (Metalor), DT White-Post (VDW), DT Light-Post (VDW) and ER Dentin Post (Brasseler). Ten posts of each experimental group were selected for a three-point bending test, and one was processed for SEM evaluation. A universal testing machine loading at an angle of 90° was employed for the three-point bending test. The test was carried out until fracturing of the post. After fracture testing, the posts with the highest and the lowest values of flexural strength of each system were additionally processed for SEM analysis. SEM evaluation was performed using a PC-measurement program to assess the fiber/matrix ratio and fiber dimensions.
Results. The fracture load of the tested systems ranged from 60 to 96 N and the flexural strength from 565 to 898 MPa. DT White-Post and DT Light-Post (898 and 842 MPa, respectively) had significantly higher flexural strengths than the other posts. Style Post (565 MPa) showed a significantly lower flexural strength than all other posts. The differences in fiber diameter ranged from 8.2 to 21 μm and for the fiber/matrix ratio from 41 to 76%. Of the various structural characteristics investigated, only the fiber/matrix ratio showed a significant correlation to the flexural strength ($r = 0.922$, $p = 0.003$).
Significance. The FRC-posts investigated displayed significant differences with regard to fracture load and flexural strength. A strong and significant linear correlation between the fiber/matrix ratio and the flexural strength was found.

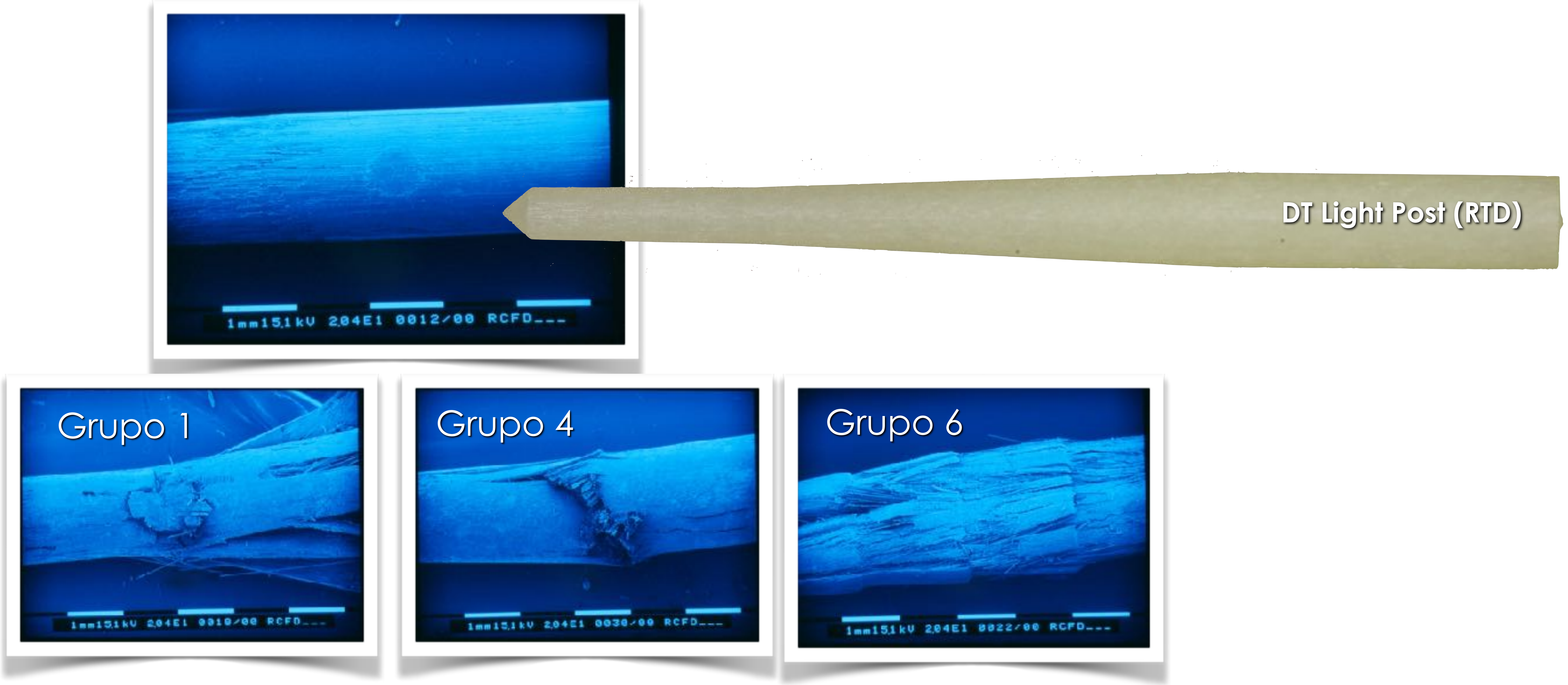
1. Introduction

For 15 years endodontic posts made out of fiber reinforced composites (FRC) have been described in the literature [1,2]. Glass-, silica- and carbon fiber reinforced materials especially, have been marketed and provided the dental profession with the first true alternative to cast or pre-fabricated metal posts [3–6]. FRC-posts contain a high percentage of continuous reinforcing fibers embedded in a polymer matrix. Matrix polymers are commonly epoxy resins or other polymers with a high degree of conversion and a highly cross-linked structure [7–9]. The elastic moduli of fiber posts are closer to dentin than that of any metal post [10]. The first clinical trials reported promising results [3,4,11,12]. Laboratory studies examined different

* *Corresponding author at*: Arnold-Heller-Strasse 16, 24105 Kiel, Germany. Tel.: +49 431 5972874; fax: +49 431 5972860.
E-mail address: hjwenz@proth.uni-kiel.de (H.-J. Wenz).
0109-5641/$ – see front matter © 2006 Academy of Dental Materials. Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.dental.2006.01.018

