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Indirect Veneer

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degree
B.D.S

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DEDICATION

This project is wholeheartedly dedicated to my beloved parents, who have been my source of inspiration and gave me strength when I thought of giving up. To my sisters, mentor, friends who shared their words of advice and encouragement to finish this study. And finally, I dedicated this project to the almighty God, thank you for the guidance, strength, power of mind, protection and skills.

DECLARATION

I certify that this project entitled "Indirect veneer" was prepared by the fifth-year students **Hamsa Mohammed Radhi** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Signature :
Dr. Marwah Ismael Abdulazeez
The supervisor

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Introduction:-

Today, the main reasons for applying restorative dental materials is not only to restore dental tissues lost because of caries or trauma, but also to correct the form and colour of teeth for social acceptance. In some parts of the world, it is estimated that up to 50 percent of individuals seek dental care simply to improve the appearance of their dentition.1In reconstructive dentistry, missing dental tissues can be restored through a number of treatment options.

For many years, full-coverage crowns were considered the most predictable treatment option fullcoverage crowns require substantial removal of sound dental tissues to gain space for the restorative material, and to achieve macro-retention. This can weaken the tooth, which might lead to pulpal injuries, and patient discomfort during or after drilling (Pjetursson *et al.*, 2007).

Esthetic or cosmetic dentistry has become one of the main areas of dental practice emphasis and growth for several years. Recently, the main reason for applying restorative dental materials is not only to restore dental tissues lost because of caries or trauma, but also to correct the form and color of teeth for social acceptance (Gresnigt, 2011), Recreating a smile need not be limited to the anterior teeth, but may extend to include the posterior teeth. The number of teeth involved in the esthetic treatment plan will depend upon the patient's facial and dental esthetic analysis (Mistry, 2012).

Little information is available in the literature on the survival rates of different laminate materials. There was no evidence as to whether indirect laminates are better than direct ones. Direct composite laminate veneers are less expensive than the indirect options and they can be accomplished in one session and they offer excellent esthetic potential and acceptable longevity, with a much lower cost than equivalent ceramic restorations for the treatment of both anterior and posterior teeth. However, they still suffer from a limited longevity since they are susceptible to discoloration wear and marginal fractures, thereby reducing the esthetic result in the long-term and ceramics remain the preferred esthetic option for many clinicians (Gresnigt and Ozcan, 2007; Dietschi, 2011).

Aims of the study

The goals of this review are :

(1) to describe the evidence behind the use of ceramics vs composite resin to restore teeth with anterior veneers using a minimally-invasive strategy .

(2) to discuss the choice of materials and techniques for anterior veneer restorations.

CHAPTER ONE

Review of literature

1. Advantages of Veneers Include (Anderson et al,2013):

1- Minimal tooth preparation required.

2- Porcelain veneers are stronger and more durable than composite veneers.

3- Alternative to full coverage restoration in case of incisal fractures or tooth discoloration .

4- Color stability.

2. Disadvantages of Veneers Include. (Anderson et al, 2013):

1- Potential for over-contouring.

2- Requires laboratory procedures.

3- Porcelain enamel margins may be thin and difficult to finish.

4-Brittle margins.

5- Pitting by acidulated fluoride treatment.

6- Cannot be repaired easily.

7-Can sometimes be difficult to temporize.

8- Color cannot be altered substantially after placement.

9-Placement is difficult and time-consuming.

3. Indications: (Magne and Belser, 2002)

1) Type I – teeth resistant to bleaching:

a) tetracycline discoloration.

b) No response to external or internal bleaching.

2) Type II – Major morphologic modifications:

a) Conoid teeth.

b) Diastema and interdental triangles to be closed.

c) Augmentation of incisal length and prominence.

3) Type III – Extensive restoration:

a) Extensive coronal fracture.

b) Extensive loss of enamel by erosion and wear.

c) Generalised congenital and acquired malformations

4. Contraindications: (Highton and Caputo, 1987).

1. Full coverage restorations are preferred over veneers in case of insufficient coronal tooth structure. A fractured teeth, with more than one-third of loss of tooth structure, are a poor case for veneers
2. Actively erupting teeth should not be subjected for veneering.
3. Patients with parafunctional habits like bruxism should hardly receive veneers .
4. Endodontically treated teeth are again not recommended for veneers as they present a poor receptive surface for bonding and full coverage restorations are indicated.

5. Case Selection :-

1. Color defects or abnormalities: Defective amelogenesis, tetracycline staining, fluorosis, devitalized teeth, teeth with generalized facial discoloration from amalgam shine-through and teeth darkened by age which are not conducive to vital bleaching or microabrasion procedure (Goldstein, 1998; Mangani et al., 2007).

Figure 1 :- Tetracycline stained teeth treated with veneer (Mangani et al., 2007).

2. Surface defects: Small cracks in the enamel caused by aging, trauma or ice-chewing can weaken the enamel and stain darkly. In these situations, porcelain laminate veneers will mask the stains and seal and strengthen the teeth. Teeth with numerous shallow, unaesthetic restorations on the labial surfaces also can be dramatically improved (Goldstein, 1998).

Figure 2 :- Surface cracks and staining of teeth corrected with veneer . (Goldstein, 1998).

3. Closing of diastemas, single or multiple spaces between the teeth, and improving the appearance of rotated or malposition teeth. Persons who have relatively sound teeth but who do not want to undergo orthodontics may be helped with laminates that create the esthetic illusion of straight teeth (Goldstein, 1998; Villani and Juneja, 2012).

Figure 3 :- Diastema closed with veneer .(Goldstein, 1998)

4. Short teeth: These teeth can be lengthened to a more esthetic appropriate size.

Figure 4 :- Lengthening of short teeth with veneer .(Goldstein, 1998).

5. Malocclusions or periodontally compromised teeth: laminates can restore or change the configuration of the lingual surfaces of anterior teeth useful for creating canine function or correcting anterior guidance. Porcelain laminates can also be used to reshape interproximal embrasure spaces when the gingival tissues have receded (Goldstein, 1998).

Figure 5 :- Gum recession corrected with veneer .(Goldstein, 1998).

6. Abnormalities of shape: Microdontia, atypical tooth shape; malformed incisor, retained deciduous teeth (Mangani et al., 2007; Villani and Juneja, 2012).

