INTRODUCTION

Missing teeth in the anterior aesthetic region represent an urgent need for dental intervention and often require an early treatment strategy that restores both the aesthetic and functional aspects of the dentition. Missing anterior teeth may be congenital or as a result of traumatic incidents, caries and periodontitis.[1]

Lateral incisors represent the most common congenitally missing anterior teeth in the anterior maxilla, it may present unilateral or abscence bilateral. The 2nd cause leading to anterior tooth loss is trauma weather as a direct result of an incident or late as a complication.[1]

This loss present as a complex set of challenges for the clinician to restore.[2] To achieve an optimal esthetic and functional result, Treatment options vary from orthodontic treatment, single tooth implant supported crown restoration, Resin bonded fixed partial dental prosthesis (RBFPD) or conventional 3 unit fixed dental prosthesis. Deciding which treatment is best for each patient depend on multiple clinical variables. Optimum treatment plan should be chosen according to the situation.

Implant is always considered the best option to restore single missing teeth if the patient is a good candidate for it. However, very often implant supported restoration is not the treatment of choice for many reasons, such as medically compromised patients, deficiencies of the soft and hard tissues, extra cost due to complicated operations involving grafting surgery poor oral hygiene, and patients' fear of surgery.[3]

The 2nd most conservative treatment option is RBFPD especially with the rapid evolution of the adhesive dentistry, as applied to dental ceramic restorations. Many successful reports have been published regarding the use of veneers, inlays, onlays, and fixed partial dentures (FPDs).[4, 1]

The standards of dentistry are being elevated, with a greater importance being positioned on esthetics in addition to functionality. Minimally invasive dentistry has become an critical component in creating restorations that are functional and have increased longevity especially after the significant developments in adhesive dentistry.

Cantilever all ceramic resin bonded fixed dental prosthesis (RBFDPs) present a minimally invasive, highly esthetic, treatment choice in restoring missing upper lateral; asthey offer additional advantages such as minimal tooth preparation, low cost, no risk of pulp injury. [5]

Labial veneer retained fixed partial dentures (VRFPD) has been proposed for single tooth replacement with the same criteria of the RBFPDs. They are indicated in cases of single tooth replacement in cases need of modification of the shape or masking minimal to moderate discoloration of the adjacent teeth However, due to insufficient data, it could not be clinically advised.[5]

REVIEW OF LITERATURE

Resin bonded histoy

Resin-retained bridges have been used clinically for many years ago, and today are considered to be capable of producing long lasting, aesthetic results. Their success is partly due to the development in materials of construction, designs and adhesive cements. [6]

Resin bonded or resin retained bridges (RBBs/RRBs) were firstly introduced in 1970s. These restorations are minimally invasive fixed prostheses which rely on the concept of bonding to enamel. [7]

The concept of adhesion in dentistry was introduced by Buonocore in 1955, when he etched enamel with phosphoric acid and bonded acrylic resin to it. [7] This technique has been developed allowing restorative materials to be attached to enamel with little or no tooth preparation.

Rochette Bridge was the first type of RBB, which relied on the retention generated by resin cement tags through a characteristic perforated metal wings retainer used for splintting the periodontally affected lower anterior teeth. [8]

Howe and Denehy et al (1977) [8] utilized the bonded metal framework to teeth to construct a retainer with perforated metal framework as a fixed partial denture and a metal ceramic pontic to replace missing anterior teeth.

However, longevity of this type of restoration was limited due to debonding. Alot of effort to enhance micromechanical retention by many methods of altering the surface of the metal retainer were developed.[9]

The name Virginia Bridge was first developed at Virginia Commonwealth University, School of Dentistry by **Moon and Hudgins in 1984**. It has a macroscopic mechanical means of retention. It was fabricated with the help of a Lost salt crystal technique. [9]

Marylad bridge was first introduced by **Thompson and Livaditis in 1983** in the university of maryland, they developed a technique of electrolytic etching of Ni-Cr and Co-Cr alloy. in an attempt to increase the bonding to retain the metal framework. [10]

Metal RBFDP have been in service for years, in spite of its partial or complete debonding which sometimes appeared as secondary caries on the abutment or complete separation from the abutments. Attempts to minimize complications were made by adding retentive features to the preparation such as slots and boxes. [11]

