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Experimental Initial Partial Polymerization Method for Fuji II Placement Evaluated for Microleakage With/ Without Fuji Coat

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Clinical Relevance

Sometimes it can be more efficient to impart greater viscosity to resin-modified glass ionomer restorative material for condensability during placement.

SUMMARY

Purpose: **This laboratory study evaluated an experimental 1-second initial partial polymerization (IPP) technique using Fuji II LC vs the manufacturer's standard placement (control), both with and without Fuji Coat, relative to microleakage.**

Methods: **Class V restorative preparations were placed on the buccal and lingual aspects of 30 permanent, caries-free and restoration-free, third molar teeth. Fuji II LC restorations were placed either following manufacturer-specified guidelines or IPP for 1 second prior to contouring and full light curing. Half of the restorations were placed using the IPP experimental technique and half of the teeth were finished using Fuji Coat LC. Following thermocycling, specimens were sectioned and dye penetration was measured. SPSS 16 was used for statistical analysis ($p<0.05$).**

Results: **Mean microleakage results: experimental/varnish (0.08 ± 0.15 mm), control/varnish (0.17 ± 0.35 mm), experimental/nonvarnish (0.33 ± 0.33 mm), and control/nonvarnish (0.58 ± 0.47 mm). Univariate analysis of variance demonstrated significantly less microleakage for the experimental technique ($p<0.001$), use of finishing varnish ($p<0.001$), and the combination of experimental/varnish ($p=0.013$).**

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Conclusions: **The initial partial polymerization technique of Fuji II LC placement significantly reduces microleakage. Fuji Coat LC results in further diminished microleakage.**

INTRODUCTION

The increasing trend toward esthetic, minimally invasive restorations has caused a shift in favor of adhesive resin composite and glass ionomer (GI) restorations,[1,2] commonly involving Class II, III, and V surfaces, especially of pediatric teeth. Adhesive restorations require less tooth preparation than most other types of fillings,[2] and such minimal removal of tooth structure in cavity preparation remains an important objective of modern dentistry.[3]

Glass ionomer restoratives have evolved greatly in the last few years.[4] While these materials allow for more esthetic and conservative restorations, they are also more technique-sensitive.[5,6] Microleakage is the leading cause of replacing bonded restorations and is responsible for roughly 30% or more of direct restorations being replaced.[7,8] This can be caused by shrinkage stress, inadequate wetting or adaptation of the material along the cavity wall, and gaps formed between the material and the tooth caused by thermally and mechanically induced stresses.[7] Microleakage can result in staining of restoration margins, recurrent decay, pulpal sensitivity or damage, and further breakdown of certain restorative materials.[7]

Primary benefits of resin-modified glass ionomer (RMGI) materials over traditional GI materials are their improved translucency, finishability at time of placement, and greater stability regarding imbibition/dehydration.[2,9,10] RMGI materials offer reasonable esthetic qualities along with relative ease of handling; low coefficient of thermal expansion; and chemical bonding to cementum, dentin, and enamel as well as to plastics and nonprecious metals.[6,11,12] Added to these advantages are the release and absorption of fluoride ions over a period of time, a nonetching placement technique, pulpal biocompatibility, soft tissue tolerance, adhesion in a wet field, lower shrinkage values, and reduced microleakage.[13,14] With potential to act as a fluoride reservoir, GI type restorations are sometimes considered the treatment of choice for patients with high caries activity.[15]

GIs are unique in that they form a chemical and micromechanical bond with dentin and, to a lesser extent, with enamel.[9,16] They exhibit greater affinity to dentin than do resin-composite materials.[17] Bonding to enamel is largely reliant on ionic and polar forces, whereas bonding to dentin is a more complex interaction.[16] The curing process for glass ionomers is a chemical acid-base reaction that results in an ion-exchange layer between the material and the tooth surface.[18,19] This layer consists of ionic crosslinks formed as the polyacrylate ions found in the material diffuse with phosphate and calcium ions located on the tooth surface.[18,19] From this interaction, an adhesive bond is formed with the hydroxyapatite crystals.[18,19]

The adhesive bond between GI materials and the dentin/enamel surface requires a clean substrate for intimate access of adhesive to its surface, complete wetting of the substrate surface, and liquid-to-solid transformation of the adhesive.[16] Unlike resin-based materials, GIs require only a mildly acidic conditioning agent, and stronger etchants run the risk of substantially reducing the calcium available for binding chemically.[20] The conditioner must be rinsed off thoroughly but without leaving the surface overly desiccated. Adequate surface moisture is important to prevent collapsing of the collagen structure of the dentin and to keep dentin tubules exposed for micromechanical bonding in the form of resin tags.[20] Resin tags into conditioned enamel also provide some micromechanical bonding to enamel.[20] Moist, conditioned surfaces allow more complete wetting of the bonding surfaces by the adhesive.[21] The existing hydrophilic or polar nature of glass ionomer materials has been further enhanced by addition of the hydroxyethyl methacrylate (HEMA) resin component.[16]