Figure 6 :- Peg shaped lateral incisor corrected with veneer .(Mangani et al.,2007)

7. Progressive wear patterns: If sufficient enamel remains and the desired increase in length is not excessive, porcelain veneers can be bonded to the remaining tooth structure to restore the shape, color, or function of the teeth. (Goldstein, 1998).

Figure 7 :- Veneer for teeth with progressive wear .(Goldstein, 1998).

8. Functionally-sound porcelain fused to metal or all ceramic crowns with unsatisfactory color. The labial surface of the old porcelain is prepared as you would for a conventional laminate. After an impression, a veneer is constructed in the new shade. The existing crown surface is roughened with air abrasion, and then etched with a buffered intraoral use hydrofluoric acid and silanated. The laminate is then bonded to place with resin cement. However, the cost of this procedure is basically the same as making a new crown, so its use should

be limited to those patients not wanting their entire crown or bridge remade (Goldstein, 1998).

Figure 8 :- Unsatisfactory color of ceramic crown .(Goldstein, 1998).

9. Malpositioning and correction of minor malposition such as rotated tooth and change of angulation (Mangani et al., 2007).

Figure 9 :- Malposed teeth corrected with veneer . (Mangani et al., 2007).

6. Types of Indirect laminate veneers :-

6.1 Indirect Composite laminate veneers

Indirect composite restorations offer some benefits as compared to direct restorations, such as better mechanical performance and a significant reduction in polymerization shrinkage (Dietschi et al., 1995). Wear resistant, esthetic, and relatively less prone to postoperative sensitivity (Terry and Lienfelder, 2004).

Maximizing the degree of conversion and minimizing shrinkage stresses are opposing goals which are difficult to achieve with direct composite restorations (van Heumen et al., 2008). Additional clinical benefits include precise marginal integrity, ideal proximal contacts, excellent anatomic morphology, and optimal esthetics (Touati and Aidan, 1997). Due to the similar composition of the luting cement and composites, the marginal adaptation of composites is better than that of ceramics.

No-prep Veneers are thin composite veneers with a thickness of more than 0.5 mm,used to change the color and/or shape of teeth when no tooth preparation is required. Unlike contact lenses (veneers that are 0.5 mm or less in thickness, not discussed in this article), no-prep veneers are normally layered with dentin and enamel shades in varying degrees of opacity / translucency.

From a dental materials standpoint, the main advantage of this approach over a directly placed composite veneer is the enhanced physical and mechanical properties afforded by the extra-oral chairside tempering process due to increased monomer conversion.

(Wassell RW, McCabe JF, 1997).

The clinical success of indirect resin-based composite veneers is attributed to the intimate bond achieved between the restoration and the tooth structure through the resin cement. A chemical bond is formed between the bonding agent and resin cement and, to lesser extent, between the bonding agent and the veneer (Sarabi et al., 2009). indirect veneers made of processed composite(in special heatand photo-polymerization devices at the dental laboratory)possess limited bond strength because of the reduced potential to form chemical bond with the bonding medium. Therefore, in order to provide additional micromechanical retention, the internal surface of indirect veneer should be roughened (Hegde and Khatavkar, 2010).

6.2 Porcelain Laminate Veneer:

Porcelain veneers are thin-bonded ceramic prosthetics that restore the facial surface and part of the proximal surfaces of anterior teeth that require esthetic treatment.(Ferro et al., 2005).

They typically consist of thin shells of porcelain, the fitted surface of which has been etched with hydrofluoric acid and coated with a silane coupling agent. Using a resin-based cement, the veneer is bonded to enamel that has been prepared with a phosphoric acid etchant (Burke FJ,2017). Due to their high esthetic appeal, as well as their proven biocompatibility and long-term predictability, porcelain veneers have become a reliable restorative procedure for the treatment of teeth in the front area of the mouth. (Aykor A, Ozel E. 2009).

Porcelain veneer technique utilizes the bonding capability of these materials to securely attach a thin shell of porcelain (the porcelain veneer) to a tooth. Although porcelain is inherently brittle, when it is firmly bonded to a tooth, it becomes very strong and durable (Magne et al., 2013, LeSage, 2013).

Randomized clinical trial up to 3 years follow-up of indirect resin composite and ceramic veneers by Gresnigt et al showed that both veneer materials showed statistically similar survival rates (Gresnigt et al., 2013) .

6.3 Types of porcelain laminate veneers :-

6.3.1 Traditional feldspathic stacked veneers

Feldspathic veneers are created by layering glass-based (silicon dioxide) powder and liquid materials. Silicon dioxide, also referred to as silica or quartz, contains various amounts of alumina. When these aluminum silicates are found naturally and contain various amounts of potasium and sodium, they are referred to as feldspars. Feldspars are primarily composed of silicon oxide

(60%–64%) and aluminum oxide (20%–23%), and are typically modified in different ways to create glass that can then be used in dental restorations.
Feldspathic porcelain's mechanical properties are low, with flexural strength usually from 60 to 70 MPa (Giordano R, McLaren EA,2010). Feldspathic porcelain provides great aesthetic value and demonstrates high translucency, just like natural dentition (Culp and McLaren, 2010).
Currently, requests for less-invasive treatments and higher levels of aesthetics have enhanced the indication of feldspathic veneers. With this material, it is possible to have a thick- ness of less than 0.5 mm, with or without preparation in the enamel. To preserve the health of the gingival tissues and prevent overcontouring, a slight 0.5 mm reduction of tooth surface is found to work best (McLaren EA,2010).

6.3.2 Pressed ceramic veneers (Glass based ceramics)

Glass ceramics may be ideally suited for use as dental restorative materials. Their mechanical and physical properties have generally improved, including increased fracture resistance, improved thermal shock resistance, and resistance to erosion. Improvement in properties depends on the interaction of the crystals and glassy matrix, as well as on the size and amount of crystals. Finer crystals gener- ally produce stronger materials. They may be opaque or translucent, depending on the chemical composition and percent crystallinity (Giordano R, McLaren EA ,2010). These materials, termed pressable ceramics, were manufactured to be extremely dense and demonstrated much higher strength ratings, such as flexural strengths up to 180 MPa (McLaren and Cao,2009).
Increased strength in glassy ceramics is achieved by adding appropriate fillers that are uniformly dispersed throughout the glass, such as aluminum, magnesium, zirconia, leucite, and lithium disilicate.
The first fillers to be used in dental ceramics contained particles of a crystalline mineral called leucite, added to the ceramic, so that the leucite comprised about

50%–55% of the material.(Guess PC, Schultheis S, Bonfante EA, Coelho PG, Ferencz J, Silva NRA, 2011).

