REST 717 Winter 2022

Cementation

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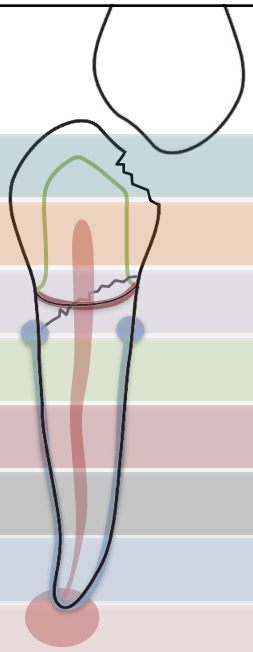

Common clinical complications in fixed prosthodontics

- Wear of the opposing tooth (132~274μm/2yr) §
- Esthetics (6%)*
- Porcelain fracture (3~7%)* / Wear (171~344μm/2yr)§
- Loss of retention (2~7%) *
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Cementation & Esthetics

Zirconia

- Resin cement shade did not affect final color perception (even for high translucency zirconia) [1]

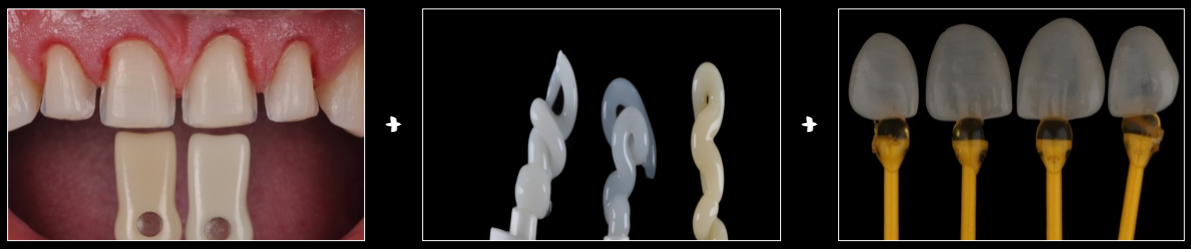
Translucent glass ceramic

- The final shade of a ceramic restoration is highly influenced by the translucency and the color of the cement. [2]

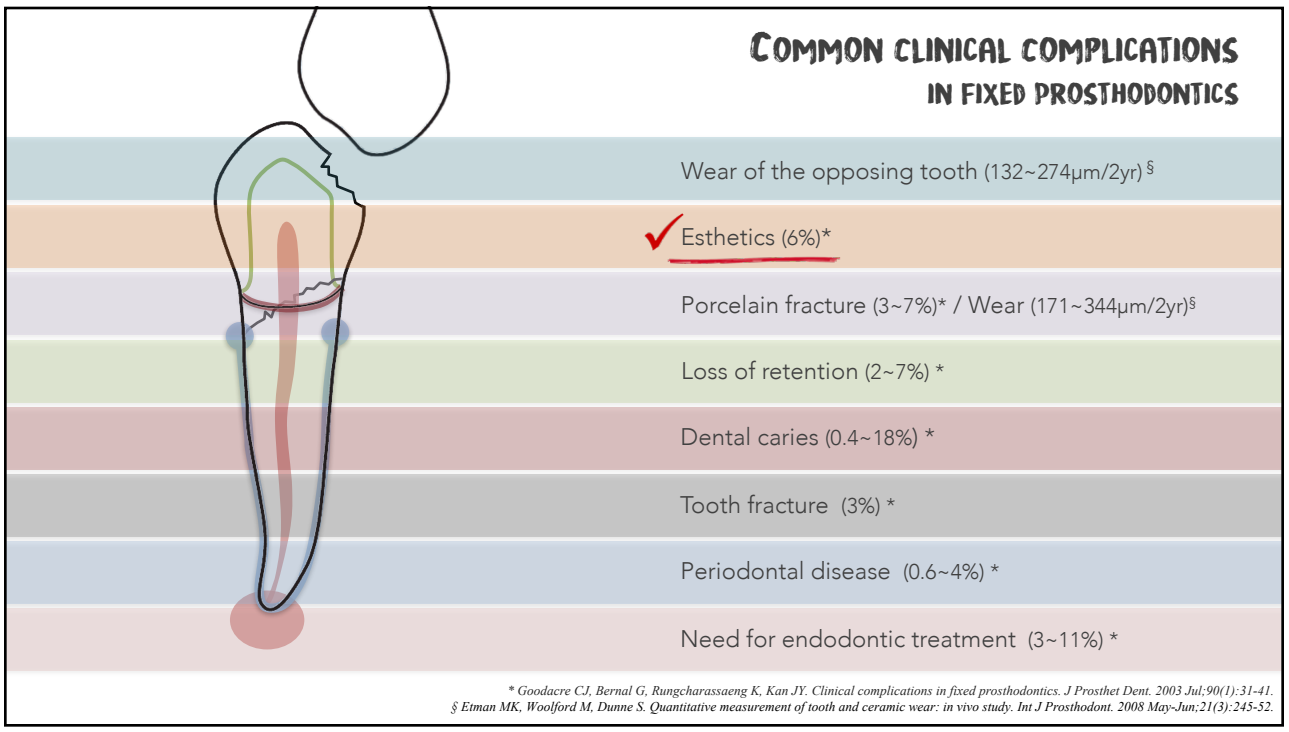
1. Ayash G, Osman E, Segaan L, Rayyan M, Joukhadar C. Influence of resin cement shade on the color and translucency of zirconia crowns. J Clin Exp Dent. 2020 Mar 1;12(3):e257-e263.
2. Carrabba M, Vichi A, Tozzi G, Louca C, Ferrari M. Cement opacity and color as influencing factors on the final shade of metal-free ceramic restorations. J Esthet Restor Dent. 2022 Mar;34(2):423-429.