The most common type of failure with RBFDPs was the debonding of the cast metal framework from the luting cement, but debonding of the luting cement from the enamel surface has also been reported. [12,13,14,15] These restorations may present disadvantages with regard to esthetics and biocompatibility.[16, 17] Moreover, The esthetically unsatisfactory grayish “shine through” of metal is a common problem in the anterior region. The biocompatibility of certain nonprecious alloys has been questioned because of their corrosive, allergenic, and even mutagenic potentials. [16, 17, 18]

With the continuous development of dental ceramics and in an attempt to overcome these problems all ceramic RBFDPs were introduced on early 1990s by Kern M with Inceram Alumina as an esthetic alternative to the traditional RBFDP. [5]

In clinical service, these all-ceramic RBFDPs sometimes showed fractures within the proximal connector between one of the retainers and the pontic.[19]

Resin bonded bridges with multiple abutments are more likely to debond due to the differential movement of abutment teeth, especially where occlusal contact involves the natural tooth surface. In these cases occlusal force leads to the tooth and the retainer being driven apart causing failure of the cement lute.[20]Where two abutment teeth have been used it is unlikely that both retainers will debond simultaneously. When only one retainer fails, the bridge is likely to remain in situ promoting the development of caries beneath the failed retainer. [21, 22, 23]

A single-retainer all-ceramic RBFDP made from glass infiltrated alumina ceramic was introduced in 1997.(24) Clinically, these single-retainer RBFDPs showed even higher survival rates than the classic two-retainer RBFDPs made from alumina ceramic.(5)

Kern and Sasse (2011)(25) reported 10-year survival rates for glass-infiltrated alumina-based RBFDPs of 73.9% for three-unit fixed-fixed designs and 94.4% for two unit cantilever designs. The same authors reported a survival rate of 93.3% after 5 years for single-retainer zirconia based RBFDPs. (26)

Sailer et al. (2013) (27)evaluated the clinical performance of single-retainer lithium disilicate glass ceramic-based RBFDPs, using lower lateralincisor as an abutment to replace missing central incisor. Finding a 5-year survival rate of 100%.

Labial veneer retained cantilever Fixed Dental Prosthesis:

Labial veneer retained FDPs were reported in cases of replacing missing tooth and with the need of shape modification or color change for better esthetic outcome.(28)

Sun et al (2013) (28)reported a series of 35 cases that had undergone single anterior tooth replacement using cantilever lithium disilicate veneer retained fixed dental prosthesis (VRFPDs) either from the labial aspect or lingual aspect, using canine as an abutment. Visual annual evaluations were assessed for 46.57 months. Results showed 100% success rate with no failure during this period in terms of facture, chipping, debonding or caries.

Veneer

Ceramic veneers are considered as the most popular, well accepted, conservative procedure which was introduced to the dental world during late and 1930s. [29]

Porcelain veneers firstly introduced by Dr.Charles Pincus as he described a technique in which porcelain veneers were retained by a denture adhesive temporarily during cinematic filming. [30] Over the past decades these types of restoration have undergone considerable improvement and refinement over the past to reach the predictable restorative concept in terms of longevity, periodontal response and patient satisfaction. [31]

Ceramic laminate veneers have become the first most conservative restorative option in correcting tooth form, position, shape, and color in cases of sever discoloration. [32]

Ceramic veneer bonded to enamel show a high clinical survival rate. Clinical observation period reported in litreature range from 18 month to 15 years. One study showed that 93% success rate of 3500 ceramic veneers.for more than 15 years, with only 7% failure rate. [33]

Different laminate preparation designs

Veneer restorations were prepared on unprepared tooth surface. However, currently, conservative intraenamel preparations of 0.3–0.5 mm with a chamfer gingivally are recommended. The difference in preparation design comes with respect to the incisal edge, with some clinicians advocating the preservation of incisal edge while others prefer to overlap the incisal edge. (34)

Thus, basically, regarding the laminate preparation, four basic types of preparation have been described, namely the window or intraenamel preparation, the feathered edge preparation, incisal overlap and incisal bevel. (35)

Most preparation.designs require.a uniform tooth reduction to give enough space for restoration. Window preparation show fracture resistance value similar to unprepared teeth. (36) Window preparation design may be considered an option when strength is the primary goal as the margin design is characterized by high values of elasticity to better sustain high dynamic stresses.