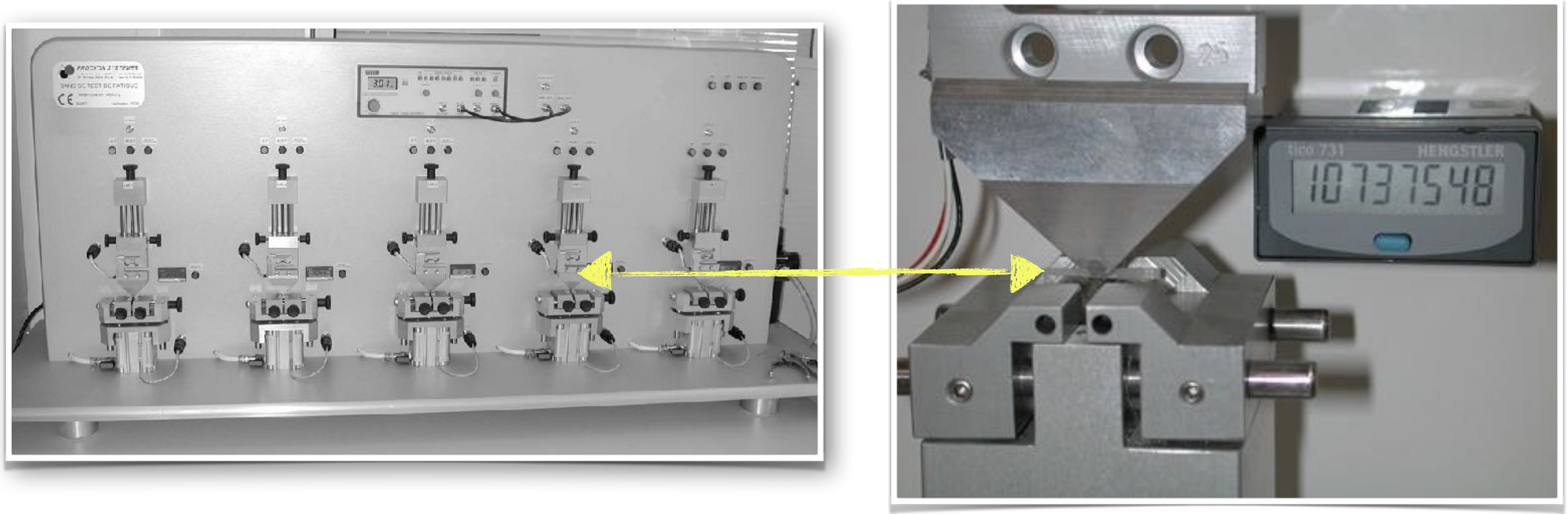
- **Diámetro del poste**
- **Proporción fibra/matriz**: relación en porcentaje entre el área de fibras y de matriz por mm^2 (del 35 al 65%)
- **Presencia de defectos estructurales** en la matriz y/o en la fibra (burburjas, cracks o poros)
- **Densidad** de fibras (número de fibras por mm^2)
- **Distribución** de las fibras (uniforme / no uniforme)
- **Mala calidad de la adhesión de la fibra a la resina**: agente de enlace
- Incorporación de materiales radiopacos en la matriz o en la fibra
- Calidad de la superficie externa
- Diámetro de las fibras (de 8 a 20 micrones)
- Orientación de las fibras
- Proceso de fabricación
- Tipo de fibra (vidrio, carbono, cuarzo, zirconio)
- Tipo de matriz (Bis-GMA, UDMA / resinas epóxicas)

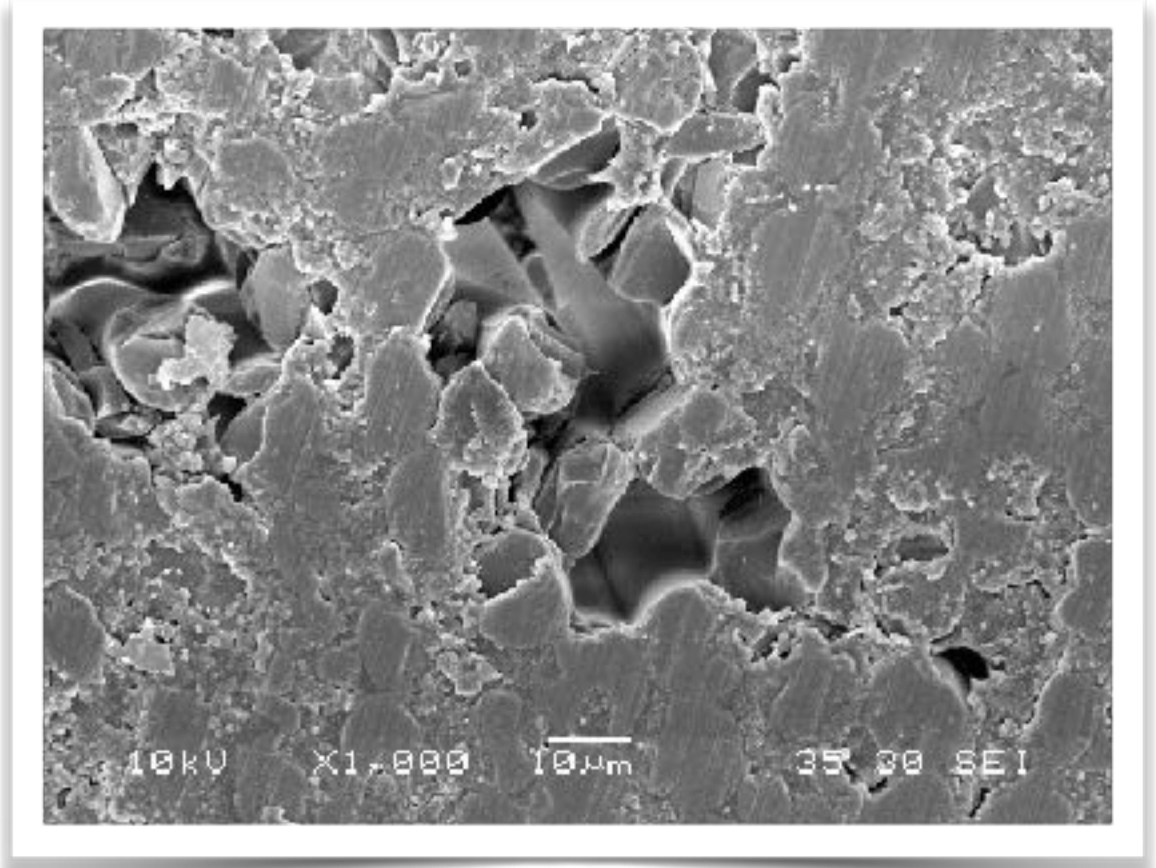
Seefeld F, Wenz J, Ludwig K, Kern M. Resistance to fracture and structural characteristics of different fiber reinforced post systems. Dent Mater 2007 Mar; 23(3):265-71