Cementation & Esthetics

Factors determining the color/shade of translucent ceramic restoration



Sump shade + Cement + Restoration



CEMENTATION & FRACTURE RESISTANCE

ZIRCONIA

- Zirconia-based restorations can be cemented conventionally due to their high fracture resistance. [3]

GLASS CERAMIC

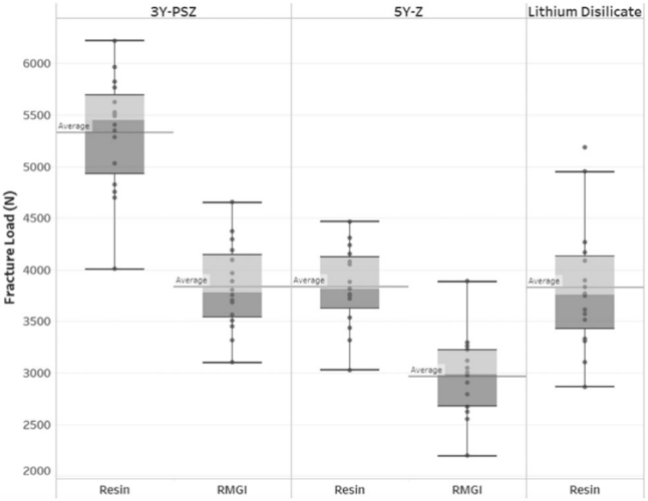
- Adhesive cementation has been shown to increase fracture loads and improve longevity. [3]
- For conventional glass-ceramic restorations, the adhesive technique is critical. [3]

3. Conrad HJ, Seong WJ, Pesun IJ. Current ceramic materials and systems with clinical recommendations: a systematic review. J Prosthet Dent. 2007 Nov;98(5):389-404.

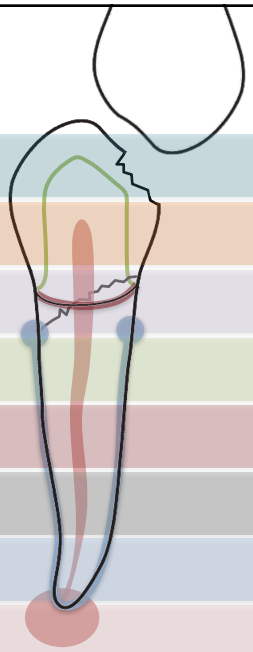
Cementation & Fracture resistance

Lawson et al. JP 2019 [4]

- ✓ Tested with 0.8mm thickness
- ✓ Tested after 100,000 cycles of fatigue loading.
- ✓ All LiSi2 crowns cemented with RMGI failed in fatigue.
- ✓ All ceramic crowns (3Y-PSZ, 5Y-Z, lithium disilicate) at 0.8mm thickness benefited from the use of resin cement.



4. Lawson NC, Jurado CA, Huang CT, Morris GP, Burgess JO, Liu PR, Kinderknecht KE, Lin CP, Givan DA. Effect of Surface Treatment and Cement on Fracture Load of Traditional Zirconia (3Y), Translucent Zirconia (5Y), and Lithium Disilicate Crowns. J Prosthodont. 2019 Jul;28(6):659-665.



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30 yrs old, female

CC: #8 is too dark and too big.

Dental Hx :
#8 is vital. The all ceramic crown was placed 2 years ago. Midline diastema was closed by over-contouring #8. Shade match was excellent when the restoration was delivered.
No caries / periodontal disease.

