REVIEW ARTICLE CODEN: AAJMBG

Indirect Restorations - A Review

Deepa Astekar*, Hemant Vagarali, Madhu Pujar, Veerendra Uppin and Manjula Kittur

Department of Conservative Dentistry and Endodontics, Maratha Mandal Nathajirao G. Halgekar Institute of Dental Sciences and Research Centre, Bauxite Road, Belagavi, Karnataka, India

Received: 19th December 2019; ***Accepted:*** 15th March 2020; ***Published:*** 01st April 2020

Abstract: The choice of restorative material in extensive loss of tooth structure because of caries or fracture depends upon the amount of remaining tooth structure that can be utilized for gaining resistance and retention form. The direct restorations are usually not feasible and advisable in teeth where more than half tooth structure is lost. The indirect restorations such as inlays and onlays provide the required resistance and retention forms as well as support for the remaining tooth tissue. Indirect restorations such as ceramic veneers play a major role in esthetic rehabilitation. This article critically reviews applications and materials used for indirect restorations.
Keywords: Indirect Restorations**,** Cast Gold Restorations, Composite Inlays, Ceramics Inlays.

Introduction

Esthetics is one of the top priority for which more patients seek dental treatment. Caries, trauma, anatomical variations of the teeth are some of the causes which require aesthetic rehabilitation of anterior segments [1]. The present treatment modalities provide various approaches such as direct and indirect aesthetic veneers, which efficiently restore the lost tooth structure. The choice of the restorative material depends upon the amount of remaining tooth structure that can be utilized for gaining resistance and retention form [2-3].

Restorative dentistry is focused on regaining decayed and damaged teeth in such a way that, its form, function and esthetics are reestablished and exposed dental tissue are protected against the infiltration of harmful fluids. To achieve this, the dentist can generally choose between a direct or indirect restorative technique. Today, direct adhesive restorations are in many cases a viable alternative, however, they are not without their shortcomings. When there is no adhesive bond between the restoration and the dental hard tissues, marginal gap formation will result, leading to microleakage which may cause secondary caries and post operative sensitivity [4-6]. By using indirect techniques, many of the shortcomings may be avoided.

Materials used in indirect restorations:

In 1984, the ADA proposed a simple classification for dental casting alloys. Three categories are described [7-9]:

- High noble (HN)
- Noble (N)
- Base metal (PB) (Predominant)

According to Sturdevant there are four distinct groups of alloys;

- Traditional high gold alloys
- Low gold alloys
- Palladium – silver alloys
- Base metal alloys

Cast-Gold Restorations:

The use of gold for restorations in dentistry has declined with the development of composite and porcelain restorations. However, conservative cast-gold restorations continue to be the treatment of choice for restoration of posterior teeth and the distal aspect of canines for many clinicians. The primary advantage of gold casting is its permanence; a gold restoration can last a lifetime [10-11]. Although gold castings are relatively technique sensitive and demanding of the operator, this type of restoration, well

executed, offers the patient restorative comfort and long-term service. *Dr. Richard Tucker* has developed techniques for cavity preparations, fabrication, and finishing of conservative gold castings that have become a standard of excellence.

Characteristics of Gold Restorations [12-13]:

1. Gold alloys do not oxidize and discolor the teeth.
2. A thin layer of gold can protect fragile areas of teeth.
3. The gold restoration itself will not fracture in the isthmus or other areas.
4. The marginal gap at the tooth-gold interface can be nearly imperceptible if handled properly. Reducing the problem of plaque accumulation at the margins should contribute to better tissue health.
5. The cast-gold inlay can be finished to have a highly polished and smooth surface, which is pleasant to the tongue and compatible with the oral tissues. Such a finish is more plaque resistant than a rough surface.
6. Gold castings such as 3/4, 7/8, or full crowns can prevent fracture or relieve sensitivity when tiny fractures are present.

Composite Resin as Indirect Restoration:

When a composite resin is cured, polymerization shrinkage occurs in the resin matrix. With the direct technique, such shrinkage can cause a marginal gap where the bond strength is the weakest, such as at the dentin-composite resin interface. When composite resin is cured in the laboratory by light, heat, or other methods, the shrinkage occurs before the restoration is bonded into place; thus only a thin layer of luting composite resin is subject to shrinkage at the tooth-restoration interface. This results in less marginal gap, which reduces the likelihood of marginal leakage, sensitivity, recurrent decay, and staining. In addition, studies have shown that some laboratory techniques (such as those that use pressure or vacuum plus heat or light catalysts and those that use heat processing after or simultaneously with light) produce a greater degree of polymerization than that achieved with light alone [14].