HEMA and bis-glycidyl methacrylate (Bis-GMA) were introduced to make glass ionomers photosensitive for visible-light hardening[17] in order to provide dental operators greater control of the working time. Glasspoole and others[20] found that the bond strengths of most light-cured RMGIs significantly exceeded those of self-cured materials. Perhaps due to the immediate adherence of the material to tooth structure as opposed to adhesion developing over time, RMGIs are reported to exhibit better adaptation to dentin than traditional glass ionomer materials.[22] The relative resin content of tooth-colored restorative products determines whether their characteristics are more closely related to traditional GIs or to resin composites.[17]

Water is an important component of the setting reaction of GI materials and affects the structure of the material.[23,24] Water balance must be controlled to permit sufficient maturation of GI materials

before exposure to the oral environment.[23,24] Traditional GI cements and, to a lesser extent RMGI materials, are prone to hydration or dehydration following placement.[23,24] On one hand, excessive hydration immediately following placement can be harmful to the surface of the material,[23] but dehydration on the other hand can lead to shrinkage and crazing.[24] GI restorations, including RMGIs, should be covered with a protective varnish to prevent hydration and dehydration for the first hour.[17]

RMGI materials have become versatile and widely used. One challenge that remains, however, is the low viscosity at initial placement. The material's fluidity can cause it to slump and sag out of the preparation during placement. Difficulty in manipulating low-viscosity material can lead to voids in the restoration. Greater time for placement or difficulty in handling can lead to increased likelihood of contamination, particularly in some pediatric patients.[5]

Investigators in the present study found that a brief, 1-second partial light-cure during placement of RMGI material mildly stiffened the consistency and improved its handling characteristics. The material became packable and no longer tended to flow out of some of the restorative preparations. This initial partial polymerization (IPP) technique for improved management and control of the material has not been addressed or included in the manufacturer's instructions. The purpose of this investigation was to determine if there would be any adverse microleakage effects on Fuji II RMGI restorations placed using this IPP technique compared with those placed following the manufacturer's standard procedure.

METHODS

Thirty extracted, caries- and restoration-free permanent molars were collected from two oral surgery offices and stored at room temperature in sterile, deionized water for less than 6 months. The teeth were then cleansed of soft tissue with a curette and stored in deionized water with 0.05% sodium azide until ready for use.[25]

The specimens were randomly divided into two groups of 15 (Figure 1) and placed in two separate containers with individual numbered compartments. Each specimen's number was engraved into the enamel of the mesial tooth surface with a diamond bur. Group 1 specimens had GC Fuji Coat LC placed over the restorations, while group 2 specimens did not. To ensure that each specimen was subjected to

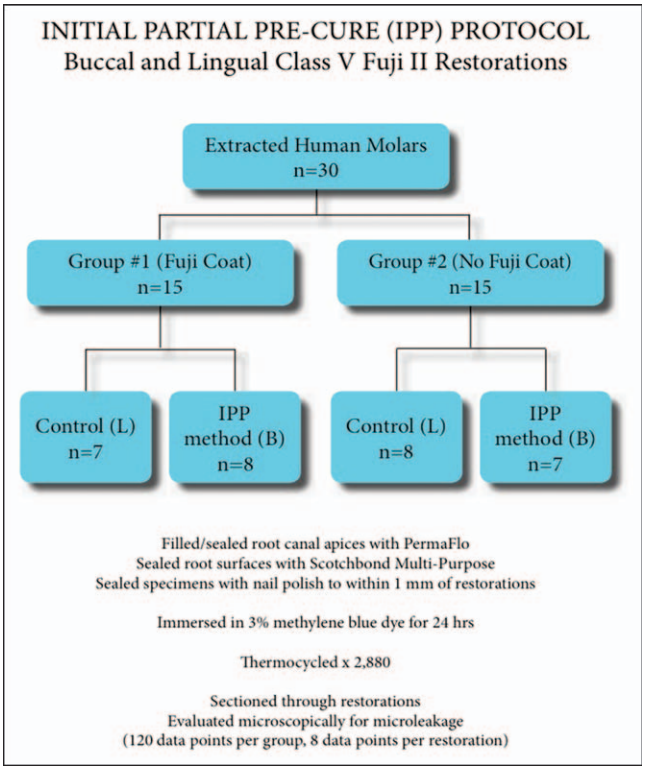

Figure 1. *Flow chart showing group subdivisions of this study leading to 120 data points from the original 30 human extracted molars.*

the same time between each step in the procedure, one tooth was alternately selected from each group throughout the duration of the test. This would also ensure that any potential for improvement or fatigue effect in the operator's technique would be evenly distributed between both groups and across both restorative techniques.