Figure 10 :- Feldspathic ceramic laminate veneers backed on refractory (maxillary teeth) , (Veneziani ,2017).

6.3.3 Computer Aided Design/Computer Aided manufacture (CAD/CAM) laminate veneer

Advancements in dental materials, computer technology, and equipment have made it possible to fabricate an indirect esthetic restoration in one appointment while the patient is waiting. The computer aided design/ computer-aided manufacture (CAD/ CAM) is used for electronically designing and milling restorations. The restoration can be designed in less than five minutes and milled in 10-12 minutes, resulting in significant time savings for both the patient and dental practice (Trost et al .,2006).

The computer-controlled fabrication diminishes the potential for inaccuracies due to human error and makes it possible to generate a restoration within a clinically acceptable fit of 50 µm, as established by the American Dental Association (Estanfan et al.,2003).

CAD stands for ‘computer-aided design’ and describes a virtual design of the restoration. CAM stands for ‘computer-aided manufacturing’ and describes the production of dental restorations by using machine units. This technology has become widespread in dentistry and seems indispensable today (Poticny, D.J.; Klim, J.2010) .

6.4 Material selection for CAD\CAM veneer :-

6.4.1 Glass/Crystal

Vitablocs Mark II is a fine-grained feldspathic ceramic that produces fine crystal (average size = 4 μm). The pore-free ceramic is easier to polish and demonstrates low enamel wear and high strength (Fasbinder,2002),(Vitablocs Mark II, 2012). According to the manufacturer, the feldspar particles are uniformly embedded in the glass matrix, avoiding a detrimental "sanding (abrading) effect" on the antagonist (Vitablocs Mark II,2012). When polished, the strength of this ceramic material is approximately 130 MPa and it could reach 160 MPa or higher if glazed. This strength is approximately twice that of conventional feldspathic ceramics and also is higher than several pressable ceramics (Vitablocs Mark II, 2012),(Giordano et al.,1996).

6.4.2 Glass/Leucite

Glass/leucite materials include Empress CAD (Ivoclar Vivadent) which is a leucite glass-ceramic of the SiO2-Al2O3- K2O materials system with approximately 45% leucite crystals ranging from 5 to 10 μm in size (Ivoclar Vivadent, 2011). The leucite (KAlSi2O6) crystals increase the material's strength and slow down or deflect crack propagation, while the crystalline phase absorbs fracture energy. The Empress CAD blocks exhibit a flexural strength of approximately 160 MPa, which his similar to the Vita Mark II blocks, Able to be polished as well as glazed (McLaren and Puri,2013).

6.4.3 Lithium Disilicate

IPS e.max CAD (Ivoclar Vivadent) is a lithium disilicate glass-ceramic for CAD/CAM applications. The blocks are produced by massive casting of transparent glass ingots. A continuous manufacturing process based on glass technology (that is, pressure-casting) is utilized to prevent the formation of defects (pores, accumulation of pigments, and so forth) in the bulk of the ingot. Partial crystallization ensures that the blocks can be processed in a crystalline intermediate phase, which enables fast machining with CAD/CAM systems. The partial crystallization process leads to a formation of lithium metasilicate (Li_2SiO_3) crystals, which are responsible for the material's optimal processing properties, edge stability, and relatively high strength (Ivoclar Vivadent, 2011). After the milling procedure, the restorations are tempered and lithium disilicate ($Li_2Si_2O_5$) crystals are formed, which impart the ceramic object with the desired high strength (Ivoclar Vivadent, 2011).

In the "blue" state, the material exhibits strength of 130-150 MPa and is thus comparable to other glass ceramic blocks available for the CEREC. Once milled, the blocks are crystallized in a furnace, which increases the strength of the material to between 360-400 MPa. Not only is the strength increased, but the final color of the restorations is changed from the blue color to the final esthetic shade (McLaren and Puri,2013).

An in vitro study by Abdul Khaliq and Al-Rawi compare Fracture strength of laminate veneers using different materials and techniques showed that IPS e. max CAD laminate veneers were least likely to fracture and most likely to completely debond (Abdul Khaliq and Al-Rawi,2014).

6.4.4 Nano Ceramic/Resin

Nano-ceramic restorative material is a unique CAD/CAM block based on the integration of nanotechnology and ceramics. According to manufacturers, the material is said to offer the ease of handling of a composite material with a surface gloss and finish retention similar to a porcelain material. Lava Ultimate™ (3M ESPE) contains a blend of nano-particles agglomerated to clusters and individual bonded nanoparticles embedded in a highly cross-linked polymer matrix. It is a combination of aggregated zirconia/silica clusters (composed of 20-µm silica and 4-µm to 11-µm zirconia particles with an approximately 80% ceramic load (3M ESPE, 2012),(Fasbinder,2012), (Fasbinder and Poticny, 2013). The inclusion of nano-particles in the Lava Ultimate block offers the potential for easy adjustment and creation of a high-gloss surface finish similar to porcelain.

The fracture resistance of a material is a function of fracture toughness and flexural strength. With a reported flexural strength of 200 MPa, the nano-ceramic block has a higher initial strength than feldspathic and leucite-reinforced porcelain blocks, The fracture toughness of the nano-ceramic material is greater than feldspathic materials and direct composites, while being less brittle than feldspathic glass-ceramics and, therefore, less prone to cracking during try-in and function (Kassem et al .,2011).

An in vitro study by Hamza *et al*, reported that aging of the nano-hybrid ceramic had a superior marginal fit and inferior color stability (Hamza et al .,2018).