Thus the physical properties of tensile strength and hardness may be improved, providing for longer lasting and stronger restorations. The rapid advances in composite resin technology are expected to produce materials that not only rival the beauty and physical properties of porcelain, but that also solve the problems associated with this time-proven material.

Composite Resin Systems:

Three types of composite resin material are available for use in indirect techniques: micro filled resins, small particle composite resins and hybrid resins. All show excellent wear resistance, but small particle composite resins and hybrid resins can be etched to produce micromechanical retention. They also can be silanated to enhance the bond strength. A new category of processed composite resin recently was introduced. Polymer-glass, polymer-ceramic, and ceromer (ceramic-optimized polymer) are all terms used to describe these materials. In reality, they are all composite resins with improved properties. Several systems also have incorporated fiber reinforcement to allow fabrication of metal-free fixed partial dentures [15].

I. *Artglass:* Artglass is a polyglass, an indirect restorative material with improved resin and filler technology designed as an alternative to porcelain. Consisting of multifunctional methacrylates, bifunctional monomers, 20% silica fillers, and microglass fillers. The silica filler reportedly reduces slumping and improves sculptability. A high-output strobe light is used to cure the material.

- *Uses :*
  - For metal and nonmetal crowns
  - Fixed partial dentures
  - For inlays, onlays
  - Veneers.

II. *Belle Glass HP:*

- Dual cure indirect polymer-ceramic is a low-wear, high strength microhybrid.
- Physical properties are reported to include the strength of porcelain combined with an average wear rate of 1.2 to 1.5 μm per year.
- This material can achieve a cure of 98.5% with the use of fiber-optic light, a heat level of 140^0 C, and pressure of 60 pounds

per square inch (psi) in a nitrogen environment. This curing percentage exceeds that which can be achieved with a single entity, such as a fiber optically driven light.

- The high flexural strength of this material is reported to offer far greater fracture resistance than unsupported porcelain.
- *Uses:*
  - Inlays, onlays
  - Anterior veneers
  - Implants
  - Full coverage
  - Metal free-fixed partial dentures
  - Long-term provisional restorations or splints.
- Use of this polymer-ceramic has undergone more than 5 years of in vitro clinical documentation.

III. *Clearfil CR Inlay:*

- It is a hybrid composite resin that is filled 86.5% by weight.
- Available in six shades, this light-cured composite resin has been formulated with extra body to make condensing and carving easier. Its heavier body allows for buildup and minimizes sag.
- The inlay is processed in the CRC-100 Curing Oven. The inlay is bonded into place with CR Inlay Cement, a dual-cured luting composite resin. Light irradiation for 40 seconds per surface sets the cement and stabilizes the inlay, and additional chemical curing beneath the restoration ensures a secure bond.
- It is recommended that vinyl polysiloxane impression material be used because of its low deformation, and extra-hard plaster stone is recommended for the model.
- *Uses:*
  - Inlays and onlays. *Coltene Inlay System:*
- It was first designed for direct/indirect application.
- Separating medium is placed on a tooth prepared with divergent walls and without undercuts.
- A composite resin inlay is fabricated directly in the tooth removed and placed in a special oven that provides heat at 120^0 C and light for 7 minutes, followed by cooling for 1 minute. The inlay may be fabricated in the office, avoiding the need for temporization, or the dentist may place a provisional restoration and have the patient return after the restoration has been fabricated in the office or dental laboratory.
- *Uses:*
  - Inlays and onlays
  - Laminate veneers.

IV. *Cristobal [15-16]:*

- Cristobal is composed of barium glass particles, 74.2% by weight, with an average particle size of 0.7μm in a matrix of bis-GMA, TEDMA and UDDMA.
- It is reported to have very low polymerization shrinkage (0.12% after 24 hours), a low wear rate (less than 5 μm per year) and high compressive and flexural strengths. Cristobal's cure rate is reported to be 92.6% by light cure alone.
- *Uses :*
  - Crowns
  - Inlays and onlays
  - Laminate veneers
  - Veneers on metal substructures
  - Multiple-unit metal-free restorations.