Class V preparations were excavated on the buccal and lingual surfaces coronal to the cementoenamel junction of the extracted molars. All preparations were placed by the same operator (the primary investigator) and measured approximately 3 mm wide × 1.6 mm deep × 4 mm long. These dimensions were translated to the specimens by small marker holes punched in a Mylar strip designating the four corners of the preparation. This template was positioned over the buccal and lingual surfaces of the tooth, and marks were placed on the tooth surface through the perforated plastic. A deionized-water-cooled high-speed turbine handpiece (Midwest Tradition Highspeed Handpiece, Dentsply Professional, York, PA, USA) was used with a 330 carbide bur (H330RZ-FG size 008, 1.6 mm length, Axis Sybron Dental Specialties, Coppell, TX, USA) to prepare the preparations. The length of the bur head

served as a depth guide, and each bur was replaced after 10 preparations. Surfaces to be restored using the experimental IPP technique were marked with two horizontal hash marks on the apical third of the root surface. Eight specimens in group 1 and seven specimens in group 2 had the experimental IPP technique used on the buccal surfaces. Preparations were cleansed with air and deionized water, then placed back in deionized water in their individually labeled compartments. Once all the preparations had been completed, specimens were placed in Ziploc bags filled with deionized water and cleansed in a sonic bath (Quantrex L&R Ultrasonics, L&R Manufacturing Company, Kearny, NJ, USA) for 45 minutes to ensure that all debris was removed.

GC Cavity Conditioner (GC America Inc, Alsip, IL, USA), with 20% polyacrylic acid, was then applied to the cavity preparation for 10 seconds. This conditioner was rinsed away thoroughly with deionized water and dried without desiccating the dentin or enamel surfaces using Kimwipes (Delicate Task Wipers, Kimberly-Clark Kimtech Science, Neenah, WI, USA) to wick the moisture away. GC Cavity Conditioner is recommended by the manufacturer to improve the adhesive strength of GC Fuji II LC material to tooth structure.

GC Fuji II LC capsules were first tapped firmly against the workbench surface to loosen the powder, and then activated by pushing the plunger until it was flush with the main body. Each capsule was placed immediately into the metal GC capsule applicator, and the lever clicked once to ensure full activation. After mixing in the amalgamator (Ivoclar Vivadent Silamat, Amherst, NY, USA) for 10 seconds at high speed (4000 rpm), each mixed capsule was immediately loaded into the GC capsule applicator with two clicks applied to prime the capsule. The RMGI was extruded directly into the cavity preparations, minimizing air bubbles. The material was then either contoured and light-cured according to the manufacturer's specifications with a one-time full 20 seconds of polymerization light exposure or submitted to a 1-second IPP step prior to condensing into the preparation and contouring followed by the final 20-seconds light-polymerization step. Being less than 1.8 mm in depth, all restorations were placed in bulk instead of incrementally, then condensed and contoured using a No. 11 IPC (Interproximal Carver, Ultradent Products Inc, South Jordan, UT, USA). GC America Inc recommends that all Fuji II LC restorations greater than 1.8 mm in depth be placed incrementally to avoid excessive curing shrinkage that can result in cohesive failure of a restoration.[26] A 3M Elipar S10 LED visible-light polymerizing device (3M ESPE, St Paul, MN, USA) was selected for its 1-second exposure-time-setting feature to achieve consistency in the partial polymerization step. Clear vinyl plastic tubing (clear vinyl tubing, 10 mm [3/8 inch], ID No. SVIG 20, Watts, North Andover, MA, USA) was cut approximately 50 mm long and adapted as a friction-fit sleeve over the light-guide tip. This could be adjusted up or down on the light guide shaft to serve as a proximity gauge (Figure 2). Illumination from the polymerizing light was transmitted through the lumen of the tube to the restorative material. Any possible light concentrating effect was totally inadvertent. Testing at various distances determined that 43 mm produced optimal consistency of the Fuji II material for appropriate manipulation. Irradiance at this distance was measured to be 180-190 mW/cm^2. Calibration was determined with a Demetron Light Meter (Kerr Sybron Dental Specialties, Middleton, WI, USA) to assure correct power and light wavelength in the range of 430-480 nm.

Following subsequent full light polymerization, restorations were finished flush to the tooth surface with a 30-bladed finishing bur (Komet H274UF 016, Komet, Rock Hill, SC, USA) under water spray, and polished with medium-fine and fine Ultradent Jiffy Cups (Ultradent). GC Fuji Coat LC was then placed over the restorations in group 1 and light cured for 10 seconds. Capsules were routinely stored at 4°-25°C. Once the restorations had been placed, the specimens were stored in deionized water at 23°C with 100% humidity.