6.4.5 Ceramic Resin Hybrid

The most recent material to be introduced from Vita is the Vita Enamic block. In this block, the dominant ceramic network is infiltrated with a reinforcing polymer network structure that is fully merged with one another. Due to the dual ceramic-polymer network, the new material exhibits the benefits of ceramic and resin in one material. While the compressive strength of the blocks is similar to Vita Mark II, the flexural strength is much higher, allowing the material to perform at high strength. Ideal for inlays, onlays and crowns (McLaren and Puri .,2013).

6.4.6 Vita Suprinity, zirconia-reinforced lithium disilicates (ZLSs)

These new glass-ceramics were designed to contain lithium silicate as the main crystalline phase in a vitreous matrix reinforced with zirconium dioxide crystals (~10%) (Rinke et al .,2016). These new zirconium-reinforced lithium silicate materials maintain good optical properties, are easily milled in CAD-CAM machines and attain good surface finishing, as they have a high amount of glass matrix (Krüger et al ., 2013). The two existing commercial examples of lithium silicate glass-ceramics are:

a) Suprinity (Vita Zahnfabrik, Bad Sachingen, Germany), a material marketed in a partially crystallized state and that requires an additional thermal cycle in a furnace.

b) CELTRA Duo (Dentisply-Sirona, Bensheim, Germany), a material that is already in its final crystallization stage (Gracis et al ., 2015).

These novel zirconia-reinforced lithium silicate glass-ceramics have good mechanical properties associated with an excellent esthetic quality, thus being a valid alterative to lithium disilicate materials for prosthetic rehabilitations with high aesthetic demand. The main advantage of these materials is their time saving ability for the production of dental restorations, since they are faster to be milled in CAD-CAM machines than lithium disilicate glass-ceramics (Rinke et al.,2016). And are already offered in their fully crystallized state (CELTRA Duo, Dentisply-Sirona, Bensheim Germany) no furnace need) or need a very short crystallization cycle (Suprinity, Bad Sachingen, Germany).

An In Vitro Study by Pereira *et al* Analysed the Marginal Adaptation of Porcelain Laminate Veneers Produced by CAD/CAM Technology using five CAD/CAM materials demonstrated that All CAD/CAM laminate veneers except for Empress and Suprinity in the middle and incisal thirds showed good results (ie, gaps < 120 µm in the cervical, middle, and incisal thirds) (Pereira et al .,2018).

7. Tooth preparation for laminate veneers:

In the early days of veneers, either a no-preparation or minimal tooth preparation, not extending into the dentin, was suggested (Friedman MJ,1993) (Stacey GD,1993) (Fradeani et al,2005).

This is once again gaining popularity with certain companies. Dentists routinely remove at least 0.5 mm-0.8 mm enamel. Removal of some enamel aids in achieving better bond strength. (Van Meerbeek et al,1998; Peumans M,2000) but care must be taken not to remove more than 0.5 mm-0.8 mm, especially in the proximal and cervical areas. Even though dentin adhesives have improved dramatically, porcelain bonding to enamel is better than porcelain bonding to dentin. (Van MeerbeekB,1998)

8. Classifications of veneer preparations

Referred to as no-, minimal-, or conventional-veneer preparation, with lack of veneer classifications create a large gray zone of misunderstanding and miscommunication with patients and within the dental profession. Studies show that when a conservative approach is taken and significant tooth structure remains, dentists can provide patients with a better prognosis for the restored teeth (LeSage, 2013). (Table 1) shows the basis for a new veneer classification system as proposeded by LeSage in 2013.

Reduction	Facial	Enamel remaining
CL-I No-prep or practically prep less	Detectable with magnification, with or without gingival finish line	95% to 100%
CL-II Modified prep-less or minimally invasive	Up to 0.5 mm	80% to 95%
CL-III Conservative design	0.5 to 1 mm	50% to 80%
CL-IV Conventional all-ceramic design	1+ mm	>50%

Table 1 :- New veneer calssification system

9. Variations and considerations in preparation design

9.1. Incisal Occlusal reduction

Preparation either window prep. without Incisal of involvement of this consider most conservative and maintain enamel in incisal third, which results in a visible line between enamel, resin, and ceramic; in addition, the remaining structure is more prone to fracture. The other possibility is the "feather" preparation, which recovers the incisal of the tooth, maintaining its format. The critical points of this technique are the difficulty in positioning the ceramic restoration at the moment of its cementation and in matching the optical properties of the remaining incisal structure (Della Bona, 2009). So, to obtain adequate color properties at the incisal third of the laminate veneers, the preparation needs to allow a thickness of ceramic of 1.5-2.0 mm, and this is possible with the "overlap" preparation (Pini et al., 2012).

Figure 11 :- Incisal window preparation (Zlatanovska et al .,2016).

Concerning the preparation of the occlusal surface of premolars, the laminate veneer may partially or completely covers the buccal cusp. It must also be emphasized that a greater reduction of the cusp, routinely recommended at 1.5 mm. A study by Archangelo et al. showed that the complete covering of the cusps in teeth restored with resin composite improved retention and resin strength, diminishing the occurrence of failures. Moreover, the use of reinforced ceramic systems associated with greater protection of the cusp with vertical reduction of over 0.5 mm may positively influence the distribution of stresses, increasing strength of the set and improving mechanical behavior of the laminate in the face of the forces acting on it (Archangelo et al., 2011).

Figure 12 :- Occlusal view of the amount of reduction required to develop the arch form outlined by the organe line (Banerji et al.,2017).

9.2. Cervical reduction

Regarding the configuration of the cervical third of the preparation the gingival margin of the veneer must be located at the same level as the gingival crest or lightly subgingival for the anterior teeth.

A study by Troedson and Derand in 1999 examined the stress distribution in ceramic veneers made with three different cervical designs: (Radz, 2011).

1- a "feather-edge" configuration (modified razor-edge configuration).

2- chamfer configuration.

3-shoulder configuration.

The results showed that in the presence of moderate stress, the cervical margin design does not influence veneer success. Further, when occlusal loads have various directions reflecting the forces applied on the tooth during mastication, a shoulder configuration is preferable. This study also demonstrated that veneer adhesion is the most important factor to reduce compression and traction forces.

It is generally agreed that the position of the cervical margin is a key factor in soft tissue reaction (Mangani et al., 2007).