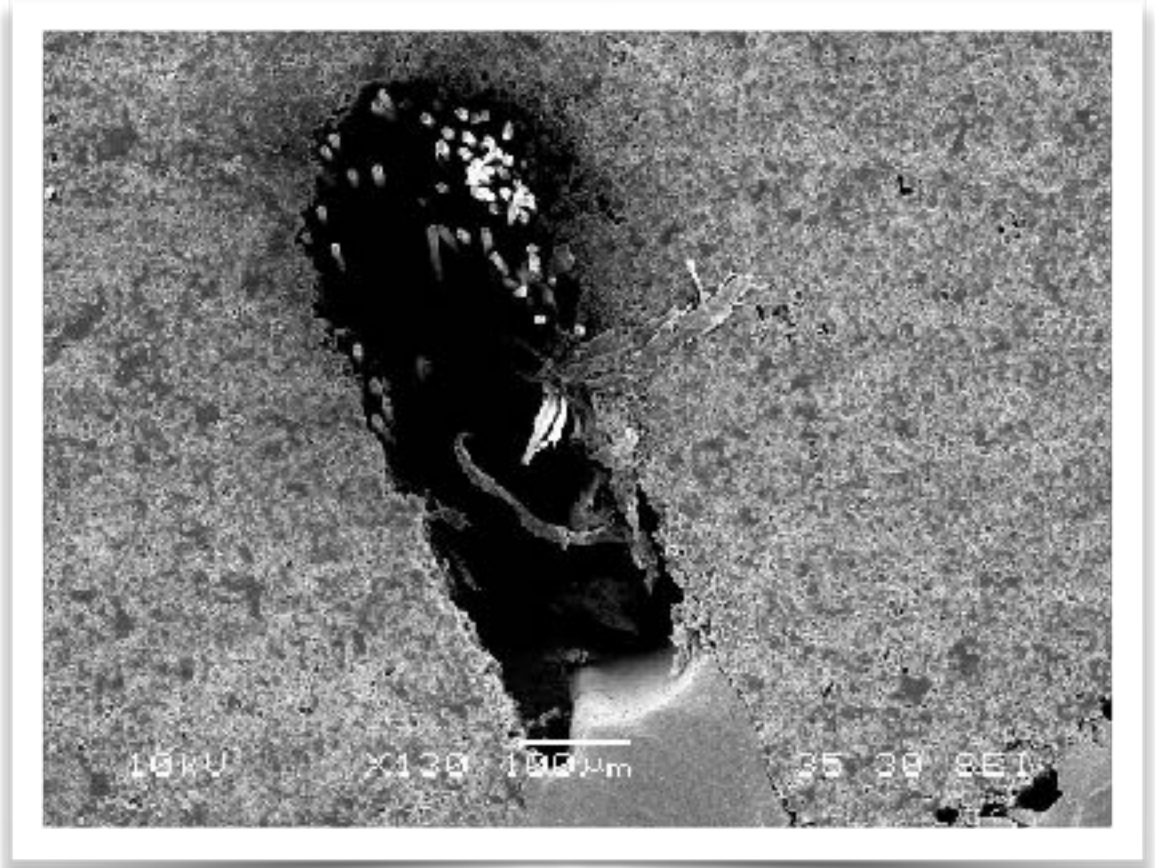


Grandini S, Goracci C, Monticelli F, Borracchini AF, Ferrari M. An evaluation using a "three-point bending" test of the fatigue resistance of certain fiber posts. Il Dentista Moderno, March 2004:70-75

La **resistencia la fractura por flexión** y a **la fatiga puede ser muy distinta entre los pernos de fibra**

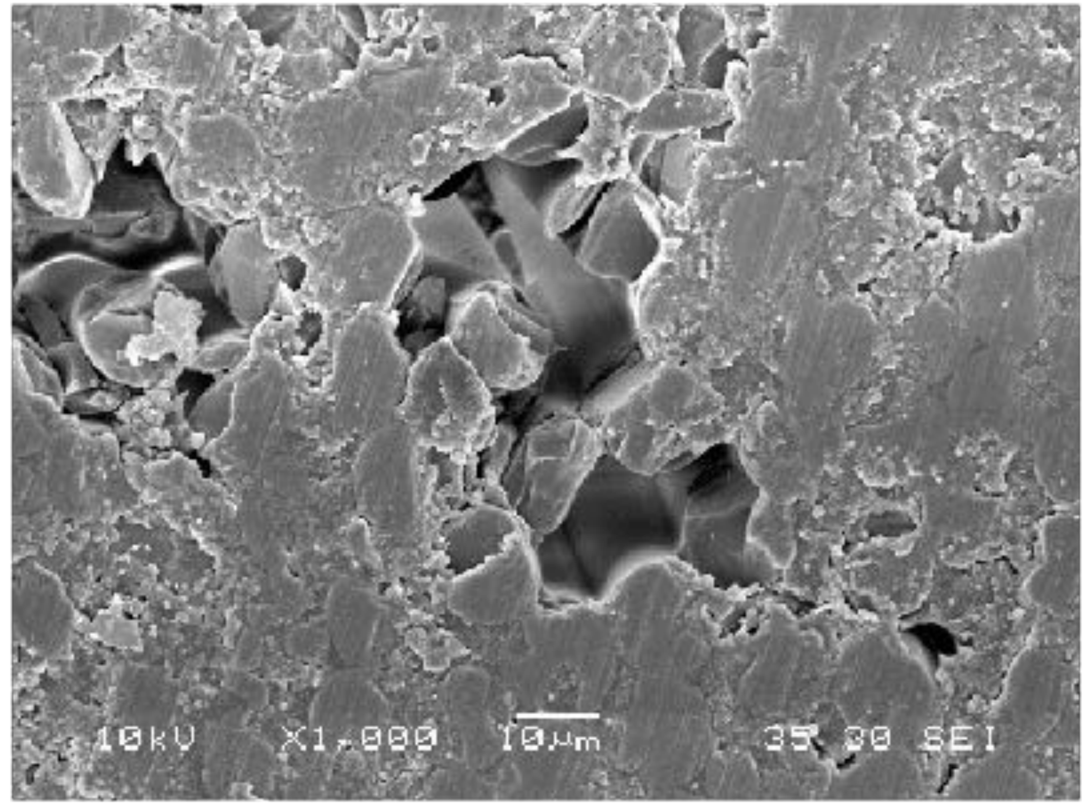


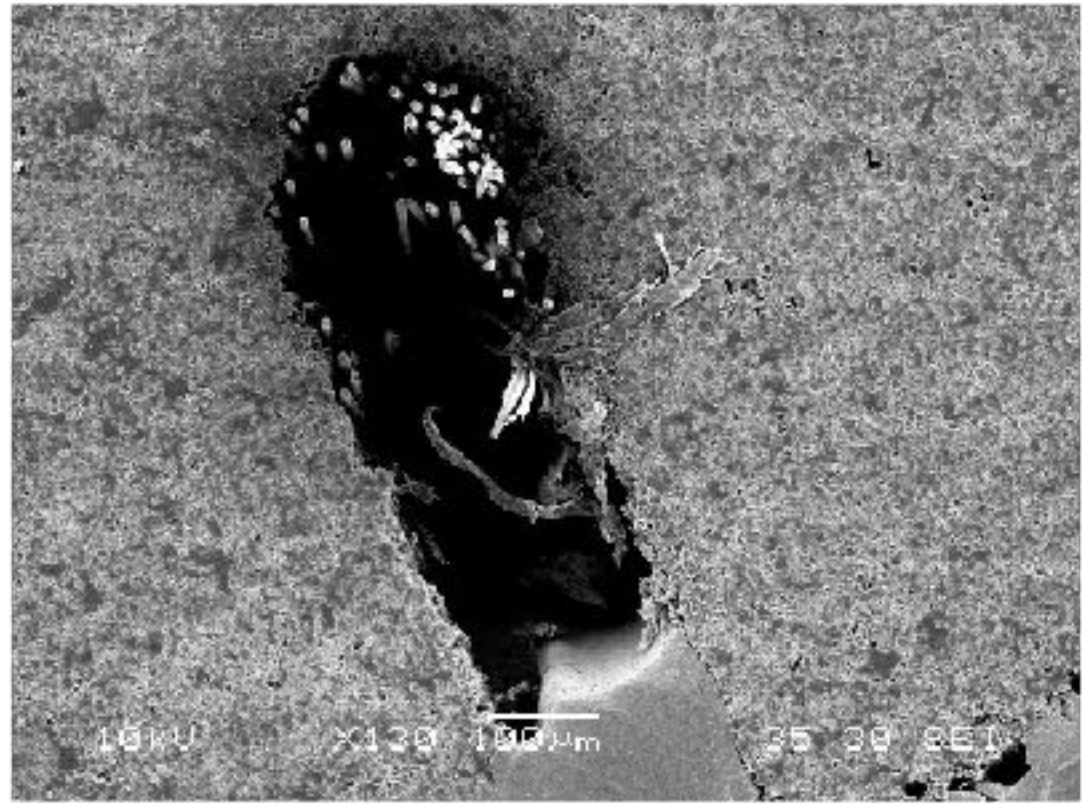




"It is noteworthy that the fiber posts with the lowest flexural strengths were found to fail the fatigue test, confirming that **internal defects**, as much as intrinsic fiber and matrix properties, contribute to the performances of the posts".