V. *Sculpture:*

- Sculpture is a polymer-ceramic, is reported to have very low water sorption and high wear resistance. The low water sorption is reported to afford greater stain resistance.
- Sculpture uses a PCDMA chemistry featuring high fracture toughness and low polymerization shrinkage. Sculpture is a shock-absorbing restorative material that is used in conjunction with osseointegrated implants.
- It is said to truly challenge the esthetics of porcelain while offering user-friendly handling, excellent marginal integrity, and polishability. Sculpture restorations are fluorescent.
- *Uses:*
  - Crowns
  - Inlays and onlays
  - Laminate veneers
  - Veneers on metal substructures
  - Multiple-unit metal-free restorations

VI. *Targis:*

- It is a ceromer (ceramic-optimized polymer).
- It is provided in base, dentin, and incisal shades. Targis is processed using a heat and light oven calibrated for ideal polymerization.
- *Uses:*
  - Crowns
  - Inlays and onlays
  - Laminate veneers
  - Veneers on metal substructures
  - Multiple-unit metal-free fiber-reinforced restorations veneers on metal substructures.

VII. *True Vitality:*

- True vitality is a hybrid composite resin with three curing modes: heat curing, self curing, and light curing.
- It allows dentists to perform indirect inlays and onlays in the office without requiring special equipment.
- True Vitality is reported to have a wear rate less than half that of amalgam; high compressive, tensile, and flexural strengths; a 3 mm depth of cure; and low water sorption. It is radiopaque.
- *Uses:*
  - Simple direct restorations
  - Inlays and onlays
  - Fixed partial dentures and crowns
  - Laminate veneers

VIII. *Visio - Gem:*

- It is a light and vacuum-cured microfilled composite resin.
- Initial curing during buildup procedures is done with a direct visible light source, called the Visio Alpha unit.Final polymerization takes place in a light and vacuum chamber, called the Visio Beta unit. The vacuum allows complete curing of the oxygen-inhibited layer and results in greater color stability and enhanced physical properties.
- *Uses:*
  - Indirect composite resin laminate veneers
  - Inlays and onlays
  - Jacket crowns
  - Custom denture teeth
  - Long-term provisional restorations.

Ceramic or Porcelain

Ceramic Inlays and Onlays: Ceramic inlays and onlays have become popular not only because of patient demand for esthetic, durable restorative materials, but also because of recent improvements in materials, fabrication techniques, and bonding systems. Among the ceramic materials used are feldspathic porcelain, hot pressed ceramics, and machinable ceramics designed for use with CAD/CAM systems [17-18]. The physical and mechanical properties of ceramics come closer to matching those of enamel than do composites. They have excellent wear resistance and a coefficient of thermal expansion very close to that of tooth structure [19-21].

Feldspathic Porcelain: A ceramic composed of a glass matrix phase and one or more crystalline phase one of which is leucite (K_{20},$A_{12}O_3$, $4SiO_2$) which is used to create high-expansion porcelain that is thermally compatible with metal allow core substructures; a more technically correct name for this is leucite porcelain because feldspar is not present in the final processed porcelain nor is it necessary as a raw material to produce leucite crystals [22-23].

Hot Pressed Glass Ceramics: In 1968, it was discovered that certain glasses could be modified with nucleating agents and, upon heat treatment, be changed into ceramics with organized crystalline forms. Such “glass ceramics” were stronger, had a higher melting point than noncrystalline glass, and had variable coefficients of thermal expansion. At first, these glass-ceramics were primarily developed for cookware and other heat-resistant products. In 1984, the glass-ceramic material Dicor was patented and rapidly became a popular ceramic for dental restorations. A major disadvantages of Dicor was its translucency, which necessitated external application of all shading [24].

Dicor restorations were made using a lost-wax, centrifugal casting process. Newer leucite-reinforced glass-ceramic systems also use the lost-wax method, but the material is heated to a high temperature and pneumatically pressed, rather than

centrifuged, into a mold. Although some studies indicate that hot pressed ceramics are not significant stronger than fired feldspathic porcelains, they do appear to provide better clinical service [25].

Conclusion

Indirect restorations play a vital role in restorative dentistry with growing demand for esthetic dental restorations. Ceramics have a diverse range of applications such as crowns, veneers inlays, onlays ect. Though their applications continue to expand, there are still certain limitations like high cost, precise laborotary procedures ect.