MARGINAL DISCOLORATION OF ALL CERAMIC CROWNS

Simeone et al, IJPRD 2015 [5]

- ✓ Up to 11 years follow up of 275 lithium disilicate crowns
- ✓ Overall survival rate : 98.2%

- ✓ Marginal discoloration
  - Superficial discoloration, but not penetrating in a pulpal direction : 25.5 %
  - Discoloration penetrates along the margin of the restorative material in a pulpal direction : 11 %

5. Simeone P, Gracis S. Eleven-Year Retrospective Survival Study of 275 Veneered Lithium Disilicate Single Crowns. Int J Periodontics Restorative Dent. 2015;35(5) :685-694.

CONTAMINATION DURING CEMENTATION [6]

✓ Saliva

- Organic materials : salivary proteins, enzymatic molecules, bacteria and food debris
- Inorganic compounds : mineral ions in water

✓ Saliva contamination

- Adsorption of salivary proteins to dental ceramics or tooth surfaces results in pellicle consisting of free bacteria which develops to a thickness of 10-20nm within a few minutes
- The resulting persistent protein contamination from saliva in particular was shown to hinder adhesion of the resin cements to ceramics.

6. Lyann SK, Takagaki T, Nikaido T, et al. Efficacy of Various Surface Treatments on the Bonding Performance of Saliva-contaminated Lithium-Disilicate Ceramics. J Adhes Dent. 2019;21(1):51-58.

MICROLEAKAGE !!!

↑

Partial debonding of the restoration margin

↑

Compromised bonding

↑

Contamination

✓ Such contaminants can adversely affect the longevity of the restoration owing to microleakage, which in turn leads to sensitivity, tooth discoloration, secondary caries and eventual loss of the restoration.

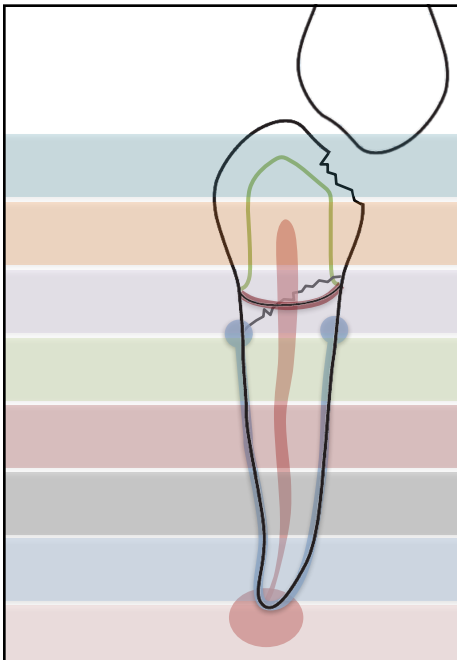
7. Taneja S, Kumari M, Bansal S. Effect of saliva and blood contamination on the shear bond strength of fifth-, seventh-, and eighth-generation bonding agents: An in vitro study. J Conserv Dent. 2017;20(3):157-160.
8. Klosa K, Wolfart S, Lehmann F, Wenz HJ, Kern M. The effect of storage conditions, contamination modes and cleaning procedures on the resin bond strength to lithium disilicate ceramic. J Adhes Dent

Microleakage !!!

Fracture or breakdown of cement can result in microleakage and….

1. Marginal discoloration
2. Pulpal irritation
3. Secondary caries
4. Loss of retention
5. Decreased fracture load

3. Conrad HJ, Seong WJ, Pesun IJ. Current ceramic materials and systems with clinical recommendations: a systematic review. J Prosthet Dent. 2007 Nov;98(5):389-404.