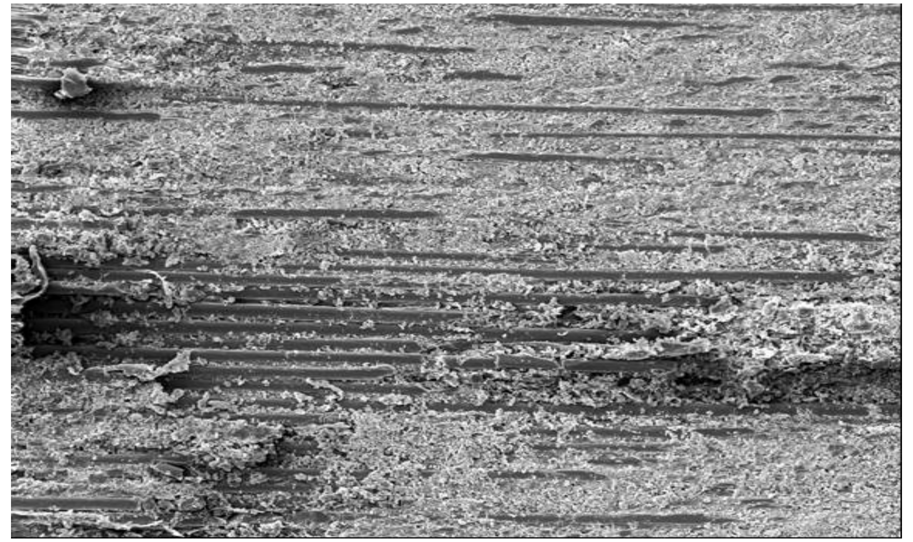
Cheleux N, Sharrock PJ. Mechanical properties of glass fiber-reinforced endodontic posts. Acta Biomater. 2009 Oct;5(8):3224-30





"Failure due to fatigue stress is a phenomenon of paramount importance from a clinical standpoint as failure commences from a small structural defect such as a void or microcrack within the material.
From this area of weakness a crack front can gradually propagate through the material, finally resulting in catastrophic failure".

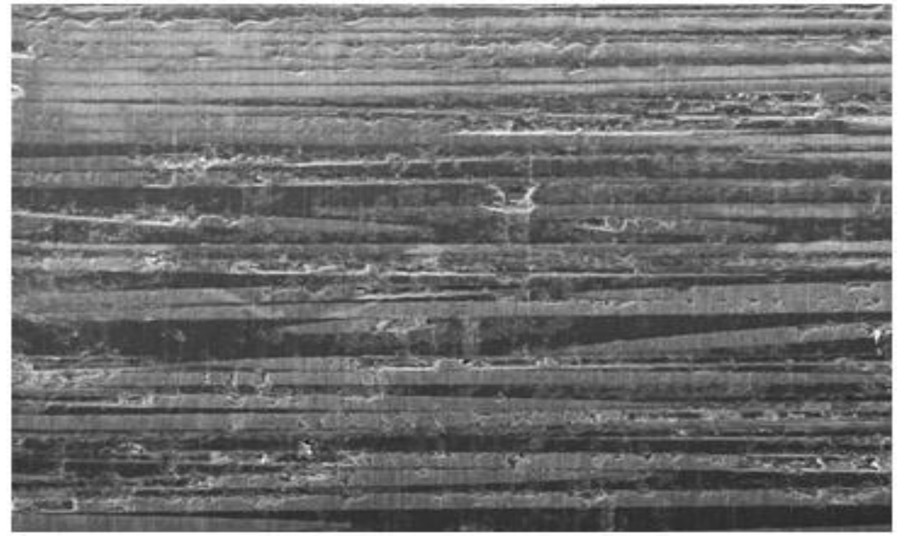
Fatigue resistance and structural characteristics of fiber posts: three-point bending test and SEM evaluation. Grandini S, Tay F, Ferrari M. Journal of Dental Materials 2004



