Received: 15 November 2022 | Revised: 22 December 2022 | Accepted: 8 March 2023

DOI: 10.1111/jerd.13037

CLINICAL ARTICLE

WILEY

Selective adhesive luting: A novel technique for improving adhesion achieved by universal resin cements

Lorenzo Breschi DMD, PhD | Uros Josic DMD, PhD | Tatjana Maravic DMD, PhD | Edoardo Mancuso DMD | Federico Del Bianco DMD | Paolo Baldissara DMD, PhD | Annalisa Mazzoni DMD, PhD | Claudia Mazzitelli DMD, PhD

Department for Biomedical and Neuromotor Sciences, University of Bologna, Bologna, Italy

Correspondence
Lorenzo Breschi, Clinica Odontoiatrica, Via San Vitale 59, 40 125 Bologna, Italy.
Email: lorenzo.breschi@unibo.it

Abstract

Objective: We aimed to introduce the concept of "Selective adhesive luting—SAL" which is explained through clinical steps and supported by preliminary laboratory evidence.

Clinical Considerations: Cementation with rubber dam is difficult to perform in case of short abutment teeth and/or subgingival crown margins. By means of universal resin cements/universal adhesive systems, which can be employed in self-adhesive as well as adhesive luting procedures, this paper presents a novel technique allowing clinicians to perform reliable cementation where rubber dam isolation is difficult. The SAL technique entails the application of a universal adhesive system only on easily accessible abutment surfaces, enabling simultaneous adhesive and self-adhesive luting in different portions of the abutment. The SAL clinical workflow is explained through prosthodontic rehabilitation of maxillary right central incisor affected by microdontia and restored with a lithium-disilicate crown. Furthermore, our laboratory microshear bond strength study supports the rationale behind SAL application demonstrating higher bond strength even when the adhesive resin is placed only on one portion of the cementation substrate.

Clinical Significance: This article advocates the application of SAL technique in clinical situations where effective adhesive luting is uncertain, since it can improve the adhesion between the tooth and universal resin cements.

KEYWORDS
adhesive system, crown, luting, universal resin cement

1 | INTRODUCTION

The shift from restoring teeth with conventional metal-ceramic to all-ceramic crowns has been possible due to great advancements achieved in the field of dental materials and adhesive dentistry. Unlike metal-ceramic crowns, all-ceramic restorations offer improved esthetics with clinical longevity.[1] Indeed, lithium-disilicate (LiSi) ceramic has demonstrated low annual failure rate (only 0.17% per year) during 16.9-year follow up, with low risk of failure regardless the patients' age/sex and restoration's thickness.[2] Such optimal clinical performance is directly related to the formation of a reliable and durable bond between the tooth structure and ceramic material. To this end, the choice of luting

FIGURE 1 Short abutment where proper rubber dam placement during luting phase can be difficult.

material, as well as strictly following the adhesive procedure steps as recommended by the manufacturer, is fundamental.[3]

Resin-based composite cements are considered the materials of choice for luting of partial and full-coverage indirect restorations made of LiSi ceramics.[4] Current dental market offers a great variety of resin cements, mainly classified according to their polymerization mechanism (light-, self-, and dual-cure)[5] or the number of clinical steps and adhesive mechanism used during luting procedures (multi-step/adhesive and one-step/self-adhesive resin cements).[6] Unlike multi-step/adhesive resin cements that require the use of a previous conditioning of a dental substrate with a primer/adhesive, self-adhesive cements do not entail any pre-treatment and are applied directly to the tooth surface,[7] thus making it an attractive choice for clinicians seeking simplicity. Although evidence from laboratory studies suggests that higher bond-strength values can be obtained when indirect restorations are cemented with multi-step resin cements,[8] a recent systematic review of clinical trials has reported no differences between multi-step and self-adhesive luting in terms of survival rates of LiSi ceramic crowns.[9]

Universal resin cements (URCs) represent the latest novelty in dental adhesive industry.[10,11] These materials can be used either in the self-adhesive mode or in combination with their respective adhesive system,[12] depending on the clinical situation and dentist's preference. According to a recent laboratory study, when a universal resin cement is used with its adhesive system (adhesive luting technique), increased bond-strength to both enamel and dentin were obtained.[7] Unlike self-adhesive, adhesive luting achieved by multi-step cements is sensitive to clinical procedures requiring certain prerequisites to be accomplished, such as a completely dry work field.[9] Consequently, the versatility of URCs can be appealing in challenging clinical situations where proper isolation with rubber dam is difficult to achieve, such as short abutments (Figure 1) or preparations with subgingival crown margins. In these situations, a sort of a "hybrid technique" could be performed, relying on simultaneous adhesive and self-adhesive luting of indirect restorations. This could be achieved by selective application of the adhesive system solely on abutment surfaces that are easily accessible and controllable from saliva and blood contamination (i.e., occlusal/incisal portions of crown preparations)—thus performing adhesive luting in this portion of the abutment, whereas the rest of abutment surfaces are subjected to the self-adhesive luting.

In the light of abovementioned and with the intent to exploit the benefits of URCs, this paper aimed to introduce the clinical concept of a hybrid technique herein referred as "Selective Adhesive Luting—SAL." A laboratory study was conducted to investigate whether the selective application of adhesive systems used before their respective URC could achieve a more reliable bond strength when cementing indirect restorations.