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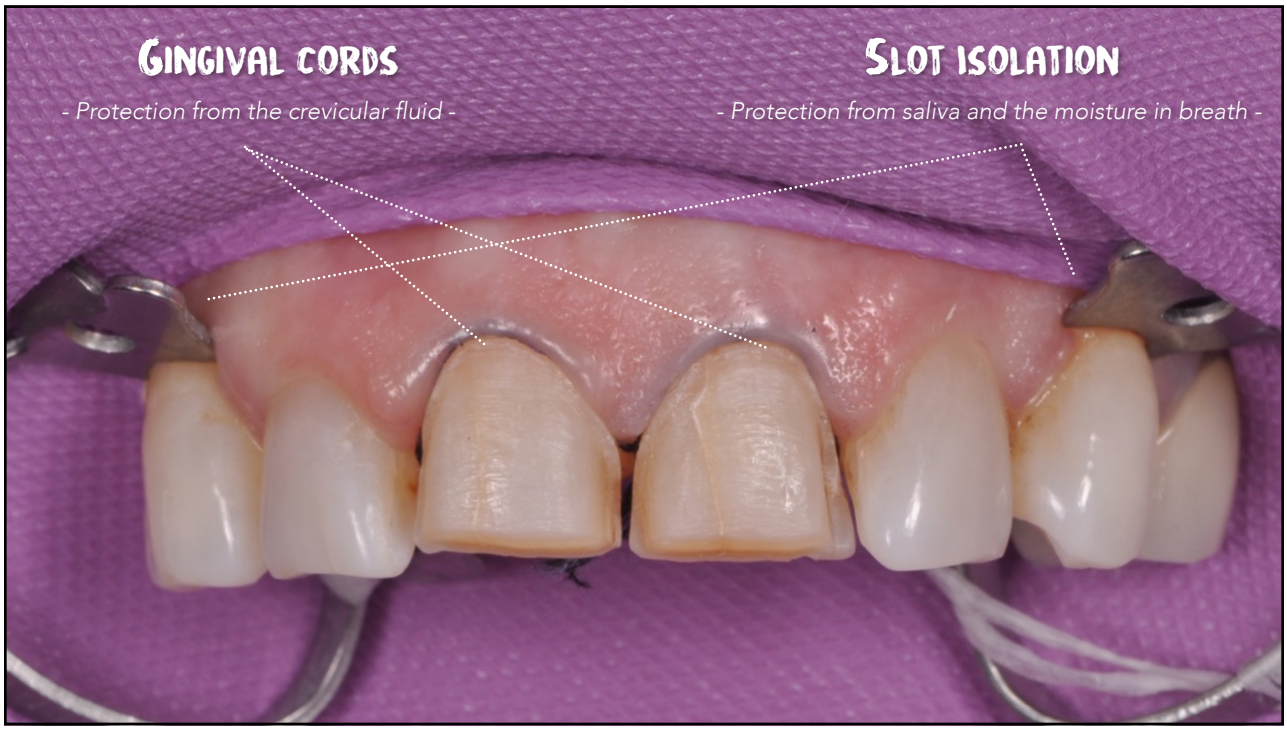
RUBBER DAM ISOLATION ? whenever possible....
Acid etching (phosphoric acid)
Primer / Bonding agent application
Cementation (composite rein cement)
Delivered (IPS e.max Press)


GINGIVAL CORDS
- Protection from the crevicular fluid -
SLOT ISOLATION
- Protection from saliva and the moisture in breath -

Isolite

Optragate + Dry angles

CERAMIC SURFACE CONTAMINATION DURING THE TRY-IN PROCEDURE

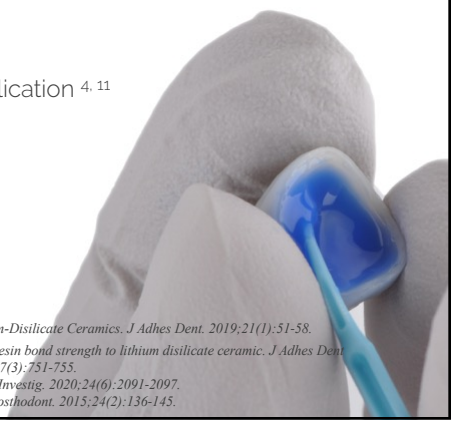
- ✓ Contamination of the already pre-etched and silanized glass surface with saliva can happen during the clinical try-in procedure. [9]
- ✓ Such contamination results in a deleterious reduction of the resin-to-ceramic bond strength. [9]
- ✓ Cleaning of contaminated surface only by water and air spray is not sufficient. [9]

9. Nikolaus F, Wolkewitz M, Hahn P. Bond strength of composite resin to glass ceramic after saliva contamination. Clin Oral Investig. 2013;17(3):751-755.

Chemical cleaning of ceramic restorations

Effective ceramic cleaning techniques

- ✓ Hydrofluoric acid etching + Silane re-application [6, 11]
- ✓ Phosphoric acid etching + Silane re-application [6, 11, 12]
- ✓ Ethanol (or ethanol containing cleaning solution) + Silane re-application [4, 11]
- ✓ Sodium hypochlorite + Silane re-application [12, 13]
- ✓ Cleaning paste (Ivoclean) + Silane re-application [12, 13]



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10. Klosa K, Wolfart S, Lehmann F, Wenz HJ, Kern M. The effect of storage conditions, contamination modes and cleaning procedures on the resin bond strength to lithium disilicate ceramic. J Adhes Dent
11. Nikolaus F, Wolkewitz M, Hahn P. Bond strength of composite resin to glass ceramic after saliva contamination. Clin Oral Investig. 2013;17(3):751-755.
12. Yoshida K. Influence of cleaning methods on the bond strength of resin cement to saliva-contaminated lithium disilicate ceramic. Clin Oral Investig. 2020;24(6):2091-2097.
13. Aladağ A, Elter B, Çömlekoğlu E, et al. Effect of different cleaning regimens on the adhesion of resin to saliva-contaminated ceramics. J Prosthodont. 2015;24(2):136-145.