9.3. Proximal reduction

At the proximal region, the preparation must follow the papilla and extend until interproximal contact (Della Bona, 2009), Perdigao and Lopes, 1991 argue that the preparation must extend to the contact area without involving it; conversely, Christensen in 1993 and Caleffi and Berardi in 1994 suggest including half the contact area in the preparation (Mangani et al., 2007). No conclusive evidence can be found for what is the best way to prepare the interproximal area of a tooth for a laminate veneer.

Opinions range from virtually no preparation, to a preparation that stops just short of the interproximal contact, to a slight opening of the interproximal contact. The evidence is clear that margins in enamel are preferred. The margin design here should be such that the margins are not visibly detectable and that a minimum amount of tooth structure should be removed to accomplish this goal (Radz, 2011).

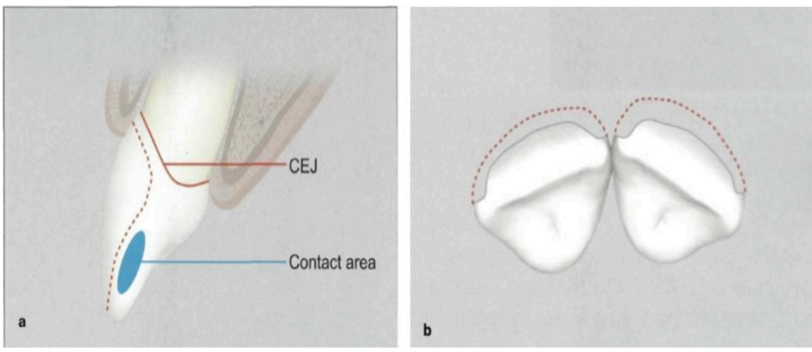

Figure 13 :- a,b Preferaably , the interproximal margine should stay short of the contact area (Gürel,2003a).

9.4. Ultra-thin preparation

In recent years, experienced, skilled ceramists have been able to consistently create porcelain veneers that are 0.3 mm thick. This ability has now allowed many dentists to become even more conservative in their preparation of teeth for porcelain veneer. The same previously mentioned preparation guidelines can be used, but now 0.3-mm depth cutters are used to control the preparation depth to an absolute minimum (Radz, 2011).

10. Mock-up

Additive wax-ups, silicon guides and corresponding diagnostic templates are very helpful in increasing the survival rate of restorations and patient satisfaction. (Magne and Douglas, 1995) To get a better idea instantly of what the eventual outcome will be, utilization of the composite mock-up is wonderful as an aid. (Miller, 2000) The neighboring tissues or teeth provide three dimensional information that is necessary to give the restoration the correct volume and shape. A diagnostic "composite mock-up" which is the direct application of composite without surface preparation that perches itself on the teeth, is indicated when such elements are missing, or when an alteration of tooth forms is necessary. (Dietschi, 1995) A silicone key makes the final fix of the situation once it is programmed. (Vanini, 1996) From the preparation to the PLV build-up and restoration finishing, the clinician is guided by these spatial references. The restorative steps will be facilitated by the visual inspection of the frontal, lateral and incisal planes. (Roulet and Degrange ,2000).

10.1. Technique of mock-up construction

Depending on the difficulty of the case, it takes from 5 to 20 minutes to prepare the new smile design with composite mock-ups for the whole upper arch. The easiest way of doing the mockup is with the freehand carving method. (Dietschi ,1995) The composite is rolled between the fingers and applied over the dried tooth structure. It is shaped with the help of the fingers and special hand carving instruments and then light cured. The teeth can be lengthened or protruded, or the color can be altered for the patient to visualize. After placing the composite mock-up on the tooth, if any part is over exaggerated (in other words, if too much composite is applied and polymerized), it can be corrected with the help of a fissure diamond bur. However, careful attention should be given not to touch the intact tooth structure while doing so. Leaving a scratched enamel surface will be unfortunate if the patient does not accept the treatment.

10.2. Material used for mock-up construction

I. Composite resin: characterized by the transfer of the aesthetic rehabilitation planning directly into the patient's mouth with light-cured composite resin. Typically carried out with enamel resins due to its excellent polishability and immediate mimetism using ceramics, applied in a single layer over each tooth without any acid etching, distributing the resin in a cervicoincisal and mesial-distal direction, and shaping the tooth as established by the planning, always to be based on the prescribed aesthetic principles. Despite the imperative necessity to manipulate the composite resin with dexterity and of offering an idealized morphology which includes application, finishing and polishing, this technique saves time between appointments (Magne and Belser,2004).

II. Bis-acrylic resin: where the aesthetic rehabilitation planning is transferred to the patient's mouth with bis-acrylic resin. Despite its good finishing and polishing characteristics, bis-acrylic resins are monochromatic and may cause great estrangement to the patient with respect to the immediate result. Therefore, it is recommended to carry out a wax-up that offers not only the ideal dimensions, but a maximum of morphological and surface texture features. In this manner, the reflection of light is controlled, so that what will be valued is its highlighted idealized dental morphology.

III. Acrylic resin: differs from the mock-up with bis-acrylic resin due to the rigidity of the acrylic resin mock-up, fabricated in the laboratory. Despite its excellent polychromatic property, it is possible to be applied and exhibit an excellent finishing and polishing, the high cost must be taken into consideration, except for cases of anticipated periodontal surgery, in which this technique is preferable (Decurcio and Cardoso et al, 2012).