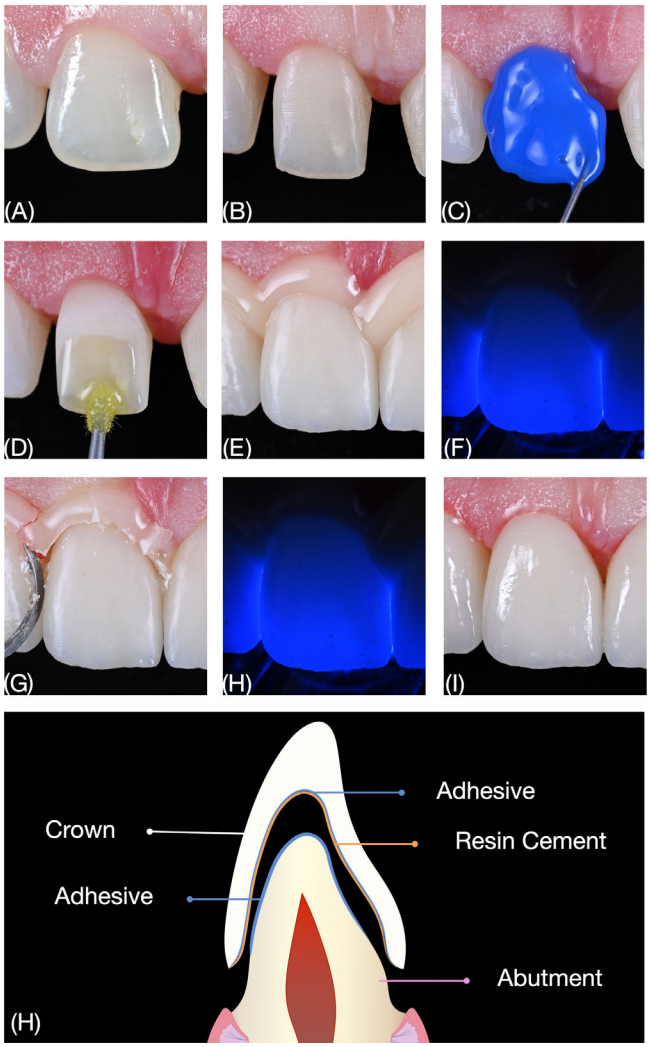

FIGURE 2 (A) Pre-treatment intraoral photography of maxillary right central incisor. (B) Clinical situation after the preparation of maxillary right central incisor. (C) 37% phosphoric acid etching for 15 s. (D) A universal adhesive (CLEARFIL Universal Bond Quick) is applied with rubbing motion to the incisal surface. (E) Lithium-dislicate crown (IPS e. Max Press Multi A1; Ivoclar) layered with feldspathic ceramic powder (IPS Ivocolor Shade; Ivoclar) luting with a universal resin cement (PANAVIA SA Cement Universal) compatible with its universal adhesive system. (F) Light-cure with with a polywave Valo lamp (Ultradent Products Inc.) with 1450 mW/cm^2 for 2 s. (G) Removal of the excess resin cement with a sharp instrument. (H) Light-curing for a total of 40 s (20 s from palatal, followed by additional 20 s from the labial side). (I) Post-cementation intraoral photography of maxillary right central incisor restored with a lithium-disilicate crown. (K) Schematic representation of the SAL technique where the adhesive system is applied onto easily accessible tooth surfaces, positioning it away from the gingival margin, where saliva and blood contamination might accidentally occur.