POSTE 1

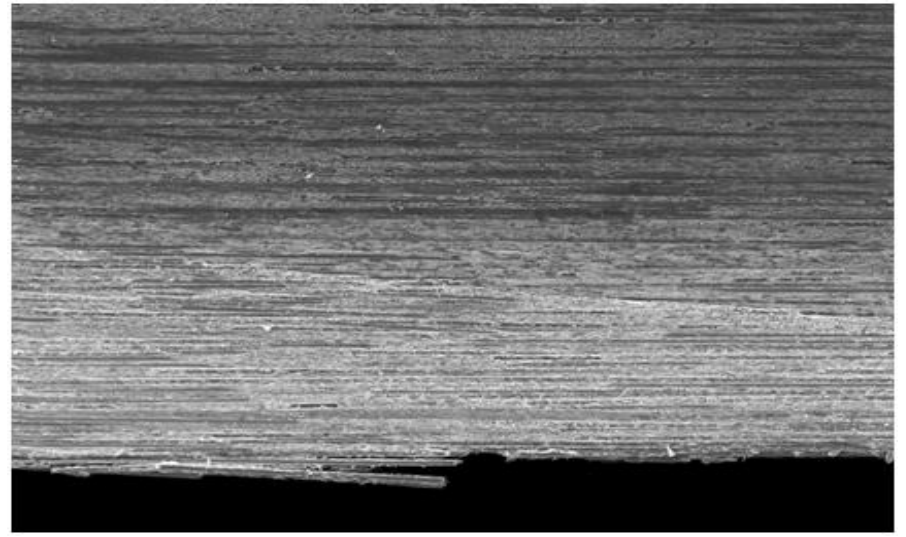
POSTE 2

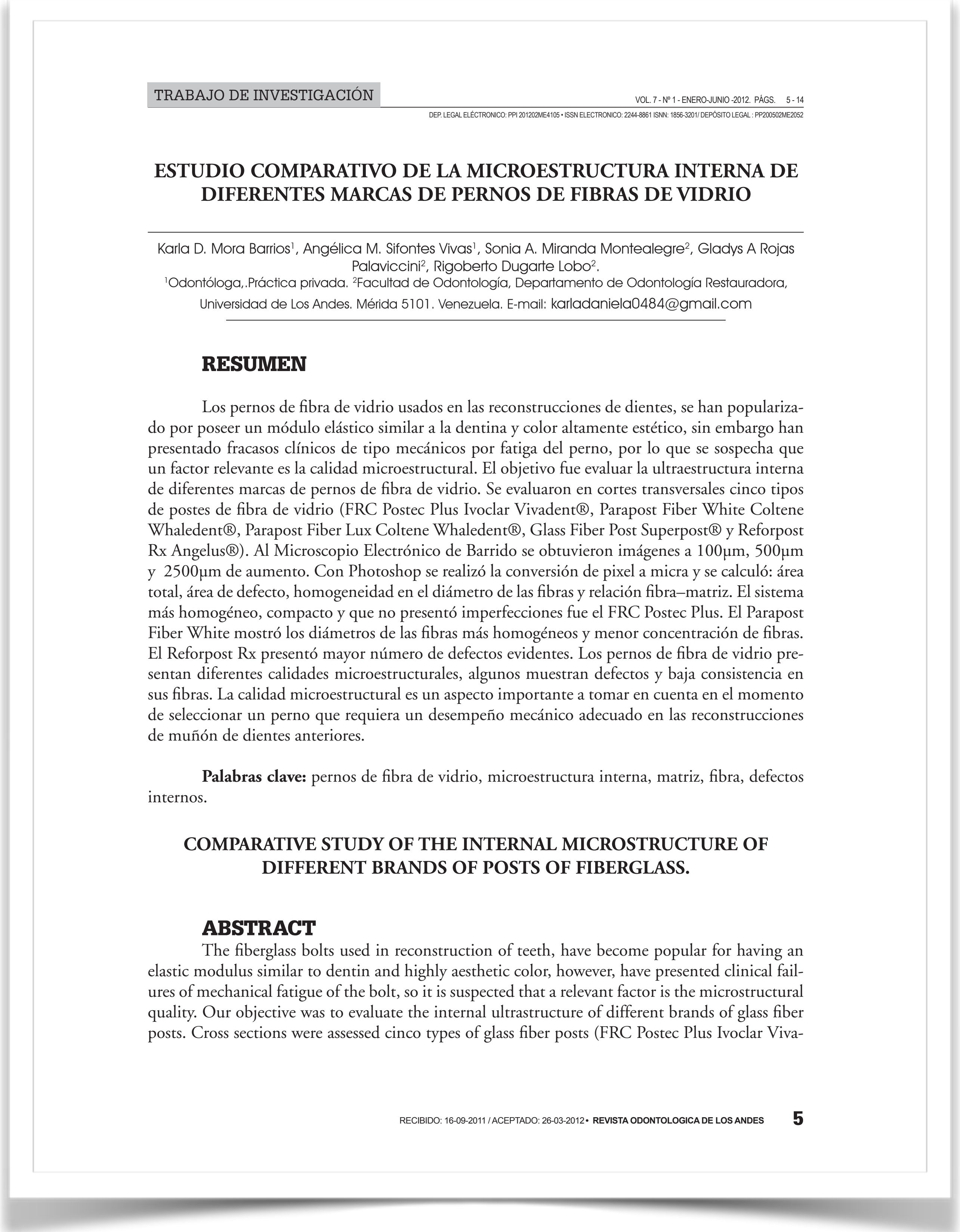
POSTE 3



POSTE 4

POSTE 5





TRABAJO DE INVESTIGACIÓN

VOL. 7 - Nº 1 - ENERO-JUNIO -2012. PÁGS. 5 - 14

DEP. LEGAL ELÉCTRONICO: PPI 201202ME4105 • ISSN ELECTRONICO: 2244-8861 ISNN: 1856-3201/ DEPÓSITO LEGAL : PP200502ME2052

ESTUDIO COMPARATIVO DE LA MICROESTRUCTURA INTERNA DE DIFERENTES MARCAS DE PERNOS DE FIBRAS DE VIDRIO

Karla D. Mora Barrios[1], Angélica M. Sifontes Vivas[1], Sonia A. Miranda Montealegre[2], Gladys A Rojas Palaviccini[2], Rigoberto Dugarte Lobo[2].

[1]Odontóloga,.Práctica privada. [2]Facultad de Odontología, Departamento de Odontología Restauradora, Universidad de Los Andes. Mérida 5101. Venezuela. E-mail: karladaniela0484@gmail.com

RESUMEN

Los pernos de fibra de vidrio usados en las reconstrucciones de dientes, se han popularizado por poseer un módulo elástico similar a la dentina y color altamente estético, sin embargo han presentado fracasos clínicos de tipo mecánicos por fatiga del perno, por lo que se sospecha que un factor relevante es la calidad microestructural. El objetivo fue evaluar la ultraestructura interna de diferentes marcas de pernos de fibra de vidrio. Se evaluaron en cortes transversales cinco tipos de postes de fibra de vidrio (FRC Postec Plus Ivoclar Vivadent®, Parapost Fiber White Coltene Whaledent®, Parapost Fiber Lux Coltene Whaledent®, Glass Fiber Post Superpost® y Reforpost Rx Angelus®). Al Microscopio Electrónico de Barrido se obtuvieron imágenes a 100μm, 500μm y 2500μm de aumento. Con Photoshop se realizó la conversión de pixel a micra y se calculó: área total, área de defecto, homogeneidad en el diámetro de las fibras y relación fibra–matriz. El sistema más homogéneo, compacto y que no presentó imperfecciones fue el FRC Postec Plus. El Parapost Fiber White mostró los diámetros de las fibras más homogéneos y menor concentración de fibras. El Reforpost Rx presentó mayor número de defectos evidentes. Los pernos de fibra de vidrio presentan diferentes calidades microestructurales, algunos muestran defectos y baja consistencia en sus fibras. La calidad microestructural es un aspecto importante a tomar en cuenta en el momento de seleccionar un perno que requiera un desempeño mecánico adecuado en las reconstrucciones de muñón de dientes anteriores.

Palabras clave: pernos de fibra de vidrio, microestructura interna, matriz, fibra, defectos internos.