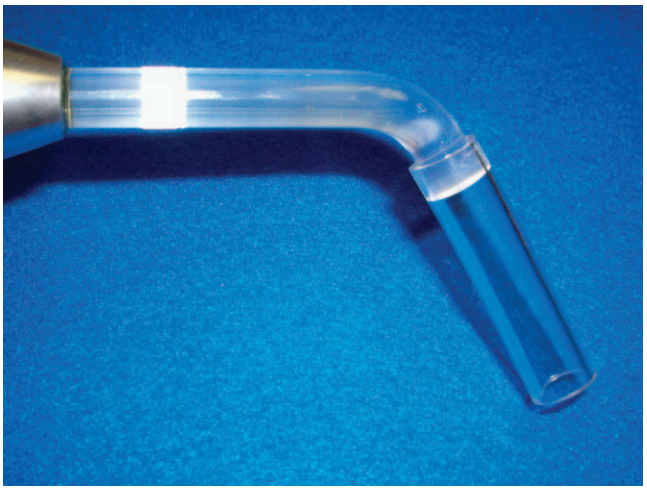

Figure 2. *Transparent vinyl tubing placed on the Elipar S-10 light guide tip as an accurate distance-measuring device calibrated for consistent 180-190 mW/cm^2 illumination of the Fuji II restorative material surface.*

The root apices of all specimens were sealed with PermaFlo composite resin (Ultradent) prior to thermocycling. This was accomplished by etching all root surfaces for 15 seconds, then applying Peak LC bonding agent (Ultradent) over the etched surfaces, and light-polymerizing for 10 seconds. Finally, PermaFlo resin was injected into the root canals, extruded over the external apical third of the roots, and light-polymerized for 20 seconds. Following thermocycling, the root surfaces were coated with 3M ESPE Scotchbond Multipurpose Plus (3M ESPE) to ensure that the roots remained sealed. This was accomplished by etching for 15 seconds, rinsing and drying the root surfaces, coating the root surface with Scotchbond Multipurpose Plus, and light-polymerizing for 10 seconds. The oxygen-inhibited layer was wiped off. To further seal all surfaces of the specimens, fingernail polish (Sally Hansen Hard as Nails Extreme Wear, Morris Plains, NJ, USA) was placed to within 1 mm of the restorations. Black fingernail polish was placed on all root surfaces, blue fingernail polish on the coronal half surrounding the experimental restorations, and orange on the coronal half surrounding the control restorations. This step was to limit dye penetration to the tooth-material interface and not be confounded by structural defects in the tooth itself. Specimens from group 1 and group 2 were placed in separate mesh pouches and immersed in a 3% solution of methylene blue dye for 24 hours in a sealed container.[27]

The teeth were next submitted to thermocycling between 5°C and 55°C in deionized water with a dwell time of 30 seconds in each bath for a period of 2880 cycles (52 hours). Once the specimens were removed from the thermocycler, plastic toothpicks (Qiaoshou Handicrafts Factory, Zhejiang, China) were fixed in position across the occlusal surfaces and centered over the buccal and lingual restorations using Zap-A-Gap cyanoacrylate and accelerator (Super Glue Corporation, Rancho Cucamonga, CA, USA). Pink-colored toothpicks indicated the GC Fuji Coat LC specimens, and green toothpicks the non-coated specimens. No contamination of the restorative surfaces occurred during placement of the toothpicks. Following dye exposure, specimens were removed from their mesh pouches and surfaces cleaned with deionized water and pumice under light finger pressure. Specimens were then encased in acrylic resin (polymethyl methacrylate diethyl phthalate polymer No. 003-07-0358, monomer No. 871-06-0719, Esschem Co, Linwood, PA, USA) with the color-coded plastic toothpicks visibly positioned at the top of the acrylic cylinders. This helped to ensure the proximity of the restorative material to the tooth structure following the sectioning of the teeth. Restorations were sectioned twice vertically in a buccal-lingual direction using a slow-speed diamond wheel saw (Model 650, South Bay Technologies Inc, San Clemente, CA, USA). The plastic toothpicks served as guides to ensure that each cut passed properly through the buccal and lingual restorations. A horizontal cut with distilled water coolant using the McBain Instruments Leitz 1600 diamond saw (McBain Systems, Simi Valley, CA, USA) subsequently separated the sectioned restorations from the apical half of the roots. All surfaces of each specimen and acrylic cylinder were dried using Kimwipes and placed in a dry storage container to prevent further dye penetration.

The method of sectioning yielded eight data points per restoration with a total of 120 data points per restorative technique (Figure 1). The vertical depth of dye penetration at the tooth-restorative interface was recorded in millimeters using a light microscope (Leco M-400-H1, Akashi Corporation, Hakone, Japan).

Statistical Package for the Social Sciences (SPSS) 16.0 computer software was used for descriptive and inferential statistics. Descriptive statistics for the dye penetration included means, standard deviations, frequencies, and graphs. Inferential statistics included *t*-tests, univariate analysis of variance (ANOVA), and Fisher least significant difference (LSD) post hoc tests, at significance level $p < 0.05$

RESULTS

Of the anticipated 480 data points, 479 were used to conduct the statistical analysis. One data point from the control group was lost from failure to section one restoration in the proper orientation.

Table 1 and Figures 3, 4 and 5 summarize the mean microleakage values and standard deviations for the sample restorations organized by restoration technique and use of finishing varnish.