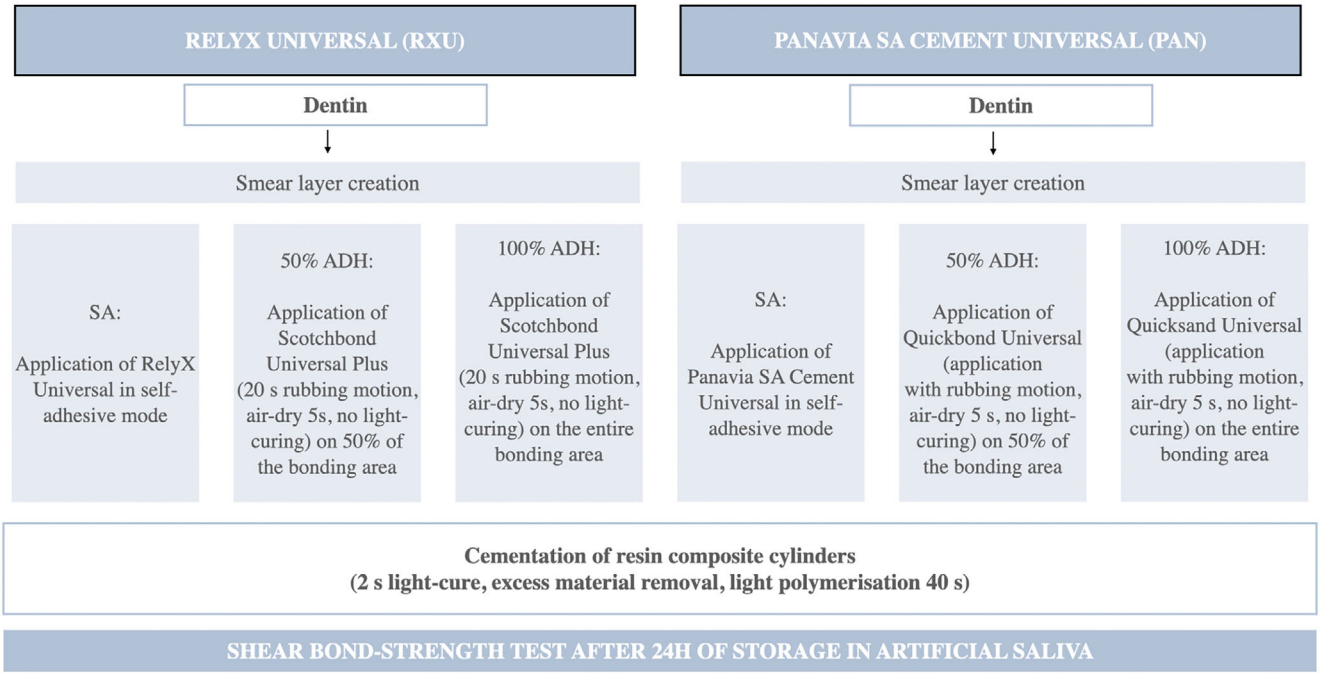

FIGURE 3 Schematic representation of treatment progression for each of the experimental groups on dentin.

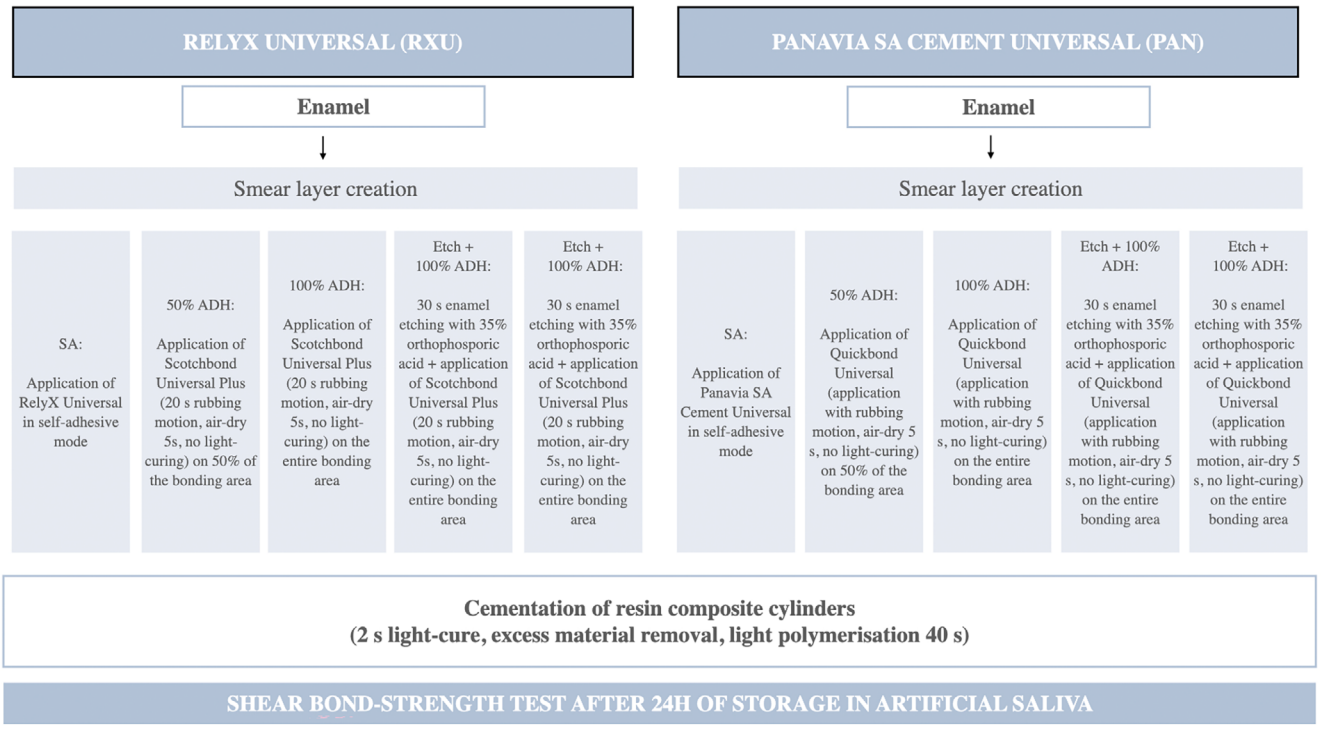

FIGURE 4 Schematic representation of treatment progression for each of the experimental groups on enamel.