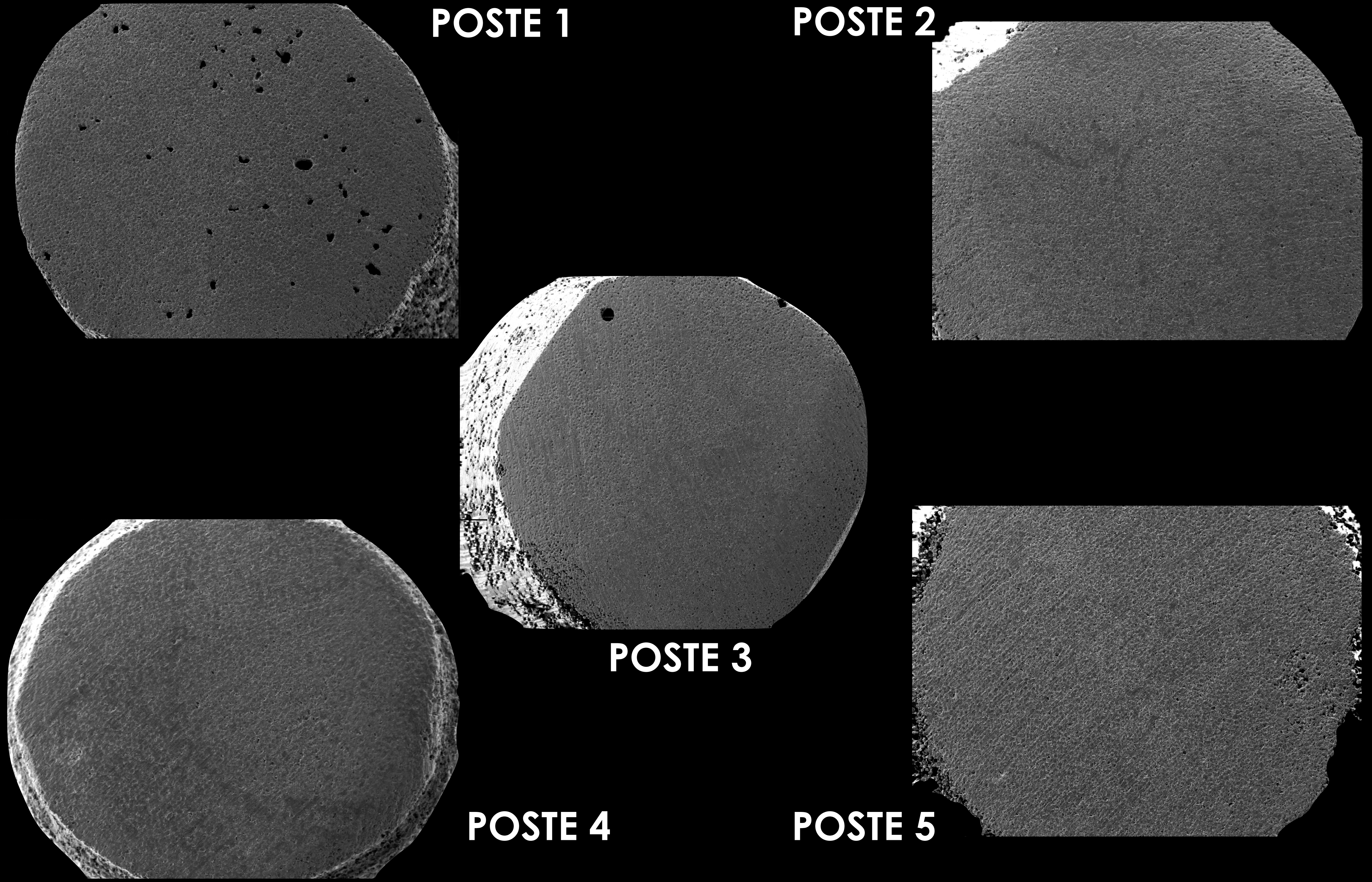
COMPARATIVE STUDY OF THE INTERNAL MICROSTRUCTURE OF DIFFERENT BRANDS OF POSTS OF FIBERGLASS.

ABSTRACT

The fiberglass bolts used in reconstruction of teeth, have become popular for having an elastic modulus similar to dentin and highly aesthetic color, however, have presented clinical failures of mechanical fatigue of the bolt, so it is suspected that a relevant factor is the microstructural quality. Our objective was to evaluate the internal ultrastructure of different brands of glass fiber posts. Cross sections were assessed cinco types of glass fiber posts (FRC Postec Plus Ivoclar Viva-

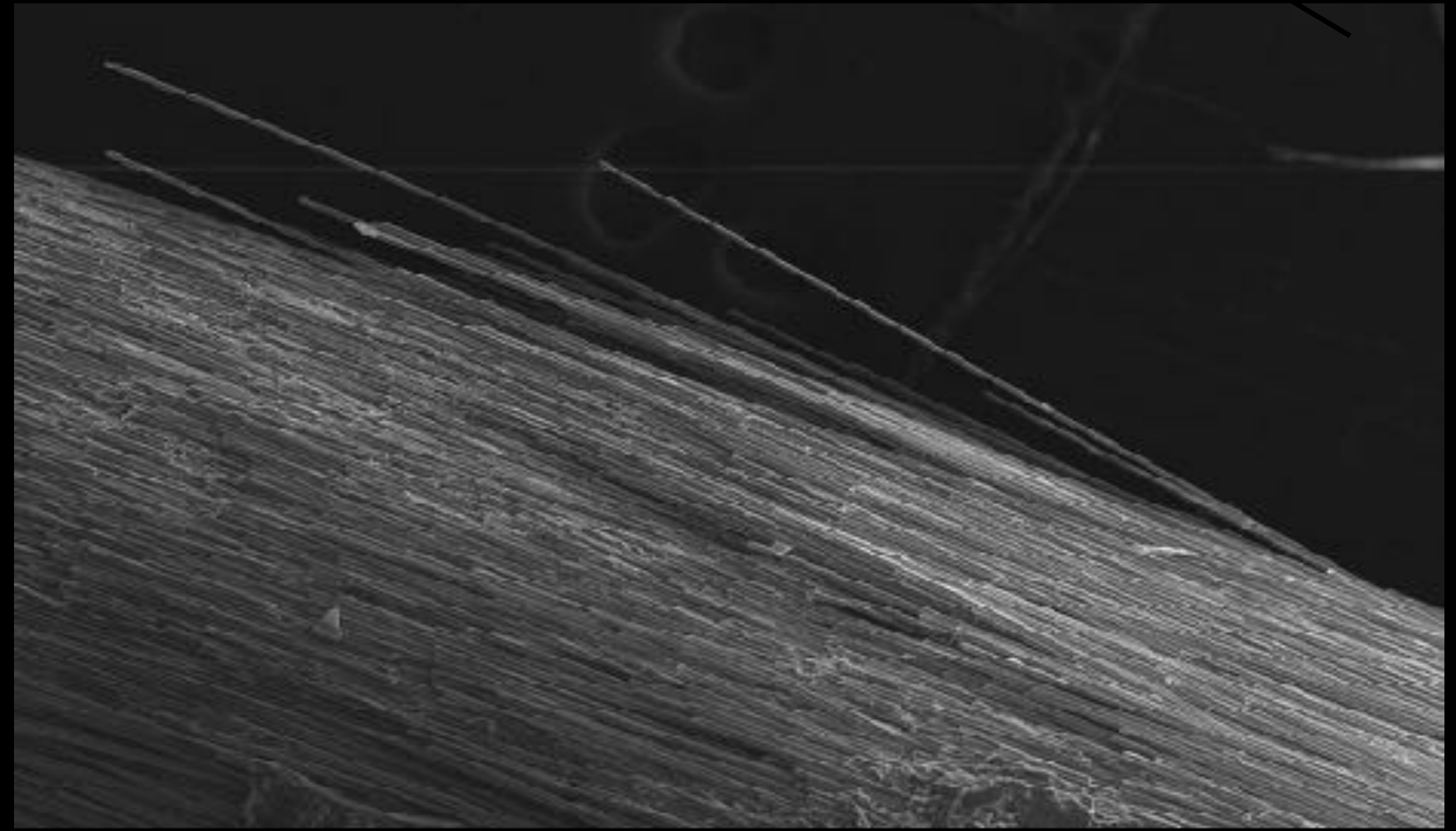
RECIBIDO: 16-09-2011 / ACEPTADO: 26-03-2012 • REVISTA ODONTOLOGICA DE LOS ANDES 5

