

SURFACE TREATMENT OF INDIRECT RESTORATIONS – A REVIEW

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ABSTRACT

The ultimate goal of restorative dentist is to get long lasting restoration for which attaining good bond strength is paramount, for which a thorough understanding of intaglio surface, its surface treatment, resin cements and adhesive system is crucial. Commonly used aesthetic restorative materials involve composites and ceramics, for the context of this particular article we will be focussing on indirect ceramic aesthetic restoration which include metal ceramic restoration, silica-based ceramic and high strength ceramic restorations.

J Ind Dent Assoc Kochi 2022;4(3):19-23.

INTRODUCTION

Modern era of aesthetic dentistry comprises of a combination of adhesion and aesthetics which could be termed as “adhesthetics”¹. The evolution of acid etchable ceramics during 1980s have made significant progress in aesthetics as well as conservative dentistry, that has improved tooth conservation, clinical longevity and ultimate patient and dentist satisfaction². Within this context, ceramic laminate veneers and ceramic crowns have been widely used for cosmetic procedures involving the anterior teeth due to the excellent esthetics, durability, and biocompatibility that characterize these materials³.

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Metal Ceramic Crown

Metal ceramic restoration could be characterized as traditional restoration which requires the implementation of preparatory features like resistance form and retention form. Along with this proper selection of cement and surface treatment enhance the bond between restorative and tooth interface⁴.

Commonly used cements for metal based restoration include zinc phosphate and glass ionomer cement. However, these conventionally used cements possess the disadvantages of greater stiffness and increased solubility which decreases the bond strength over a period of time hence the focus has been shifted to resin based luting cement⁵. Self-adhesive resin cements offer high fracture strength, adequate bond to the dental structure and low solubility when exposed to oral fluids⁶.

Surface Treatment for Metal Ceramic Restoration

- Clean the intaglio surface using ultrasonics in water for at least 5 min.
- Air abrades using alumina particles (30 to 50 µm pressure: 0.5 to 2.5 bar, approximately 15 s for an area of 10 mm).
- Apply one coat of silane coupling agent on the intaglio surface.
- Never touch the silica-coated intaglio surface with fingers.
- Do not photopolymerize.
- Apply the resin-based luting cement on the intaglio surface and position the restoration carefully on the preparation.
- Allow the cement to flow by slightly rocking the restoration. Seat the restoration and tack-cure any cement excess for approximately 2 seconds using a curing light.
- After removing the excess cement, coat the margins with glycerin gel for oxygen inhibition, and photopolymerize again (20 sec)^{7,8}.

High Strength Ceramic Restorations

When preparation designs are retentive, non-adhesive cements (ie, glass ionomer cements) or moderately adhesive cements (ie, self-adhesive resin cements) can be used successfully to retain these non-silica-based restorations⁹. Whereas in case of silica based restoration like lithium disilicate and high strength restorations like zirconia sophisticated surface treatment is carried out before cementation¹⁰. Recently, several studies have reported that high strength alumina- and zirconia-based dental ceramics cannot be etched with hydrofluoric acid because of their high crystalline phase content^{11,12,13,14}.

Surface Treatment Protocols For High-Strength Ceramics (Ie, Aluminum And Zirconium Oxide) Include 2 Methods.

A) Air-particle abrasion with small aluminum oxide particles (eg, 30 µm).

Followed by application of a primer (contains phosphonate or phosphate monomers) and resin. Phosphate monomers form covalent

bonds with the zirconia surface and have polymerizable resin terminal ends that copolymerize with the resin cements (APC technique).^{15,16,17}

B) Secondly a laboratory technique, namely the internal (INT) coating technique, where the internal surface of the zirconia restoration is thinly coated by fusing silica-based ceramic. In this technique, the internal surface of zirconia frame is modified with silica-based ceramic; therefore, the bonding of resin cement to zirconia ceramic may be improved via silane coupling agents.

Silica-based Ceramic Restorations

Among the all restoration we have discussed so far silica based ceramic (lithium disilicate) restorations give superior aesthetics and tooth conservation¹⁸.

To get predictable and long lasting restorations surface treatment for tooth as well as restoration and strict bonding protocols has to be followed.

Surface Treatment for Intaglio Surface of Restoration

- Surface treatment of intaglio surface using

9.5% hydrofluoric acid (HF) for 20 seconds – HF attacks the glassy phase of the ceramic material, dissolving the surface and exposing the silicate crystals in the matrix, creates surface roughness and the application time depends on the crystalline content of the specific ceramic substrate. A higher crystalline content requires less time for acid etching and less acid concentration.

- Rinse for 1 minute.
- Application of silane coupling agents (1minute) - provides a chemical covalent bonding between the silica in the ceramic matrix and copolymerizes with the methacrylate groups through siloxane bonds. It is important not to place an excess or thick layer of silane because additional layers of hydrolyzed silane will not bond to the porcelain surface and can result in a less than optimal porcelain bond^{19,20}. (Figure I:A-I)

Surface Treatment of Tooth Structure

- Proper isolation of tooth structure.
- Etch the enamel with 37% phosphoric acid gel (enamel 30-40 sec, dentin 10-15 sec).
- Thoroughly rinse with water.



Figure I : A) Intaglio surface of lithium disilicate crown. B&C) Application of 9.5% hydrofluoric acid (HF) for 20 seconds D) Hydrofluoric acid in the intaglio surface E) Saline rinsing F) Air drying G) Dried intaglio surface ready for bonding . H&I) Application of silane coupling agents (Photo Courtesy-Dr. Prasanth Dhanapal)

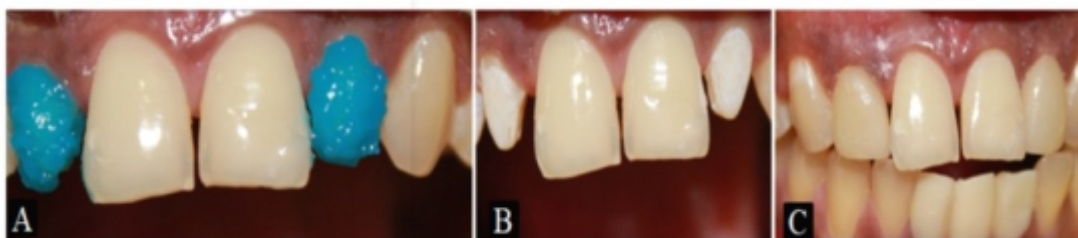


Figure II A) Etching of the tooth with 37% phosphoric acid gel B) Drying the tooth surface C) After bonding (Photo Courtesy – Dr.Prasanth Dhanapal)

- Apply bonding agent and light-cure it (20) sec. (Figure II :A-C)

CONCLUSION

The intaglio surface of the restoration where the power actually lies is always ignored, not understood or not aware of them. Making sure that the intaglio surface is prepared and treated appropriately is crucial for the clinical longevity of the indirect restoration. Optimizing intaglio surface requires an understanding involved substrate and material as well as logical and systematic methodology in their manipulation.

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