2 | CLINICAL WORKFLOW OF THE SAL TECHNIQUE

A 40-year-old female patient who had been unsatisfied with the esthetics of the maxillary right central incisor was referred to a private dental practice in May 2022. The diagnosis of microdontia was confirmed by intraoral and radiographic examination and, after discussing treatment options and obtaining patient's informed consent, the tooth was prepared for LiSi crown in accordance with the principles of minimally invasive dentistry.[13] Due to the short abutment, it was not

possible to adequately place the rubber dam before the cementation procedures. In order to improve the retention of the restoration without performing the adhesive procedures in the cervical portion of the abutment prone to saliva and blood contamination, the adhesive resin was applied only to the incisal half of the abutment without polymerization, and a URC was used for luting, enabling a simultaneous self-adhesive and adhesive luting—the SAL technique. The SAL workflow during the cementation phase is presented and described in Figure 2.

3 | LABORATORY STUDY: DEMONSTRATION OF SAL CONCEPT

3.1 | Methods

Two commercially available URCs, RelyX Universal (3M, Oral Care, St Paul, MN, USA) and Panavia SA Cement Universal (Kuraray Noritake Dental Inc, Okayama, Japan) in SA mode, and in combination with their universal adhesive systems—Scotchbond Universal Plus (3M, Oral Care, St Paul, MN, USA) and Clearfil Universal Bond Quick (Kuraray Noritake Dental Inc, Okayama, Japan), respectively, were used in the study. The adhesive system was applied either on the entire bonding interface or on 50% of the bonding interface (SAL technique). The groups are presented in Figures 3 and 4 and a detailed description of the laboratory study which investigated the influence of SAL on shear bond-strength of indirect restorations can be found in Supporting information. Table 1 summarizes compositions of the materials used in the present study.

4 | RESULTS

Results of the present study are shown in Tables 2 and 3. The shear bond strength (SBS) to dentin was significantly influenced by both "cement" and "adhesive strategy" ($p < 0.01$) and their interactions were also significant ($p = 0.035$). In general, both URCs performed

TABLE 1 Material composition obtained from manufacturer's information and safety data sheets.

Material type	Name and batch number	Composition
Universal adhesive	Clearfil Universal Bond Quick (*Kuraray Noritake Dental Inc, Okayama, Japan*) LOT 220289	Bisphenol A diglycidylmethacrylate Ethanol 2-Hydroxyethyl methacrylate 10-Methacryloyloxydecyl dihydrogen phosphate Hydrophilic amide monomers Colloidal silica Silane coupling agent Sodium fluoride dl-Camphorquinone Water
Universal adhesive	Scotchbond™ Universal Plus (*3M, Oral Care, St Paul, MN, USA*) LOT 8110903	2-Propenoic acid, 2-methyl-, diesters with 4,6-dibromo- 1,3-benzenediol 2-(2-hydroxyethoxy)ethyl 3-hydroxypropyl diethers 10-Methacryloyloxydecyl dihydrogen phosphate 2-Hydroxyethyl Methacrylate 2-Propenoic acid, 2-methyl-, reaction products with 1,10-decanediol and phosphorus oxide 2-Propenoic acid, 2-methyl-, 3-(triethoxysilyl)propyl ester, reaction products with silica and 3-(triethoxysilyl)-1-propanamine Ethanol Water Synthetic amorphous silica, fumed, crystalline-free Methacrylic acid, 3-(Triethoxysilyl)Propyl Ester Campherquinone Copolymer of acrylic and itaconic acid *N,N*-Dimethylbenzocaine (3-aminopropyl) triethoxysilane Diethylene glycol dimethacrylateI
Universal resin cement	RelyX™ Universal (*3M, Oral Care, St Paul, MN, USA*) LOT 8272192	Diurethanedimethacrylate Ytterbium (III) fluoride Glass powder (65997-17-3), surface modified with 2-propenoic acid, 2 methyl-0.3-(trimethoxysilyl)propyl ester (2530-85-0) and phenyltrimethoxy silane (2996-92-1), bulk material Triethylene glycol dimethacrylate L-Ascorbic acid, 6-hexadecanoate, hydrate (1:2) Silane, trimethoxyoctyl-, hydrolysis products with silica 2-hydroxyethyl methacrylate Titanium Dioxide Triphenyl Phosphite

TABLE 1 (Continued)

Material type	Name and batch number	Composition
Universal resin cement	Panavia SA Cement Universal (*Kuraray Noritake Dental Inc, Okayama, Japan*) LOT AT0139	Bisphenol A diglycidylmethacrylate Triethylene glycol dimethacrylate 2-Hydroxyethyl methacrylate Sodium fluoride Silanated barium glass filler Silanated colloidal silica Aluminum oxide filler 10-Methacryloyloxydecyl dihydrogen phosphate Hydrophobic aromatic dimethacrylate Silane coupling agent dl-Camphorquinone Peroxide Accelerators Catalysts Pigments
Resin composite	Filtek™ Z250 (*3M/ESPE Dental Products, St Paul, MN, USA*) LOT NC35376	Silane treated ceramic Bisphenol A polyethylene glcol diether dimethacrylate Diurethane dimethacrylate (1-Methylethylidene)bis[4,1-phenyleneoxy(2-hydroxy-3,1-propanediyl)] bismethacrylate 2,2′-Ethylenedioxydiethyl dimethacrylate Aluminum oxide

TABLE 2 Shear bond strength values (with mean and standard deviation) in MPa, for dentin as substrate ($n = 15$).