Cement & periodontal health

Plaque-retaining property [14]

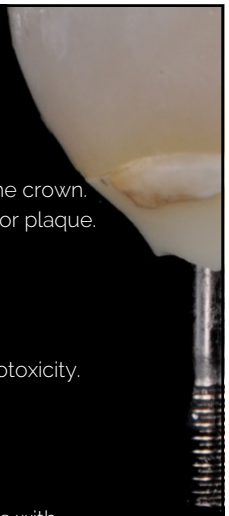
- The cement occupies the void between the restoration and the tooth, but retains plaque around the crown.
- The rough cement not only harbors bacteria, but it is dissolved by oral fluids, thus creating space for plaque.
- A greater threat to the periodontal tissue.

Biocompatibility ? [15, 16]

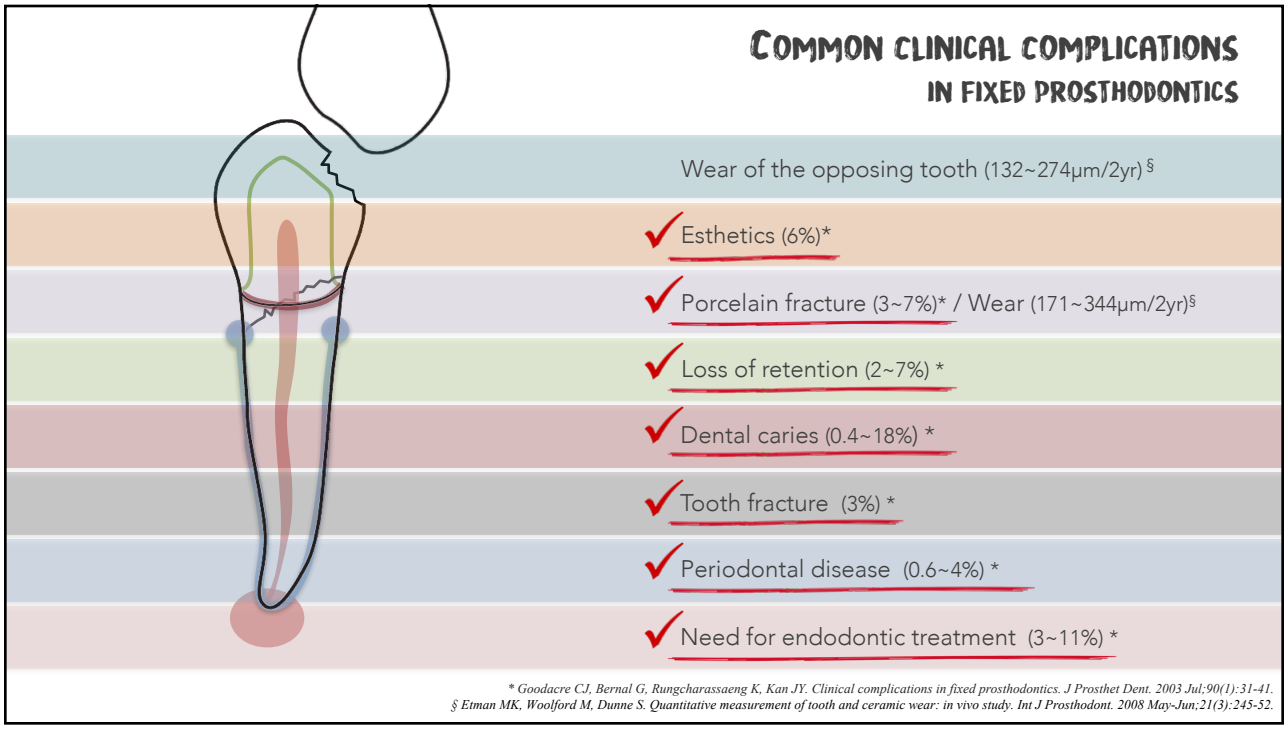
- All resin-based cements caused significant impairment of cell viability, reflecting considerable cytotoxicity.
- Resin cement resultsed in more bacterial adherence and growth compared to other cements.