The mean microleakage for the restorations using the experimental technique + finishing varnish was 0.08 ± 0.15 mm compared to 0.33 ± 0.33 mm without finishing varnish. The mean microleakage for the restorations using the control technique + finishing varnish was 0.17 ± 0.35 mm compared to 0.58 ± 0.47 mm without finishing varnish. The total combined microleakage + finishing varnish was 0.13 ± 0.27 mm compared to 0.45 ± 0.42 mm without finishing varnish. Mean microleakage of 0.20 ± 0.30

Table 1: *Mean Microleakage of Experimental and Control Techniques*

Technique	Dependent Variable Microleakage		
	Finishing Varnish	Mean, mm	SD, mm
1-Second precure (IPP)	Nonvarnish	0.331	0.330
	Varnish	0.079	0.150
Control	Nonvarnish	0.578	0.472
	Varnish	0.170	0.347
Total combined	Nonvarnish	0.453	0.424
	Varnish	0.125	0.271

Abbreviation: IPP, initial partial polymerization.

mm along the occlusal margin was lower than 0.38 ± 0.42 mm along the cervical margin.

t-Test analyses were performed for the restorative techniques, finishing-varnish usage, and restorative margin locations. Two-tailed *t*-tests showed a significant difference in observed microleakage for the three test variables (restoration technique, finishing varnish, and margin location) with significance of $p < 0.001$ for all *t*-tests.

Univariate analysis of variance, shown in Table 2, depicts the significant difference in microleakage observed in the restorative technique, finishing varnish, and a combined restorative and finishing varnish variable analysis. The experimental technique, denoted as "1-second precure (IPP)" in Table 2, had significantly less microleakage than the control group ($p<0.001$). The restorations that had finishing varnish had significantly less microleakage than the nonvarnished restorations ($p<0.001$). When the experimental IPP technique was combined with the finishing varnish variable, denoted as "precure (IPP) with varnish" in Table 2, the observed microleakage was significantly less than all other restorative techniques and finishing-varnish combinations ($p=0.013$).

Combinations of restorative technique and finishing-varnish usage were compared using the Fisher LSD post hoc test (Table 3). Comparing the precure (IPP)/varnish with the control/varnish group showed a significant difference in microleakage ($p=0.044$). And, all of the other combinations demonstrated a significant difference in microleakage ($p<0.001$) when compared against each other.

Figures 3 and 4 show the statistically significant decrease in microleakage found with the experimental IPP technique group vs the control technique group as well as the varnish-finished and nonvarnish-finished groups.

DISCUSSION

RMGI restoratives offer many popular advantages but may have one management drawback, which is fluidity upon placement. It has been found that a controlled appropriate degree of partial polymerization could effectively change the material from