	Groups		
Cement	SA	50% ADH	100% ADH
PAN	8.12 ± 3.18^{Ab} (6.6M/0AD/0AC/93.3CC)	12.10 ± 3.51^{Ba} (75M/25AD/0AC/0CC)	13.76 ± 2.88^{Ba} (73.3M/26.6AD/0AC/0CC)
RXU	9.48 ± 3.0^{Ac} (25M/75AD/0AC/0CC)	19.4 ± 6.69^{Ab} (91.7M/8.3AD/0AC/0CC)	24.64 ± 5.02^{Aa} (100M/0AD/0AC/0CC)

Note: The percentages of different failure modes are presented in parentheses under each respective bond strength value.
Abbreviations: AD, adhesive at the dentin interface; AC, adhesive at the composite interface; CC, cohesive in composite; M, mixed failure; PAN, Panavia SA Cement Universal; RXU, RelyX Universal; SA, self-adhesive; 50% ADH, adhesive system applied on 50% of the bonding interface; 100% ADH, adhesive system applied on the entire bonding interface.

better when used in combination with their respective adhesive systems than in the self-adhesive mode, and in the latter they obtained the lowest SBS values among the groups ($p < 0.05$). No statistically significant differences were observed between the two cements when they were used in self-adhesive mode, although the *p*-value was marginal ($p = 0.05$). However, when associated with their adhesive systems, RelyX Universal showed higher bond-strength values when compared to Panavia SA Cement Universal ($p < 0.001$), regardless of the percentage of surface covered with the adhesive (50% or 100%).

Similarly to dentin, the SBS to enamel was significantly influenced by both "cement" and "adhesive strategy" ($p < 0.05$) and their interactions were also significant ($p < 0.05$). No statistically significant differences were observed between the two cements used in self-adhesive mode ($p = 0.37$). When associated with adhesive systems and/or etching procedure, RelyX Universal showed superior performance compared to Panavia SA Cement Universal ($p < 0.05$). Within the groups, RelyX Universal associated with its adhesive system and/or etching, generally performed better compared to self-adhesive mode ($p < 0.05$). Lastly, Panavia SA Cement Universal used with its adhesive system and etching, as well as with the adhesive system covering the entire bonding interface demonstrated significantly higher SBS values compared to self-adhesive mode ($p < 0.05$).

Failure modes distribution of the tested specimens, expressed as percentages of the total number of samples tested, are presented in Tables 2 and 3. A prevalence of mixed failure was largely observed among groups both in dentin and enamel (Tables 2 and 3).

5 | DISCUSSION

The growing need for simplification and versatility has opened the doors to the "universal" concept, both for adhesive systems and resin cements. The term "universal" is commonly referred to the possibility of using the same product in a variety of clinical situations with greater tolerance to technique sensitivity, decreased clinical chair-side time compared to multi-step cements, and decreased number of materials to be used in dental office.

Up to this date, several laboratory studies[14–19] that investigated biomechanical properties of URCs can be found in the literature. According to the manufacturers, the bonding performance of URCs to dentin can be enhanced with the previous application of their

TABLE 3 Shear bond strength values (with mean and standard deviation) in MPa, for enamel as substrate ($n = 15$).

Cement	Groups: SA	50% ADH	100% ADH	Etch + 50% ADH	Etch + 100% ADH
PAN	10.4 ± 2.6^{Ab} (71.4M/28.8AE/0AC/0CC)	13.2 ± 2.7^{Aa,b} (25M/75AE/0AC/0CC)	15.2 ± 2.6^{Ba} (87.5M/12.5AE/0AC/0CC)	13.9 ± 2.8^{Ba} (50M/50AE/0AC/0CC)	15.2 ± 2.4^{Ba} (83.3M/16.7AE/0AC/0CC)
RXU	10.9 ± 3.4^{Ad} (85.8M/75AE/0AC/0CC)	14.2 ± 2.1^{Ac} (60M/40AE/0AC/0CC)	19.2 ± 3.0^{Aa} (83.3M/16.7AE/0AC/0CC)	16.5 ± 5.1^{Ab} (100M/0AE/0AC/0CC)	18.6 ± 2.9^{Aa,b} (100M/0AE/0AC/0CC)

Note: Different superscript letters indicate significant differences. Lower case letters refer to differences within the rows, upper case letters refer to differences within the columns. The percentages of different failure modes are presented in parentheses under each respective bond strength value.

Abbreviations: AE, adhesive at the enamel interface; AC, adhesive at the composite interface; CC, cohesive in composite; M, mixed failure; PAN, Panavia SA Cement Universal; RXU, RelyX Universal; SA, self-adhesive; 50% ADH, adhesive system applied on 50% of the bonding interface; 100% ADH, adhesive system applied on the entire bonding interface.

respective universal adhesives. However, to the best of our knowledge, at the moment this claim has been confirmed in only one research article.[20] In this study, the tested URC (RelyX Universal) associated with its adhesive system and a multi-step cement demonstrated similar bond strength values to dentin.[20] In particular, as commonly occurs in a clinical setting, the adhesive system has been applied on the entire bonding area, resulting in a completely adhesive luting.