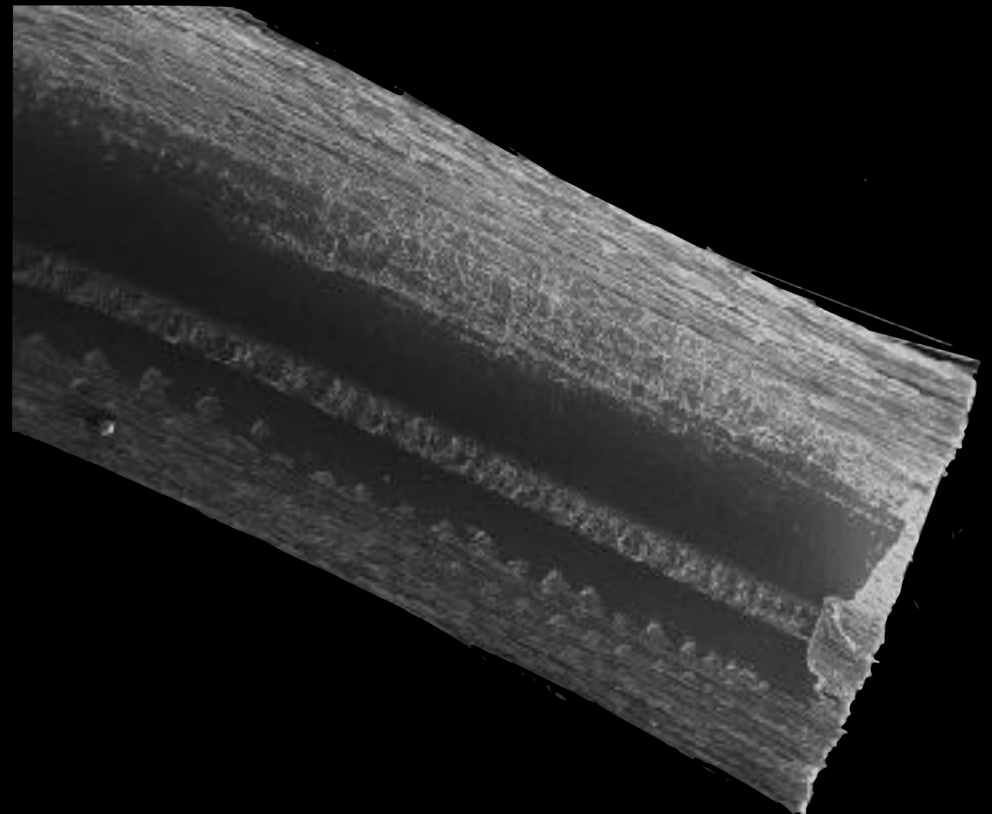
Dra. Karla Mora (Caracas, Venezuela)

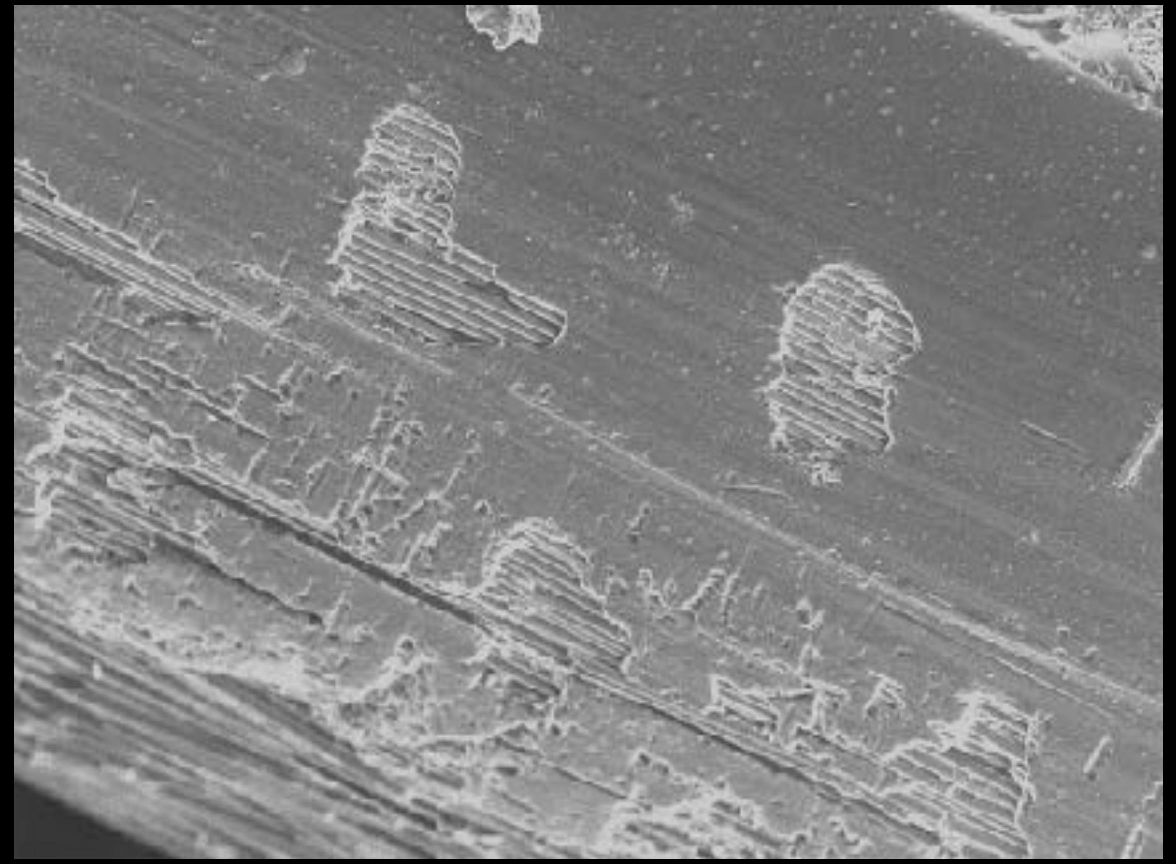


Dra. Karla Mora (Caracas, Venezuela)