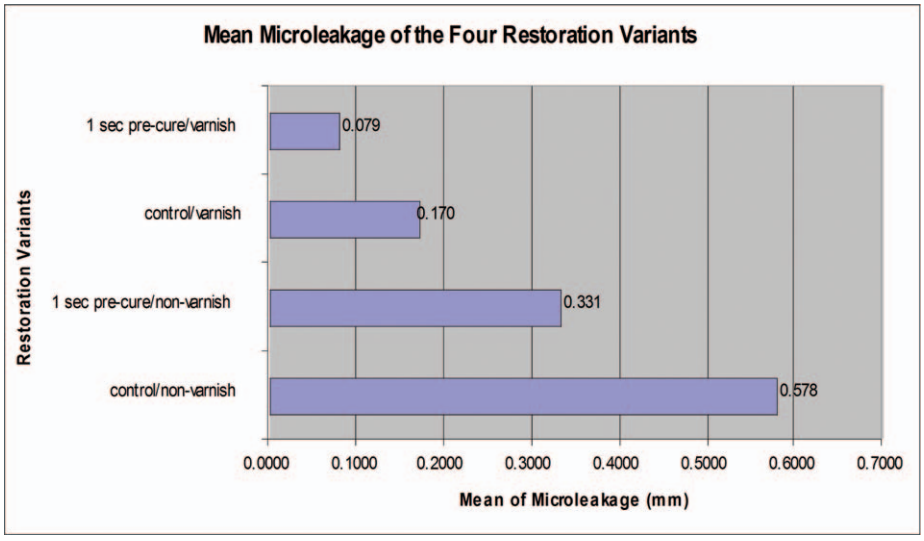

Figure 3. *Mean microleakage values of IPP and conventional groups.*

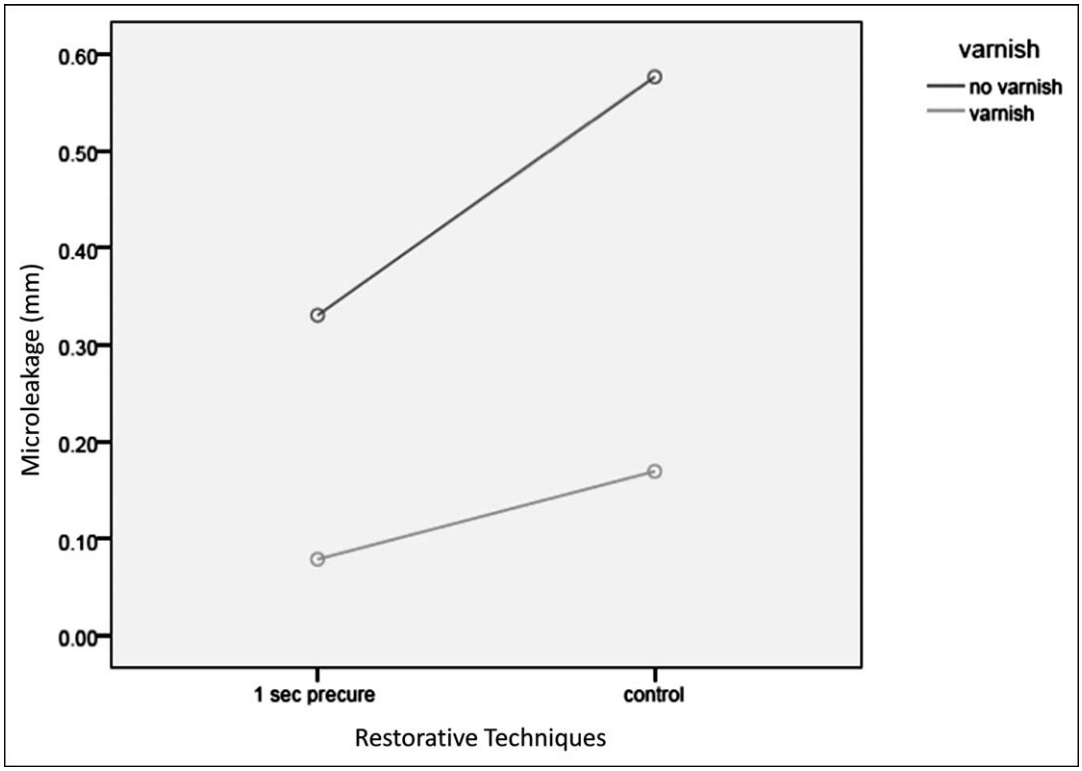

Figure 4. *Means of microleakage (mm) of restorative technique and finishing varnish.*

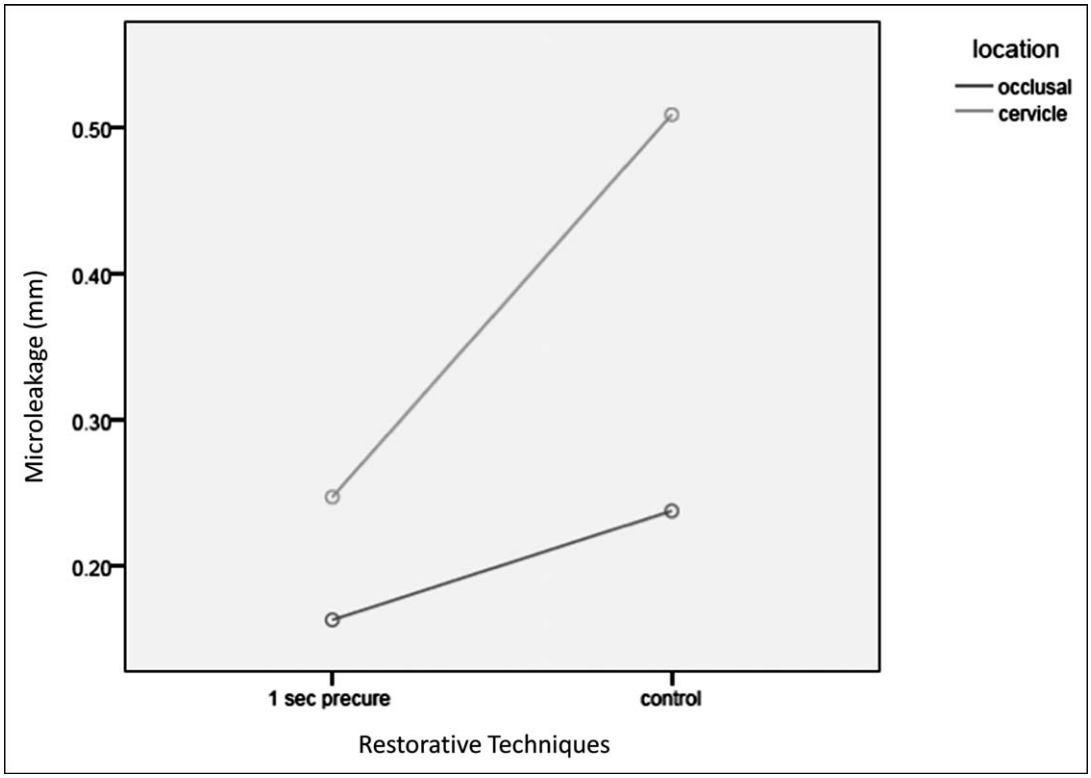

Figure 5. *Means of microleakage (mm) of restorative technique and margin location.*