Adhesive luting requires well-defined prerequisites of which proper isolation with rubber dam and a careful adherence to adhesive protocols are necessary for effective outcomes.[21] Although the use of the rubber dam should always be preferred in all adhesive procedures, in practice, dentists do not always face ideal clinical situations, and the presence of short abutments and often subgingival finishing lines make its positioning difficult,[22] if not impossible. In these situations, the use of self-adhesive resin cements, much more tolerant to wet conditions,[9,23] can be a valid option.

The peculiarity of URCs is the possibility to combine the two luting strategies in the same clinical case in order to benefit from both approaches. In the case of clinical situations that do not allow the use of the rubber dam, the selective application of the adhesive system only in the area away from contamination with saliva and blood (i.e. occlusal surface of molars and premolars) would allow an adhesive luting, while the rest of the preparation rely on self-adhesive luting that tolerates better the possible presence of saliva and oral fluids.

In the light of these considerations, a novel luting technique—"Selective Adhesive Luting—SAL" as named by the authors of this article, is suggested to be used in the above-described clinical situations (Figure 2).

The results from our laboratory study revealed that the bonding performance to dentin of the tested universal URCs can be improved even if their respective adhesive systems are applied to small dentinal surface instead on the whole bonding area, in a material-dependent manner. Indeed, no differences were observed between the selective application of Clearfil Universal Bond Quick and the entire coverage of the bonding area when Panavia SA Cement Universal was used, and comparable bond strengths were achieved between the two luting strategies (Table 2). These results cautiously suggest that, even if unable to position the rubber dam, the application of the SAL technique would allow to obtain bonding performance which is equal to totally adhesive luting. Contrary, the bonding potential to dentin of RelyX Universal continued to increase, reaching its peak when Scotchbond Universal Plus was applied to the entire bonding interface.

SAL technique was also an effective way of improving the cements' bond-strength to enamel (Table 3). In particular, when combining SAL with previous etching procedure, higher bond-strength values were observed for both cements compared to self-adhesive luting. Similarly to dentin, the bonding strength to enamel of RelyX Universal continued to increase, reaching its peak when Scotchbond Universal Plus was applied to the entire bonding

interface after acid etching step. Interestingly, acid etching step seemed to improve the efficacy of SAL technique when using RelyX Universal cement.

Another important information from the present study that should be mentioned is that self-adhesive luting resulted in lower bonding values compared to the adhesive technique, irrespective of the resin cement used (Tables 2 and 3). The following section will summarize practical considerations and benefits of applying the SAL technique.

5.1 | Hybridization of dentinal substrate

The integrity of resin-based restorations relies on the application of adhesive systems which eventually leads to the formation of a hybrid layer (HL)—a structure that is composed of demineralized collagen fibers reinforced by resin matrix.[24,25] Due to the absence of a separate adhesive system, self-adhesive cements contain functional acidic monomers which possess demineralizing potential and the ability to chemically interact with dentin.[26] Still, self-adhesive cements do not form classical HLs, as the thickness of their resin-dentin interdiffusion zone does not exceed 1 μm,[27] thus questioning their mechanical stability compared to HL formed by the traditional adhesive systems. Therefore, applying the recommended primer/adhesive, even in the cases where it is not possible to entirely cover the bonding interface of the future indirect restoration, can lead to the formation of HLs, which may contribute to the increase of bond-strength of URCs, as observed in our laboratory study. According to the present study, the selective application of the adhesive, resulting therefore in the formation of a partial HL, would be sufficient to contribute to the improved strength of the bonded restoration.

5.2 | Reduced chair-side time compared to multi-step cements

The peculiar characteristic of combining the abovementioned URCs with its respective adhesive system is that no light polymerization is required once the adhesive is applied on tooth surface. Instead, it is sufficient to air-dry the adhesive and, immediately after, carry on the cementation procedure. The absence of a separate light-polymerization step (usually requiring 5–20 s depending on the light source[28]) reduces the chair-side time and lowers the possibility of dentin saliva/blood contamination, especially where isolation with rubber dam is difficult to achieve. Nevertheless, it should be noted that both Clearfil Universal Bond Quick and Scotchbond Universal Plus are not self-cured adhesives and should always be light-polymerized, unless combining them with their respective cements.

5.3 | Simplified conditioning of the prosthetic restoration

The most accepted conditioning protocol used for luting of glass–ceramic materials involves hydrofluoric acid etching, followed by the application of a silane coupling agent,[29] which promotes adhesion between the resin cement and ceramic material.[30,31] On the other hand, when cementing a LiSi crown with a universal cement such as Panavia SA Cement Universal, no separate silane application is needed, as this cement already contains silane in the form of Long-carbon chain Silane Coupling Agent (LSCi), that has already proven to be effective in providing a good bond to both ceramics and dentin.[19] If however RelyX Universal (silane-free cement) is used for the luting of glass–ceramics, priming an indirect restoration with Scotchbond Universal Plus is necessary, since this adhesive system contains a mixture of silanes that showed promising laboratory results.[32] Hence, the available laboratory data suggests that when using a URC, a separate silanization step is not necessary, thus reducing the potential economic cost of obtaining a separate silane coupling agent.