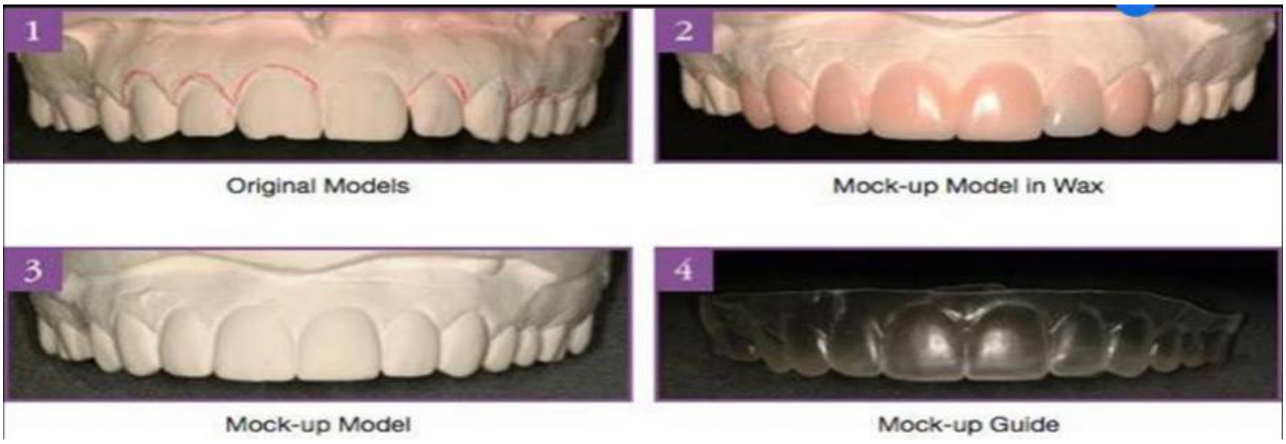

Figure 14 :- Mock-up models .(Decurcio and Cardoso et al, 2012).

11. Veneer Shade Selection

Veneers are a truly laminated structure: prepared tooth + cement + ceramic veneer. Hue, chroma, and value can be greatly influenced by the stump shade: color of the stump + color of the cement + color of the veneer = color of the final restoration (Gürel, 2003b) .

Value in the final restoration is the most notable dimension of color that the stump shade can influence. Hue and chroma are not often apparent in the lighter shades, since the saturation of hue is so low; therefore, value becomes the major variable in the esthetic effect (Gürel, 2003b).

In cases where veneers are being placed electively for cosmetic purposes, it is important to get the patient’s input. Using shade guides and photographs of previous cases, the dentist can begin to gain an understanding of what the patient is looking to achieve in the final results. It is imperative for the success of these cases that the dentist takes into consideration the patient's goals (Radz, 2011).

In cases where the LVs are being used to on 1 to 4 (or even 6) teeth, the dentist now needs to strive to reproduce a restoration(s) that matches the shade of the remaining natural teeth. With a case that will include 8 to 10 teeth in the arch, the shade selection should be an agreement between the dentist and the patient as to what shade will met the patient's goals (Radz, 2011).

11.1 Clinical Tips Shade Selection Multiple Units

1. Establish a properly lighted environment for shade selection.
2. Select the final shade of the veneers, based upon the patient's preference as well as the tone of hair, eyes, and skin.
3. Take a photograph of the selected shade tab adjacent to the unprepared tooth structureas a reference shade for the technician.
4. Select the original shade of the hydrated unprepared tooth structure as a reference point. The clinical significance is to identify the role of the enamel layer in reference to value. It is well to retain such documentation, since the patients quickly forget and lose perspective of the extent of discoloration of the preoperative dentition.
5. Select the stump shade after the final tooth preparation. Note that the stump shade can vary within each tooth as well as interproximally (between the teeth). This importance and clinical significance of this step cannot be overemphasized.
6. Take a reference stump shade photograph for the technician. (All these photographs will give the technician information and, therefore, an advantage in

fabrication of the restorations, keeping in mind the influence the stump shade affords. In essence, the restorations must compensate
for the darker, greater chroma stump shade and are frequently fabricated higher in value and lower in chroma in the correct hue.)

7. Always use a try-in or trial cement prior to the definitive luting in order to verify the final shade and acquire patient approval.

Note that dual cure cements are prone to slight changes in value owing to degradation of benzoamines in the luting agent. The final color effect will be slightly lower in value (darker) (Gürel, 2003b).

Single Units

Except for the deletion of Step 2, clinical shade selection tips for single units are the same as for multiple units.

12. Impression and Bite Registration

Once the preparations have been completed, the final impression can be obtained. Currently polyethers and vinylpolysiloxanes (VPS) are the most popular materials for final impressions. Either type of material can accurately record the intraoral condition, Optical impressions may also be used in association with a thoroughly or partially digital workflow.

Retraction cord may or may not be required. Experienced clinicians will often use a very small diameter retraction cord to create a small amount of apical displacement to record the unprepared tooth structure below the prepared margin. The gingival tissues around anterior teeth are often thin and fragile. It is critical to minimize the trauma to this tissue during cord placement.

Recently there has been the introduction of “pastelike” materials that can be used to provide slight retraction of the gingival tissue. The atraumatic nature of these materials makes them appealing for this application (Radz, 2011).

To communicate clearly the correct final orientation of the incisal plane of the planned veneers, it is important that the ceramist receives a ‘stick bite’ or ‘symmetry bite This can be as simple as two sticks within the bite registration, This allows the orientation of the facial vertical plane and the interpupillary line to be transferred to the dental ceramist, enabling the correct alignment of incisal edges relative to these planes in the final restorations (Banerji *et al*., 2017) .

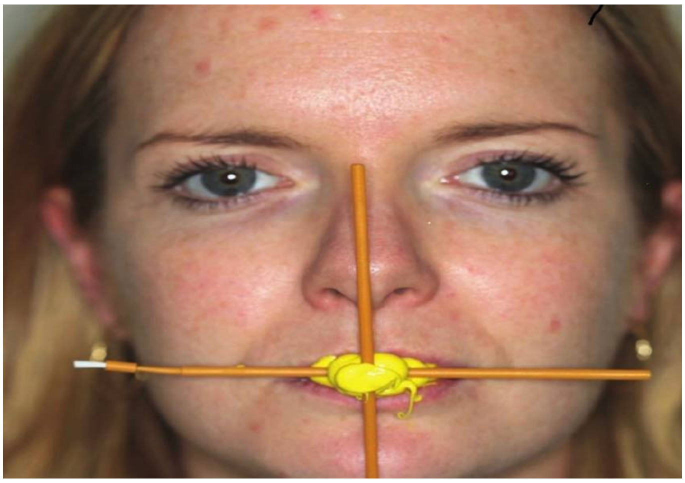

Figure 15 :- Symmetry bite or stick bite (Banerji *et al*., 2017).