Table 2: *Univariate Analysis of Variance*

Univariate Analysis of Variance		
Source	**Mean Square**	***p*-Value**
1-Second precure (IPP)	3.406	<0.001
Finishing varnish	13.049	<0.001
Precure (IPP) with varnish	0.735	0.013

Abbreviation: IPP, initial partial polymerization.

flowable to a more condensable state that holds shape and position during placement. A student pilot study determined that 1-second polymerization light time was optimal, and this technique has been used regularly in the graduate pediatric dental clinic by some operators for at least a couple of years.

Controlling fluidity is especially of concern on walls facing downward or laterally such as on maxillary teeth or Class V restorations where gravity can cause the material to sag or droop from the cavity preparation (Figure 6A,B,C). After the soft-cure (or "tack-cure") IPP step, RMGI can be initially condensed into place and remain relatively intact through subsequent additions and final manipulation before full light-polymerization (Figure 6D).

Data of the present study showed significantly less microleakage when the IPP step of Fuji II LC was employed prior to contouring and complete polymerization of the material. Apparently, this technique can allow improved handling characteristics of the material with no apparent degradation of the final bonding interface, as indicated by reduced microleakage. Combined with the manufacturer's recommended Fuji Coat LC varnish, microleakage was further reduced.

There are several potential reasons for differences observed in the amount of microleakage between the two restorative techniques. The RMGI became more packable, possibly allowing greater compaction of the filler particles and increased density of matrix material at the tooth-material interface. This condensability could contribute to a more immediate adherence of the material to tooth structure and earlier initiation of chemical bonding. The greater stability of the material due to increased viscosity may have reduced or prevented voids during placement.

Table 3: *Fisher LSD Post Hoc Test*

Fisher LSD Post Hoc Test		
Combination 1	**Combination 2**	***p*-Value**
Precure (IPP)/Varnish	Control/Varnish	0.044
	Precure/Nonvarnish	<0.001
	Control/Nonvarnish	<0.001
Control/Varnish	Precure/Varnish	0.044
	Precure/Nonvarnish	<0.001
	Control/Nonvarnish	<0.001
Precure (IPP)/Nonvarnish	Precure/Varnish	<0.001
	Control/Varnish	<0.001
	Control/Nonvarnish	<0.001
Control/Nonvarnish	Precure/Varnish	<0.001
	Control/Varnish	<0.001
	Precure/Nonvarnish	<0.001

Abbreviations: IPP, initial partial polymerization; LSD, least significant difference.

Of the 60 restorations representing the two restorative techniques, only four restorations exhibited no microleakage. Of these four restorations, all were from the Fuji Coat LC group, and three were from the experimental group with only one from the control group. The data also demonstrated a significant microleakage difference when comparing the occlusal margin with the cervical lesion. The cervical margin had significantly more microleakage, perhaps due to a variation of enamel, dentin, and possibly cementum along the margin despite efforts to keep the restorations above the cementoenamel junction and in enamel. This potential factor has been noted in previous *in vitro* studies.[18,28,29]

Use of a finishing varnish such as Fuji Coat can prevent early hydration or dehydration and is especially important during the first hour following placement of RMGI restorations.[23,24] Water plays a key role in the acid-base reaction by acting as the