Peri-implantitis [17, 18]

- Peri-implant disease has been shown to be associated with residual cement in particular to patients with predisposing periodontal disease.
- Excess cement is a potential risk factor/indicator for peri-implantitis.



14. Sorensen JA. A rationale for comparison of plaque-retaining properties of crown systems. J Prosthet Dent. 1989 Sep;62(3):264-9.
15. Frasheri I, Grimm A, Ern C, Hickel R, Folwaczny M. In-vitro cytocompatibility of self-adhesive dual-curing resin cements on human mesenchymal stem cells (hMSC) and periodontal ligament cells (PDL-hTERT). Dent Mater. 2022 Feb;38(2):376-383.
16. Raval NC, Wadhwani CP, Jain S, Darveau RP. The Interaction of Implant Luting Cements and Oral Bacteria Linked to Peri-Implant Disease: An In Vitro Analysis of Planktonic and Biofilm Growth--A Preliminary Study. Clin Implant Dent Relat Res. 2015 Dec;17(6):1029-35.
17. Linkevicius T, Puisys A, Vindasiute E, Linkeviciene L, Apse P. Does residual cement around implant-supported restorations cause peri-implant disease? A retrospective case analysis. Clin Oral Implants Res. 2013 Nov;24(11):1179-84.
18. Schwarz F, Derks J, Monje A, Wang HL. Peri-implantitis. J Periodontol. 2018 Jun;89 Suppl 1:S267-S290.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CEMENT LOADING
EXCESSIVE CEMENT VOLUME
✓ Different volumes of cement placed into the crown prior to cementation produced differences in the seating discrepancies of the crowns. 19
✓ Vertical discrepancies 19
Completely filled (90.0 μm) > Half filled (42.1 μm) > Brushed on (27.4 μm)
✓ The cement obturating the marginal gap is a weak restorative link. 14
19. Tan K, Ibbetson R. The effect of cement volume on crown seating. Int J Prosthodont. 1996 Sep-Oct;9(5):445-51.
14. Sorensen JA. A rationale for comparison of plaque-retaining properties of crown systems. J Prosthet Dent. 1989 Sep;62(3):264-9.

Cement loading

Insufficient cement volume

- ✓ Studies have revealed that an incomplete seal occurs at the interface between tooth, cement, and crown. [14]
- ✓ SEM studies have also confirmed that microbial plaque extends into the interfaces. [14]

14. Sorensen JA. A rationale for comparison of plaque-retaining properties of crown systems. J Prosthet Dent. 1989 Sep;62(3):264-9.

Cement loading

National survey (401 dentists, US only, 2012) [20]

- ✓ Brush on : 54.7 %
- ✓ Gross application : 28.4 %
- ✓ Margin application : 16.9 %

Fig 3 Gross application (GA) crown.

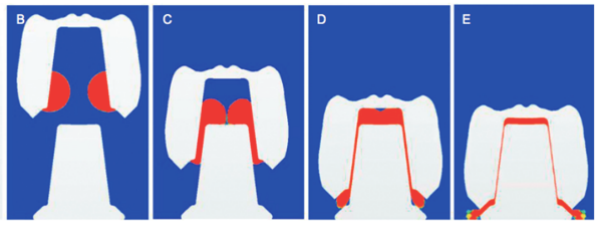
Fig 4 Brush-on application (BA) crown.

Fig 5 Margin application (MA) crown.

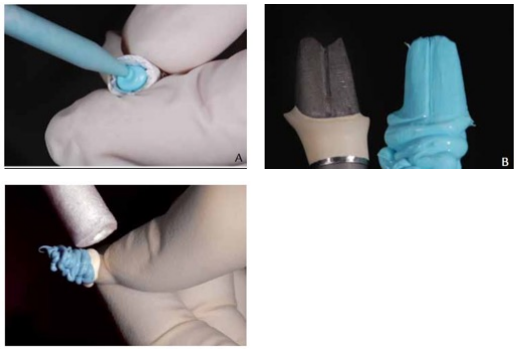
20. Wadhwani C, Hess T, Piñeyro A, Opler R, Chung KH. Cement application techniques in luting implant-supported crowns: a quantitative and qualitative survey. Int J Oral Maxillofac Implants. 2012 Jul-Aug;27(4):859-64.

Cement loading

Margin application [21]



Abutment copy (implant) [22]



21. Wadhwani C, Goodwin S, Chung KH. Cementing an Implant Crown: A Novel Measurement System Using Computational Fluid Dynamics Approach. Clin Implant Dent Relat Res. 2016 Feb;18(1):97-106.
22. Wadhwani C, Piñeyro A. Technique for controlling the cement for an implant crown. J Prosthet Dent. 2009 Jul;102(1):57-8.