5.4 | Patient comfort

Due to the reduced number of clinical steps compared to multi-step resin cements, the clinical chair-side time is reduced which may lead to greater patient comfort and satisfaction.[33]

5.5 | SAL technique may reduce the incidence of post-operative sensitivity (POS)

Multi-step resin cements used with an etch-and-rinse adhesive can cause greater initial POS when compared to self-adhesive and multi-step cements utilized with a self-etch adhesive, most likely due to the complete removal of the smear layer.[34,35] Consequently, in clinical situations where dentin is the substrate for adhesive procedures, we propose the use of URCs with their universal adhesives applied in self-etch mode, as it may cause less POS.[36,37]

6 | CONCLUSIONS

The current laboratory data concerning properties of URCs is promising, thus encouraging their clinical use. Combining a URC with its adhesive is highly recommended, as it can enhance the quality of adhesion to dentin and enamel even in cases where it is not possible to apply the adhesive to the entire bonding interface. The described technique, "Selective Adhesive luting technique—SAL," is clinically feasible—especially where rubber dam isolation is difficult to achieve, comfortable for both patient and dentist, therefore, deserving more attention in future laboratory and clinical trials.

ACKNOWLEDGMENTS AND DISCLOSURE

All authors have read and are in agreement with the final version of the manuscript. The authors declare that they do not have any financial interest in the companies whose materials are included in this article. Open Access Funding provided by Universita degli Studi di Bologna within the CRUI-CARE Agreement.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