Pobre adhesión entre matriz de resina y fibras

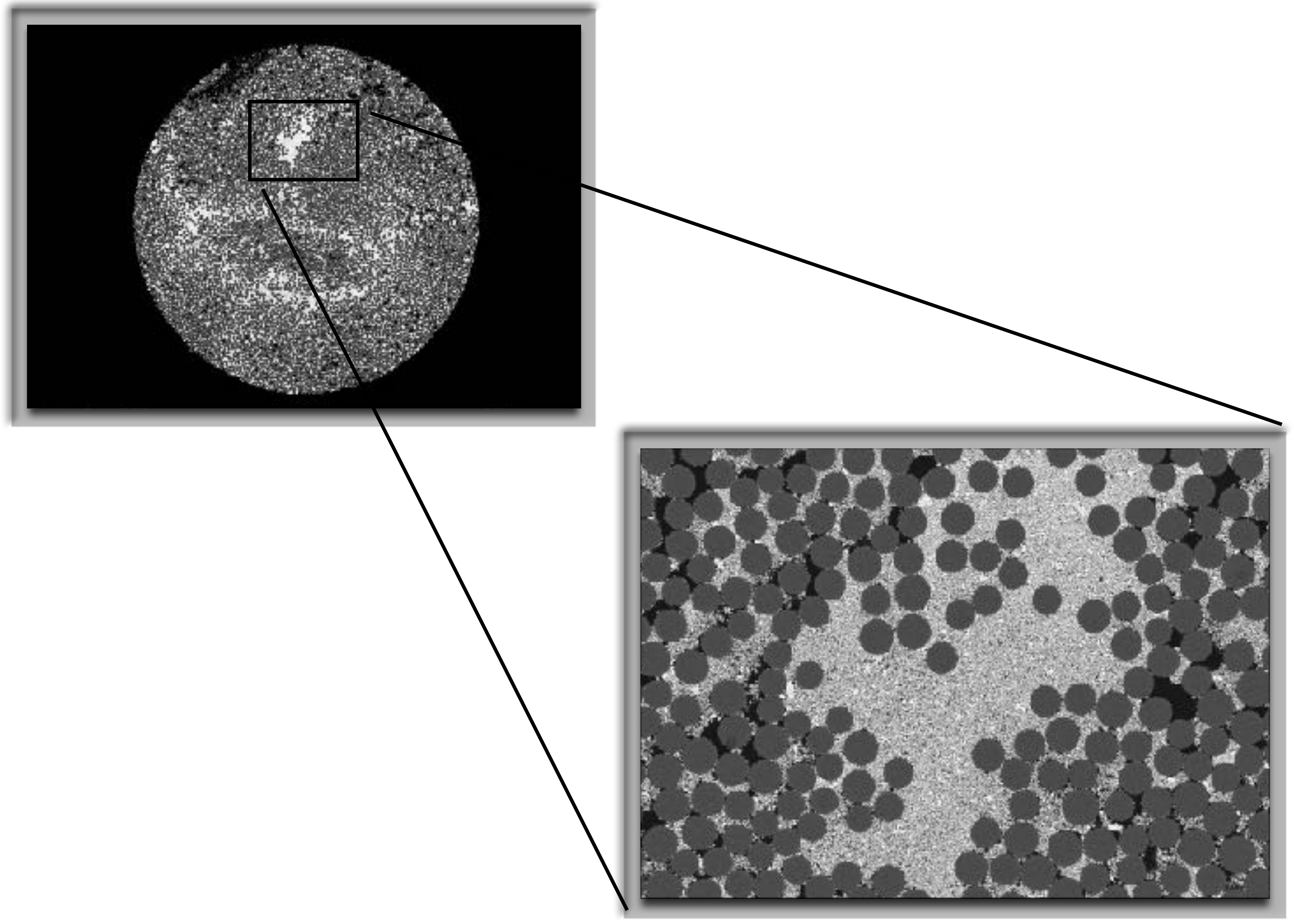


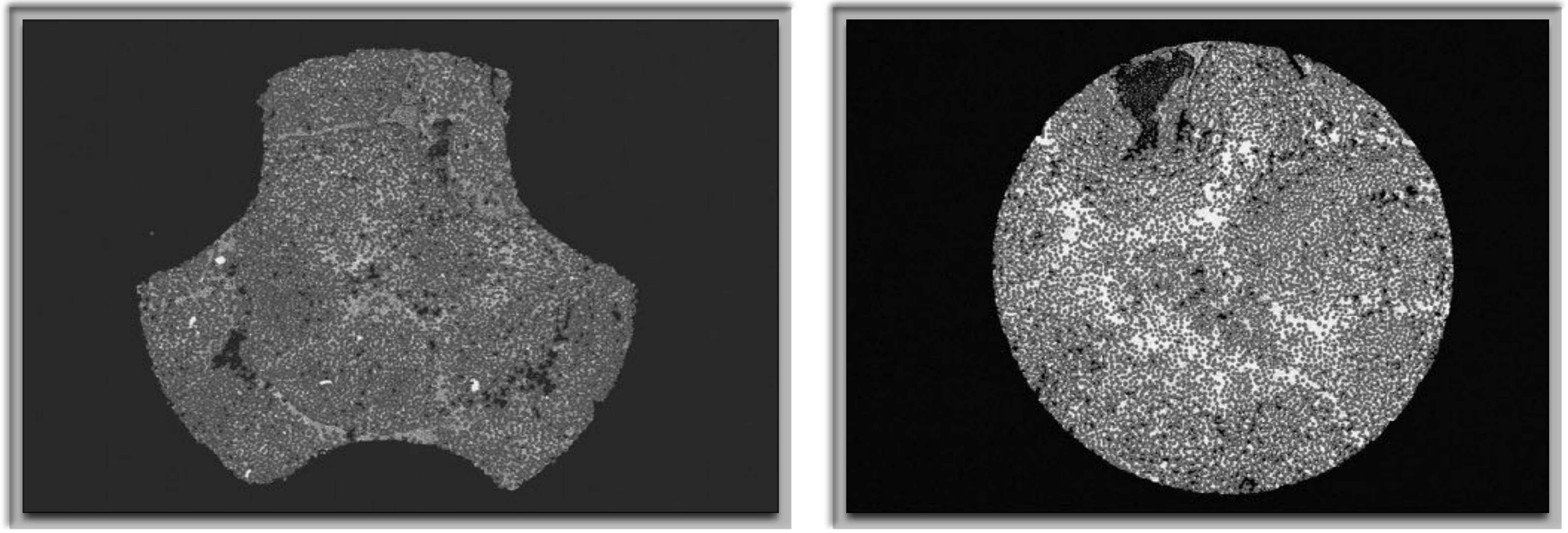




Áreas desprovistas de fibras

Área ocupada por radiopacificador (sin fibras)





“Lagunas de resina” por mala distribución de las fibras

Dres. Ricardo Portigliatti y Jorge Olmos (Argentina)


Macro-Lock (RTD)

Synthesis lab

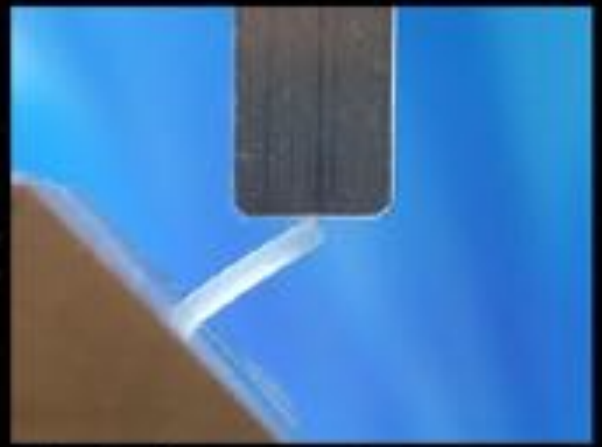
Fabrication process

Analysis degree of conversion

Light energy and transmission test equipement

Densitometer, to quantify and compare radiopacity

Flexural strength test



Static fracture resistance test

Calibrating of the rod

Thermocycling equiment

Shear strength test

Fatigue testing

The bonding (Push-out) test

Computer driven grinding

User-frienly package design

DT Light-Post (RTD)

Macro-Lock (RTD)