Cementation

- The process of attaching parts by means of cement. (GPT-9)

Conventional cementation (luting)

✓ Resin-modified Glass Ionomer (RMGI)

RelyX Luting Plus (3M)

Adhesive cementation (bonding)

✓ Composite resin cement

Multilink Automix (Ivoclar Vivadent)

Cast gold restoration / Metal ceramic restorations

- ✓ Cast gold restorations can be cemented with any type of cement. [23]
- ✓ Traditionally, zinc phosphate has been the material of choice because of its low film thickness despite of its well-documented disadvantages, including its solubility and lack of adhesion. [24, 25]
- ✓ RMGI (resin-modified glass ionomer) cement is becoming more popular because of its desirable properties including [24, 25]
  - Low solubility
  - Marginal adaptation comparable to zinc phosphate
  - Fluoride release
  - Improved retention
  - Higher tensile strength

23. Rosenstiel SF, Land MF, Crispin BJ. Dental luting agents: A review of the current literature. J Prosthet Dent. 1998 Sep;80(3):280-301.
24. Farrell CV, Johnson GH, Oswald MT, Tucker RD. Effect of cement selection and finishing technique on marginal opening of cast gold inlays. J Prosthet Dent. 2008 Apr;99(4):287-92
25. Song MY, An H, Park EJ. The Effect of Temporary Cement Cleaning Methods on the Retention of Crowns. J Prosthodont. 2017 Jun 9.

Lithium disilicate & other glass ceramic [3, 26]

- ✓Adhesive cementation required.
  - HF etching + silane + resin cement
- ✓Adhesive cementation has been shown to increase fracture loads and improve longevity.
- ✓A glass-ceramic restoration supported by a composite resin cement withstand higher masticatory forces and demonstrated improved clinical performance.

Hybrid (ceramic-reinforced) composite [27]

- ✓Adhesive cementation required.
- ✓Fracture strength as high as that of lithium disilicate when adhesively cemented

3. Conrad HJ, Seong WJ, Pesun IJ. Current ceramic materials and systems with clinical recommendations: a systematic review. J Prosthet Dent. 2007 Nov;98(5):389-404.
26. Weyhrauch M, Igiel C, Scheller H, Weibrich G, Lehmann KM. Fracture Strength of Monolithic All-Ceramic Crowns on Titanium Implant Abutments. Int J Oral Maxillofac Implants. 2016 Mar-Apr;31(2):304-9.
27. Attia A, Kern M. Influence of cyclic loading and luting agents on the fracture load of two all-ceramic crown systems. J Prosthet Dent. 2004 Dec;92(6):551-6.

GLASS CERAMIC BONDING

1 Clean the surface

2 Acid etching

- ✓ Hydrofluoric acid
- ✓ Thorough rinse after etching

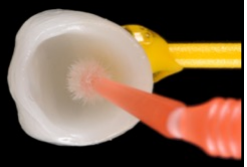
• Etching time varies depending on the type of ceramic materials and concentration of HF acid.

3 Post-etching cleaning (Optional)

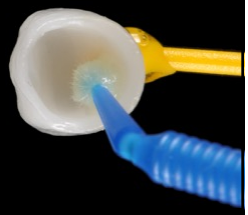
- ✓ Phosphoric acid (30s)
- ✓ Ultrasonic bath (5min)

• To remove precipitated salts of silica and fluorine
• Controversial

4 Silane application & Air dry



5 Bonding agent (No curing)



6 Resin cement application

ZIRCONIA CEMENT & RETENTION ?

Palacios et al, JPD 2006 (in-vitro) [28]

- ✓ The use of a composite resin cement with a bonding agent did not yield higher zirconia coping retention compared to the other 2 cements (RMGI) tested [1]

(Resin cement = RMGI)

Ehlers et al, JPD 2015 (in-vitro) [29]

- ✓ The composite resin cement showed significantly higher retentive strength after thermocycling compared to glass ionomer cement, RMGI and zinc phosphate cement. [2]

(Resin cement > RMGI)

Le et al, JOR 2015 (systematic review of clinical studies) [30]

- ✓ Loss of retention occurred more frequently in zirconia FDPs luted with zinc phosphate cement or glass-ionomer cement compared to those luted with resin cements. [3]

(Resin cement > ZPC, GI)