13. Photography

In the case of anterior esthetics, a picture, and all that it is able to convey, is priceless. Using slides, prints or intraoral photographs enable the dentist to easily communicate invaluable information concerning the shape and texture of the teeth. The more sophisticated video imaging is also good at conveying information about the desired form. Pictures make it easy for the laboratory technician to actually see the tooth contours, the translucencies within the incisal edge, hypoplastic spots, enamel staining and the actual intensity of the characterization. Polaroid photographic prints of the try-in stage or composite mock-ups can be used along with the necessary information written on them to be sent directly to the lab. Instant film development is possible with digital photography, allowing the dentist and technician to review images via email, no matter the distance, and in only a few seconds (Dale and Aschheim, 1993).

14. Laboratory prescription and manufacture

Advantages (walls et al, 2002):

1- Good communication with technician.

2- Careful shade selection and If you intend to attempt to modify the shade of the veneer with the luting agent then it is sensible to ask the technician to provide space for the luting resin using a proprietary die-spacing system but bear in mind that the porcelain should not be so thin that there is a risk of it being cracked by the thick composite lute.

3-It can also be beneficial to send a study cast of the teeth prior to preparation if one is available should you want to preserve the original tooth form.

Methods for manufacture of porcelain veneers (walls et al, 2002):

1- refractory die material.

2- platinum matrix laid down on a conventional working model or one of the castable ceramic materials prepared using the lost wax technique.

3- Cast glass restoration.

15. Try-in

The provisionals should be taken out and veneers tried in without anaesthesia, making it easier to check the lip support and the incisal edge position relative to the upper lip. The veneers should initially be tried one by one in order to check the marginal fit accurately, and then together, to see their overall integration with each other, with the lips and finally, with the face (Newsome, 2009). Well as, reason, the veneers should first be tried in using a translucent try- in paste. Try-in pastes are water-soluble pastes that are designed to simulate the color that is present in the final cements. The try-in pastes also act as a weak adhesive to allow the dentist and patient an opportunity to evaluate the PLV. Resin cement try-in done for color matching where if the color is acceptable cementation goes smoothly. Giti et al reported that the final color of leucite-reinforced veneering ceramic can be affected by the same shades of resin-based luting agents from different brands and different shades of resin-based luting agents from the same brand (Giti et al., 2019). No corrections by adding material can be performed on porcelain veneers, and all occlusal checks should be performed after luting to avoid accidental fracture (Banks, 1990), If resin composite veneers are used, it is possible to modify them before luting by roughening their surface, applying bonding resin, and adding a small amount of material (Burtscher, 1993).

16. Cementation

The laminate veneer technique includes the bonding of a thin laminate to the tooth surface, enamel and/or dentin, using adhesive techniques and a luting composite to change the color, form, and/or position of anterior teeth. The success of the laminate veneer is greatly determined by the strength and durability of the bond formed between the three different components of the bonded veneer complex: the tooth surface, the porcelain veneer, and the luting composite (Peumans *et al.*, 2000).

The success of bonding to teeth relies on suitable preparation and conditioning of the involved surfaces, the ceramics, and the mineralized dental tissues (Magne and Douglas, 1999, Bona and Anusavice, 2002).

A) Surface treatment of the ceramic

Effective etching of the ceramic surface will result in changes in the surface area and in the wetting behavior of the porcelain. This may also change the ceramic surface energy and its adhesive potential to resin (Della Bona, 2009).

Various techniques have been suggested for treatment of ceramic surface including micro-etching with aluminium oxide particles and chemical preparation of the porcelain surface by etching with orthophosphoric or hydrofluoric acid (Oh and Shen, 2003), (Özcan and Vallittu, 2003). Treatment with hydrofluoric acid has beenshown to produce the best bond strengths.

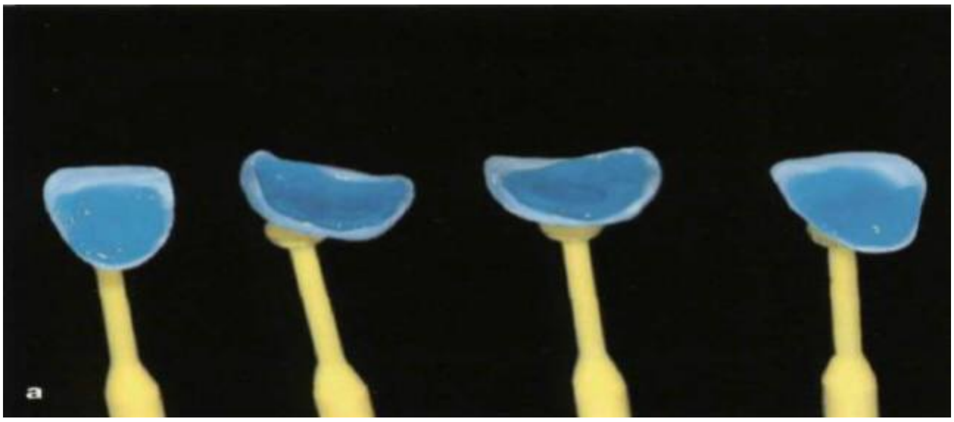

Figure 16 : The veneer should be acid etched with HFA either in the lab or at the chairside after the try-in (Gürel, 2003a).

The aim of pre-cementation surface conditioning of the porcelain is to increase the surface modification of the surface area available for bonding and to create undercuts that increase the strength of the bond to the resin luting cement (Addison *et al.*, 2008).

Acid conditioning with hydrofluoric acid is efficient in removing superficial defects and rounding off the remaining flaw tips, thereby reducing stress concentrators and increasing the overall strength (Addison *et al.*, 2008).

The treatment of the ceramic surface with hydrofluoric acid is different according to its composition. The three varieties feldspathic ceramic, leucite, and lithium disilicate-reinforced ceramic, The difference between these systems is the period of acid conditioning with hydrofluoric acid (9.5%) (Table 2) .

Ceramic	Conditioning
Feldspathic	9.5% hydrofluoric acid for 2 to 2.5 min; 1 min washing; silane application
Leucite-reinforced	9.5% hydrofluoric acid for 60 s; 1 min washing; silane application
Lithium disilicate-reinforced	9.5% hydrofluoric acid for 20 s; 1 min washing; silane application

Table 2: Ceramic composition and surface treatment protocols (Pini et al., 2012).