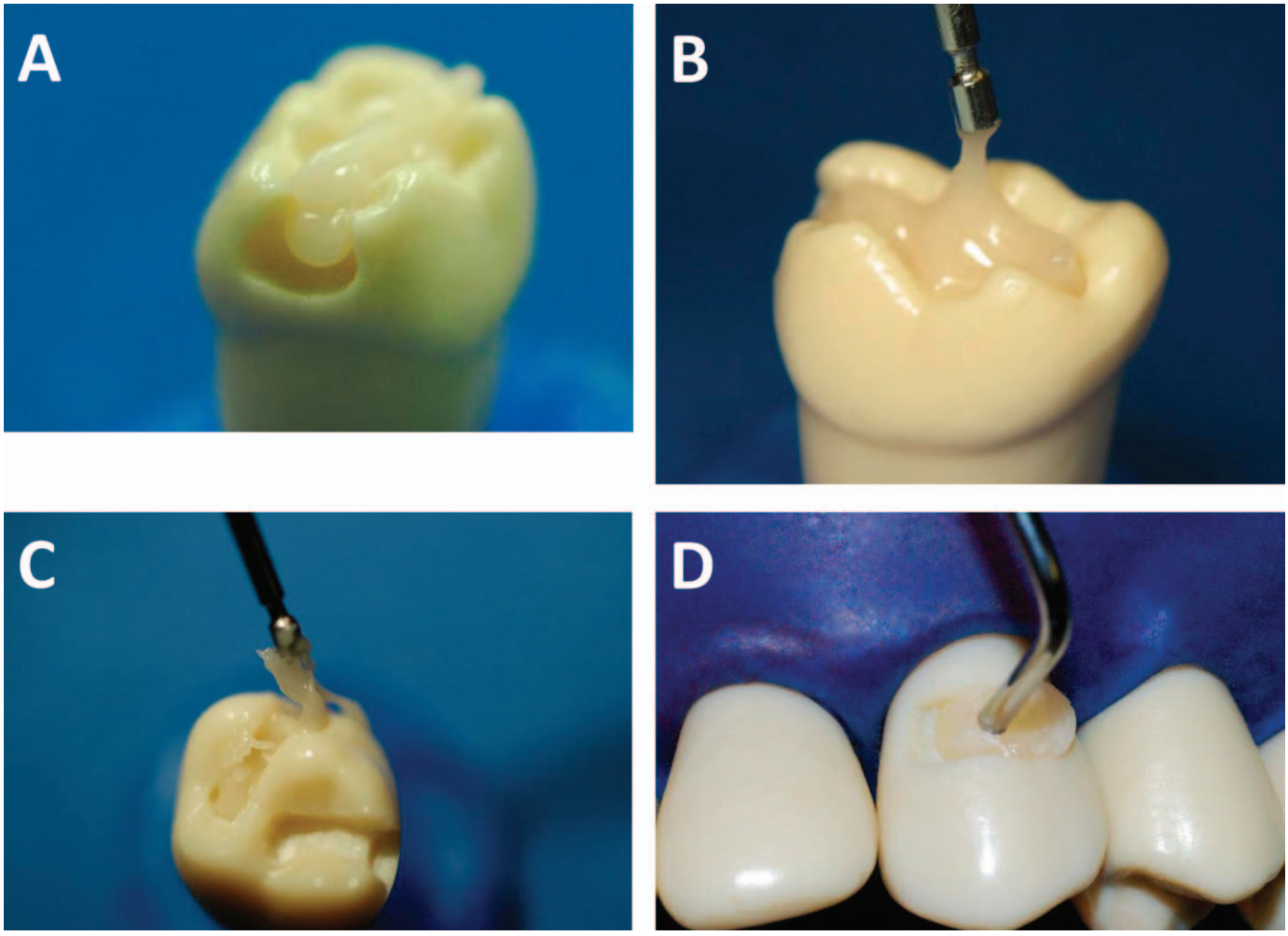

Figure 6. *Restorative material shown (A) sagging after extrusion into a tooth preparation, (B) clinging to the placement instrument, (C) sticking to surfaces outside the preparation potentially capturing voids, and (D) being condensed more controllably into place after the IPP step.*

medium for the reaction and is incorporated into the cement structure.[23] If the restoration is exposed to excessive water prior to hardening fully, the matrix-forming ions (Al and Ca) can be washed out and result in disintegration of the surface structure, discoloration, and increased surface roughness.[23] Dehydration of the material before it is fully set can result in shrinkage and crazing.[24] The dehydrated restoration is also more prone to staining and loss of adhesion.[24]

One side effect of precuring Fuji II LC can be developing fine craze lines or a chalky, rough surface texture following contouring and manipulation. Placing a slight excess of material allows the practitioner to remove this layer, while finishing and polishing the restoration. Applying Fuji Coat LC after the restoration has been polished also fills in and repairs any surface defects that may have existed. Final restorations using the IPP method were not distinguishable in appearance from those placed conventionally.

Individual practitioners would need to calibrate their light curing systems to determine the optimum length of time and light-tip proximity to achieve the desirable handling characteristics of a doughy, moderately packable state.

While this study was able to demonstrate that there may be significantly less microleakage following the experimental IPP protocol, future research might further describe the nature of the bonding interface between RMGI materials and tooth structure. Other studies could examine potential changes in surface wetting, density of material, depth of material penetration into the tooth structure, and changes to the ionic layer plus ionic crosslinks.

Investigations are also recommended to evaluate results of this technique in the actual clinical environment.

By employing the 1-second IPP step, Fuji II LC became easier to handle and manipulate during placement and was less prone to sagging or being drawn by gravity from the restorative preparation. It also resulted in apparently less microleakage than the manufacturer's currently specified instructions. This method used along with the recommended finishing varnish might help practitioners place light-polymerizable Fuji II material with greater control and possibly improved restorative integrity.

CONCLUSIONS

1. Initial partial polymerization of Fuji II LC is associated with less microleakage than placing the material without this step.
2. Applying Fuji Coat LC following finishing and polishing of the RMGI material results in significantly less microleakage.
3. The combination of controlled initial partial polymerization of Fuji II LC and using Fuji Coat LC produces significantly less microleakage than all other conditions tested.
4. Cervical margins of Fuji II LC restorations are more prone to microleakage than occlusal margins.

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Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service and/or company that is presented in this article.

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