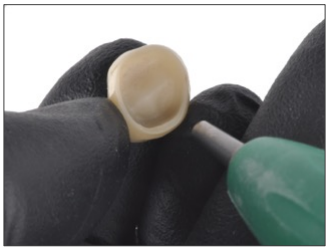
28. Palacios RP, Johnson GH, Phillips KM, Raigrodski AJ. Retention of zirconium oxide ceramic crowns with three types of cement. J Prosthet Dent. 2006 Aug;96(2):104-14.
29. Ehlers V, Kampf G, Stender E, Willershausen B, Ernst CP. Effect of thermocycling with or without 1 year of water storage on retentive strengths of lutingcements for zirconia crowns. J Prosthet Dent. 2015 Jun;113(6):609-15.
30. Le M, Papia E, Larsson C. The clinical success of tooth- and implant-supported zirconia-based fixed dental prostheses. A systematic review. J Oral Rehabil. 2015 Jun;42(6):467-80.

ZIRCONIA BONDING ?

- ✓ While considered "cementable", some zirconia restorations benefit from insertion with composite rein-luting agents. These include the followings. [31]
  1. Zirconia restorations that are thin or less strong
  2. Zirconia restorations that lack retention (short crown or onlay)
  3. Zirconia restorations that rely on resin bonding (resin-bonded FDP, veneers)
- ✓ The success of zirconia bonding relies on the adequate treatment of tooth and restoration boding surfaces. [31]

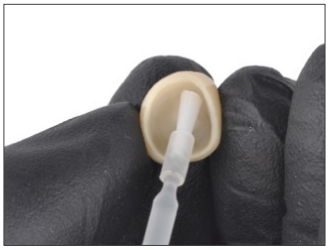
31. Blatz MB, Alvarez M, Sawyer K, Brindis M. How to Bond Zirconia: The APC Concept. Compend Contin Educ Dent. 2016 Oct;37(9):611-617; quiz 618.

ZIRCONIA BONDING STRATEGY



1 Cleaning & Air-abrasion

- Small particles (50~60μm)
- Low-pressure (below 2 bar)



2 Primer

- Typically contains special phosphate monomers (MDP)
  - ** MDP : 10-methylacryloyloxydecyldihydrogen phosphate
- Silanes have no contributing effect to long-term bond strengths to zirconia.

Monobond Plus
(Ivoclar Vivadent)
: Silane + MDP

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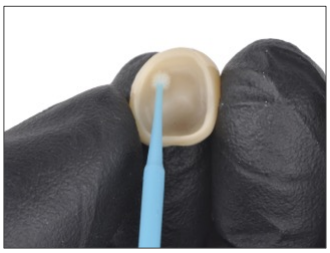
Zirconia bonding strategy



3 Adhesive

- May or may not be necessary depending on the bonding system.

4 Resin cement

- Dual-cure or self-cure resin cement

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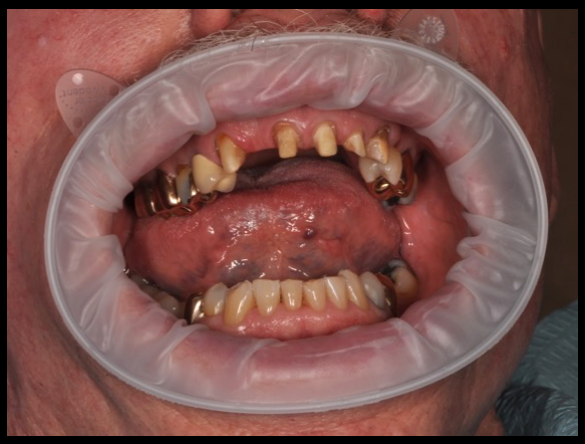
Surface treatment strategies for bonding

Substrate	Surface roughening	Chemical treatment
Tooth (dentin)	Phosphoric acid	Dentin primer
Glass ceramic	Hydrofluoric acid	Silane
Zirconia	Air abrasion	MDP-containing primer



Retractor
(Optragate)

Try-in

Check and Adjust….

1. Proximal contacts
2. Marginal fit
3. Occlusal contacts

CEMENTATION

1 Cleaning restorations (HF etching)

Other options include…

- Phosphoric acid
- Ethanol-containing cleaning solution
- Cleaning paste (Ivoclean)

Cementation

2 Cleaning teeth

Mechanical cleaning
(pumice)

Rinse

Isolate

*** Chemical cleaning (chlorohexidine gluconate cavity cleaner) - optional

Cementation

3 Cementation

- ✓ Load an adequate amount of cement.
- ✓ Apply firm pressure.

Cementation

4 Excess removal

Cementation

5 Repeat procedures for other teeth

- Week 10 – Cementation (03.10.2022)

Due by 03/17/2022 Thu 1pm