The acid should be thoroughly cleansed with air-water spray and the porcelain should then be placed into a container of distilled water (or 95% alcohol or acetone) and put into an ultrasonic bath for 4 minutes to remove any residues remaining on the surface (Mancini and Mancini, 2016).

The display of the inside of the PLV after etching should be opaque over the entire surface. If there is, any place that displays a less opaque appearance, than that area should be etched again and the same check should be repeated in that area. A way to check the etched surface is to place a drop of water intothe etched surface. If the surface is etched completely, the water will spread all over the internal surface. The cleaning process of the porcelain is aided by the increased wettability of the etched surface (Gürel, 2003a).

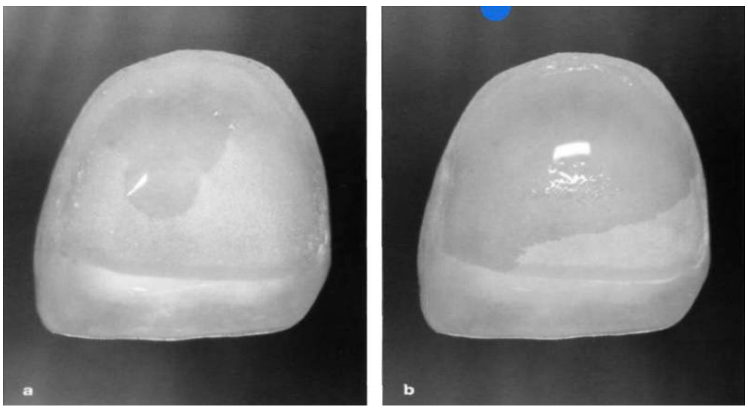

Figure 17 : (a) If a drop of water is placed on the unetched interior surface of the PLV, it will not spread and stays localized,(b) However, when the same amount of water is dropped on the same PLV surface after it has been etched, it will spread over the whole surface(Gürel, 2003a)

Silane application (coupling agent between the silica particles of ceramic and those of the composite cement)

This is allowed to remain on the veneer for 1 minute and after that the veneer should be gently blown with air to evaporate any remaining solvent (Mancini and Mancini, 2016)**.**

Silanization of etched porcelain with a bifunctional coupling agent provides a chemical link between the luting resin composite and porcelain. A silane group at one end chemically bonds to the hydrolyzed silicon dioxide at the ceramic surface and a methacrylate group at the other end copolymerizes with the adhesive resin. (Peumans *et al*., 2000).

Monobond Etch & Prime:

Recently, a new self-etching ceramic primer (ME&P;Monobond Etch & Prime, Ivoclar Vivadent; Schaan, Liecht-enstein) has been introduced as a simplified alternative tothe traditional HF acid etching + silane protocol for treat-ing the glass-ceramic surfaces. ME&P is basically a ceramic primer composed of ammonium polyfluoride, a silane system based on trimethoxypropyl metacrylate, solvents (alcohols and water), and a pigment (providing visibility with a greencolor aspect) in an all-in-one system (one-step etching technique). Therefore, this simplified technique for adhesion requires shorter time, might prevent the weakening effect of glass-ceramics (mild etching–less aggressive), as HF acid etching has the potential to impair the mechanical properties of glass ceramics (Addison *et al.*, 2007, Hooshmand *et al.*, 2008, Venturini *et al.*, 2015), The impairment ofthe mechanical properties is generated by introducing critical defects by glass corrosion/dissolution by HF acid etching,as critical defects are responsible for premature failure underlower loads (in comparison to the nominal strength of theceramic material) (Griffith, 1921). However this deleterious mechanism have been shown to be time and concentration dependents ME&P also decreases hazardous potential of the HF acid etching.

Prado *et al* reported that Hydrofluoric acid + silane resulted in higher mean μSBS (Microshear Bond Strength) than Monobond Etch & Prime for both ceramics; however, Monobond Etch & Prime had stable bonding after aging. (Prado *et al.*, 2018). Similarly, Asiry *et al* reported that Traditional two-step conditioning provides better bond strength (Asiry *et al.*, 2018). However, Murillo-Gómez and De Goes found that The self-etching silane primer provided a similar ceramic/cement bond strength to HF etching and silane application (Murillo-Gómez and De Goes, 2019).

Resin composite

Surface treatment of indirect composite resin restorations with hydrofluoric acid promotes a microstructural alteration of the composite because of the dissolution of the inorganic particles present in microhybrid composites. However, surface mechanical treatment in laboratory processed composites using sandblasting with aluminum oxide particles seems to be the best alternative to raise restoration surface energy because it promotes a nonselective degradation of the resin and results in a better adhesion to the composite cement (Soares *et al.*, 2005) surface treatments sequences are:

1. Sandblasting with 50 micron aluminum oxide particles (2.8 bar, 10 s, 1 cm)

2 .Ultrasonic bath in ethanol (5 min)

3 .Silane coupling agent application and evaporation (1 min)

4 .Adhesive application (no photopolymerization)

5 .Preheated resin composite application on the inner surface of the veneer (Re *et al.*, 2014).

17. Maintenance

Success of any restoration depends on how the patient maintains it. Maintenance on the other hand should be a combined effort of dentist as well as the patient. Patient should be motivated:

Do's (Gürel, 2003a)

•Use a soft toothbrush with rounded bristles, and floss as you do with natural teeth.

•Use a less abrasive toothpaste and one that is not highly fluoridated.

•Use a soft acrylic mouth guard when involved in any form of contact sport.

•Ensure routine cleaning.

Don'ts (Gürel, 2003a)

•Avoid food or drinks that may contain coloring.

•Do not use alcohol and some medicated mouthwashes because they have the potential to affect the resin bonding material during the early phase (the first 48 hours).

•Avoid hard foods, chewing on ice, eating ribs and biting hard confectionaries and candy.

• Avoid extremes in temperature.

CHAPTER TWO

Conclusion :-

Currently, the properties of ceramics indicate that they are materials capable of mimicking human enamel and their mechanical properties are expanding their clinical applications. Therefore, based on this literature review, it is possible to conclude that the clinical success of laminate veneers depends on both the suitable indications of the patient and the correct application of the materials and techniques available for that, in accordance with the necessity and goals of the aesthetic treatment.

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