ORCID

Lorenzo Breschi https://orcid.org/0000-0001-7621-226X

REFERENCES

1. Sailer I, Makarov NA, Thoma DS, Zwahlen M, Pjetursson BE. All-ceramic or metal-ceramic tooth-supported fixed dental prostheses (FDPs)? A systematic review of the survival and complication rates. Part I: single crowns (SCs). *Dent Mater*. 2015;31(6):603-623.
2. Malament KA, Margvelashvili-Malament M, Natto ZS, Thompson V, Rekow D, Att W. Comparison of 16.9-year survival of pressed acid etched e. max lithium disilicate glass-ceramic complete and partial coverage restorations in posterior teeth: performance and outcomes as a function of tooth position, age, sex, and thickness of ceramic material. *J Prosthet Dent*. 2021;126(4):533-545.
3. Falacho RI, Marques JA, Palma PJ, et al. Luting indirect restorations with resin cements versus composite resins: effects of preheating and ultrasound energy on film thickness. *J Esthet Restor Dent*. 2022;34(4):641-649.
4. Johnson GH, Lepe X, Patterson A, Schäfer O. Simplified cementation of lithium disilicate crowns: retention with various adhesive resin cement combinations. *J Prosthet Dent*. 2018;119(5):826-832.
5. Mazzitelli C, Maravic T, Josic U, et al. Effect of adhesive strategy on resin cement bonding to dentin. *J Esthet Restor Dent*. 2022;1-7.
6. Mazzitelli C, Maravic T, Mancuso E, et al. Influence of the activation mode on long-term bond strength and endogenous enzymatic activity of dual-cure resin cements. *Clin Oral Investig*. 2022;26(2):1683-1694.
7. Mazzitelli C, Papacchini F, Monticelli F, Toledano M, Ferrari M. Effects of post surface treatments on the bond strength of self-adhesive cements. *Am J Dent*. 2012;25(3):159-164.
8. Miotti LL, Follak AC, Montagner AF, Pozzobon RT, da Silveira BL, Susin AH. Is conventional resin cement adhesive performance to dentin better than self-adhesive? A systematic review and meta-analysis of laboratory studies. *Oper Dent*. 2020;45(5):484-495.
9. Maroulakos G, Thompson GA, Kontogiorgos ED. Effect of cement type on the clinical performance and complications of zirconia and lithium disilicate tooth-supported crowns: a systematic review. Report of the Committee on Research in Fixed Prosthodontics of the American Academy of Fixed Prosthodontics. *J Prosthet Dent*. 2019;121(5):754-765.
10. Cadenaro M, Josic U, Maravić T, et al. Progress in dental adhesive materials. *J Dent R*. 2023;102:254-262.
11. Maravić, T, Mazzitelli, C, Mancuso, E, et al. Resin composite cements: Current status and a novel classification proposal. *J Esthet Restor Dent*. 2023;1-13. doi:10.1111/jerd.13036
12. Josic U, Mazzitelli C, Maravic T, et al. Evaluation of fiber post adhesion to root dentin achieved with different composite cements: 1-year In vitro results. *J Adhes Dent*. 2022;24(1):95-104.
13. Benic GI, Mühlemann S, Fehmer V, Hämmerle CH, Sailer I. Randomized controlled within-subject evaluation of digital and conventional workflows for the fabrication of lithium disilicate single crowns. Part I: digital versus conventional unilateral impressions. *J Prosthet Dent*. 2016;116(5):777-782.
14. Aldhafyan M, Silikas N, Watts DC. Influence of curing modes on thermal stability, hardness development and network integrity of dual-cure resin cements. *Dent Mater*. 2021;37(12):1854-1864.
15. Aldhafyan M, Silikas N, Watts DC. Influence of curing modes on conversion and shrinkage of dual-cure resin-cements. *Dent Mater*. 2022;38(1):194-203.
16. Oda Y, Takahashi R, Nikaido T, Tagami J. Influence of the resin-coating technique on the bonding performance of self-adhesive resin cements in single-visit computer-aided design/computer-aided manufacturing resin restorations. *J Esthet Restor Dent*. 2022;34(4):721-728.
17. Khanlar LN, Abdou A, Takagaki T, et al. The effects of different silicatization and silanization protocols on the bond durability of resin cements to new high-translucent zirconia. *Clin Oral Investig*. 2022;26(4):3547-3561.
18. Takahashi N, Kurokawa H, Wakamatsu K, et al. Bonding ability of resin cements to different types of CAD/CAM composite blocks. *Dent Mater J*. 2022;41(1):134-141.
19. Yoshihara K, Nagaoka N, Maruo Y, Nishigawa G, Yoshida Y, Van Meerbeek B. Silane-coupling effect of a silane-containing self-adhesive composite cement. *Dent Mater*. 2020;36(7):914-926.
20. Rohr N, Martin S, Zitzmann NU, Fischer J. A comprehensive in vitro study on the performance of two different strategies to simplify adhesive bonding. *J Esthet Restor Dent*. 2022;34(5):833-842.
21. Blatz MB, Conejo J, Alammar A, Ayub J. Current protocols for resin-bonded dental ceramics. *Dent Clin*. 2022;66(4):603-625.
22. Mancuso E, Mazzitelli C, Maravic T, et al. The influence of finishing lines and margin location on enamel and dentin removal for indirect partial restorations: a micro-CT quantitative evaluation. *J Dent*. 2022;127:104334.
23. Radovic I, Monticelli F, Goracci C, Vulicevic ZR, Ferrari M. Self-adhesive resin cements: a literature review. *J Adhes Dent*. 2008;10(4):251-258.
24. Breschi L, Maravic T, Cunha SR, et al. Dentin bonding systems: from dentin collagen structure to bond preservation and clinical applications. *Dent Mater*. 2018;34(1):78-96.
25. Josic U, Maravic T, Mazzitelli C, Del Bianco F, Mazzoni A, Breschi L. The effect of chlorhexidine primer application on the clinical performance of composite restorations: a literature review. *J Esthet Restor Dent*. 2021;33(1):69-77.
26. Ferracane JL, Stansbury JW, Burke FJ. Self-adhesive resin cements—chemistry, properties and clinical considerations. *J Oral Rehabil*. 2011;38(4):295-314.
27. Scholz KJ, Bittner A, Cieplik F, et al. Micromorphology of the adhesive interface of self-adhesive resin cements to enamel and dentin. *Materials (Basel)*. 2021;14(3):492.
28. Cadenaro M, Maravic T, Comba A, et al. The role of polymerization in adhesive dentistry. *Dent Mater*. 2019;35(1):e1-e22.
29. Lima RBW, Muniz IAF, Campos DES, et al. Effect of universal adhesives and self-etch ceramic primers on bond strength to glass ceramics: a systematic review and meta-analysis of in vitro studies. *J Prosthet Dent*. 2022. In Press.
30. Matinlinna JP, Lung CYK, Tsoi JKH. Silane adhesion mechanism in dental applications and surface treatments: a review. *Dent Mater*. 2018;34(1):13-28.
31. Vichi A, Fabian Fonzar R, Carrabba M, et al. Comparison between hydrofluoric acid and single-component primer as conditioners on resin cement adhesion to lithium silicate and lithium disilicate glass ceramics. *Materials*. 2021;14(22):6776.
32. Yao C, Ahmed MH, De Grave L, et al. Optimizing glass-ceramic bonding incorporating new silane technology in an experimental universal adhesive formulation. *Dent Mater*. 2021;37(5):894-904.
33. Yuzbasioglu E, Kurt H, Turunc R, Bilir H. Comparison of digital and conventional impression techniques: evaluation of patients' perception, treatment comfort, effectiveness and clinical outcomes. *BMC Oral Health*. 2014;14(1):1-7.
34. Eltoukhy RI, Elkaffas AA, Ali AI, Mahmoud SH. Indirect resin composite inlays cemented with a self-adhesive, self-etch or a conventional resin cement luting agent: a 5 years prospective clinical evaluation. *J Dent*. 2021;112:103740.
35. Josic U, Sebold M, Lins RBE, et al. Does immediate dentin sealing influence postoperative sensitivity in teeth restored with indirect

restorations? A systematic review and meta-analysis. *J Esthet Restor Dent*. 2022;34(1):55-64.
36. Josic U, Mazzitelli C, Maravic T, et al. The influence of selective enamel etch and self-etch mode of universal adhesives' application on clinical behavior of composite restorations placed on non-carious cervical lesions: a systematic review and meta-analysis. *Dent Mater*. 2022;38:472-488.
37. Josic U, Maravic T, Mazzitelli C, et al. Is clinical behavior of composite restorations placed in non-carious cervical lesions influenced by the application mode of universal adhesives? A systematic review and meta-analysis. *Dent Mater*. 2021;37:e503-e521.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Breschi L, Josic U, Maravic T, et al. Selective adhesive luting: A novel technique for improving adhesion achieved by universal resin cements. *J Esthet Restor Dent*. 2023;1-9. doi:10.1111/jerd.13037