However when selected and used correctly, Indirect Restorations have excellent esthetic, biologic, mechanical and physical properties ensuring successful clinical outcome.

Financial Support and sponsorship: Nil

Conflicts of interest: There are no conflicts of interest.

References

1. Bruke TFJ. Trends in indirect dentistry: Introduction. *Dent Update*. 2005; 32:128.
2. Bateman G. Trends in indirect dentistry: 1. Case selection. *Dent Update*. 2005; 32:129-133.
3. Brunton PA, Christensen GJ, Cheung SW, Burke FJT, Wilson NHF. Contemporary dental practice in the UK: indirect restorations and fixed prosthodontics. *Br Dent J*. 2005; 198:99-103.
4. Randall RC, Wilson NHF. Glass-ionomer restoratives: A systematic review of a secondary caries treatment effect. *J Dent Res*. 1999; 78(2):629.
5. Bruke FJT. Trends in indirect dentistry: Conclusions. *Dent Update*. 2005; 32:374-394.
6. Laird WRE. Restoration of teeth (complex restorations). Indirect adhesive restorations. Text Book Restorative Dentistry. *Journal of Oral Habilitation.* 2005**;** 116-125.
7. Kugel G. Direct and Indirect adhesive restorative materials; A review. *Am J Dent*. 2000; 13:35.
8. Rocca GT and Krejci I. Bonded Indirect Restorations for anterior teeth; From cavity preparation to provisionlization. *Quint Int.* 2007; 38:371.
9. Graundy JR. Posterior indirect restorations. Atlas (clinical operative dentistry, crown and bridges). 2nd ed. *British Dental Journal.* 1971; 89-96.
10. Pickard HM. Indirect gold inlay technique. A Manual of Operative Dentistry 5th ed. *Oxford publishers.* 1996; 207-236.
11. Wilson, Rovelet. Inlays cast gold. Text book of advance in operative dentistry. *Dent J.* 2009; 270-291.
12. Christenson GJ. The coming demise of cast gold restoration. *JADA.* 1996; 123-127.
13. Wolf BH, Walter MH. Margin quality of titanium and high gold inlays and onlays-a clinical study. *Dent Mater.* 1998; 14:370.
14. Christensen GJ. Current use of tooth-colored inlays, onlays, and direct-placement resins. *J of Estht Dent*. 1998; 10(6):290-295.
15. Nash R. Composite resin: Indirect technique restorations. Text Book Esthetic Dentistry 2nd ed. *Oper Dent*. 2000; 97-111.
16. Krejci I, Lutz F. Wear and marginal adaptation of composite resin inlays, *JPD.* 1994; 72-233.
17. Zhang X, Yang C. CAD ana manufacture of posterior crowns Chin. *J.Dent.Res1.* 1998; 30.
18. Palin WM, Bruke FJT. Trends in indirect dentistry: 8. CAD/CAM technology. *Dent Update*. 2005; 32:566-572.
19. Makcret JR, Parry EE. Measurments of oxide adherence to dental alloys for porcelain. *JDR.* 1984; 35-63.
20. Denissen HW, Vaan Waas MA. Porcelain-veneered computer generated partial crowns. *Quint.Int.* 2002; 33:723.
21. Praston JD. The Etched, bonded porcelan inlays. Text book of Perspectives in Dental Ceramics. 8th ed. *Journal of California.* 1998; 35-50.
22. Martin N and Jedynakiewicz NM. Clinical performance of CEREC ceramic inlays; a systemic review. *Dental Mater.*1999; 15-54.
23. Roseblum MA and Shulman A. A review of all ceramic restorations. *JADA.* 1997; 128-297.
24. Van Dijken JWV. All ceramic restorations; classification and clinical evaluation. *J Dent*. 1999; 20:1115.
25. Presston JD. Rational approach to tooth preparations for Ceramo Metal restorations. *Dental Clin, North Am.* 1997; 21:683.

Cite this article as: Astekar D, Vagarali H, Pujar M, Uppin V and Kittur M. Indirect Restorations - A Review. *Al Ameen J Med Sci* 2020; 13(2):67-71.

*All correspondences to: Dr. Deepa Astekar, Resident, Department of Conservative Dentistry and Endodontics, Maratha Mandal Nathajirao G. Halgekar Institute of Dental Sciences and Research Centre, Bauxite Road, Belagavi, Karnataka, India.
E-mail: dr.deepa82@gmail.com