Calamia (1988) **(37)** supposed that the window preparation design may withstand the highest load until failure than those with incisal edge coverage. no failures reported by **Khin and Barnes** (38) with window preparation design, after 48 months of clinical evaluation.

Hui et al (1991) [39] found that window preparation design withstood the axial sterss most favourably when using two dimensional photoelastic stress analysis.

The common modes of failure seen were interfacial staining (2%), debonding and minor failures. This preparation modality may produce a weak enamel margin of poorly supported enamel prisms that may undergo chipping on mandibular protrusion. A majority of the failures occurred when the veneers were placed on existing restorations. However, microleakage of the window design at the incisal margin was less than that in the overlap design. [40, 46]

Albanesi et al (2016) [41] conducted a systematic review to evaluate the survival rates of preparation designs for ceramic veneers with and without incisal coverage. Studies included were ceramic laminate veneers studies, prospective and retrospective studies conducted in humans. Results showed out of 1145 articles, eight studies were included. It showed that the estimated survival rate for laminate veneers with incisal coverage was 88%, whereas it was 91% for those without incisal coverage. It was concluded that irrespective of incisal coverage, ceramic laminate veneers have high survival rates.

Lithium disiliscate

With the rapid development of esthetic dentistry a highly esthetic, strong ceramic material was firstly introduced by ivoclar vivadent in 1980 under commercial name IPS Empress II (ivoclar, vivadent, schaan, Lichtenstien) in form of ingot, which processed by lost wax technique and hot pressing. [42] The final microstructure of IPS Empress II consist of a unique alignment of highly interlocked lithium disilicate crystals, 5 micron in length and 0.8 micron in diameter[43]. The strength of the material generated from the stresses originated around the crystals due to the difference of the coefficient of thermal expansion between the crystal and the glassy matrix. [44]Several clinical studies reported low failure rates of IPS Empress II after observation period between 5 to 10 years as single crowns but not as multiunit prosthesis.[46] Therefore, some structural improvement was performed and presented in the market in 2005 as IPS e.max (Ivoclar, Vivadent, Schaan, Lichtenstien) which consist of a lithium disilicate glass ceramic, but with refined crystal size, presenting improved physical properties. as a result of the low refractive index of the lithium disilicate crystals, so this material has high translucency despite its high crystalline content. [45]

Lithium disilicate can be processed by either lost wax heat pressed technique or by milling CAD/CAM procedure. Pressable ceramics provide superior strength and increased accessibility for most dental laboratory services. This technique allows for accurate reproduction of the anatomical features carved in the wax pattern, but it is time-consuming. Conversely, the CAD/CAM technique has limited availability, since it requires considerable investment in scanning equipment and a milling machine, and skilled technicians. [46]

IPS e.max Press is supplied as ingots of lithium disilicate glass-ceramic in several monochromatic shades, 4 translucencies, and 2 sizes. Currently, new polychromatic ingots (IPS e.max Press Multi; Ivoclar, Vivadent, AG) provide a gradient of shades and translucencies mimicking those of a natural tooth. These are supplied in 10 shades and a single size. The microstructure of IPS e.max Press consists of approximately 70% lithium disilicate crystals measuring 3 to 6 mm in length. The product is processed with the lost wax technique, which involves waxing the restorations to the desired contours, spruing, and investing the wax patterns, melting the wax to create a mold within the investment, and then heat pressing the molten ingot into the mold in a furnace developed specifically for this product. Restorations are then divested, polished, characterized, and glazed before delivery. [46]

IPS e.max CAD on the other hand is a lithium disilicate glass ceramic designed to be used with CAD/CAM technology. A process called pressure casting leads to the production of partially crystallized IPS e.max CAD blue blocks. These blocks are composed of 40% lithium metasilicate crystals ranging in size from 0.2 to 1.0 mm, embedded in a glassy matrix. The partially crystallized state facilitates a faster milling process. After restorations are milled to the desired shape and contour, they are tempered at 850_C in furnaces developed by the manufacturer for this material (Programat P300/P500; Ivoclar Vivadent AG). In this process, lithium metasilicate crystals are transformed into lithium disilicate crystals (70% volume fraction), which are responsible for the high strength of the material. The coloring ions responsible for the blue color in the partially crystallized stage change the oxidation state when tempered, leading to the desired tooth color. (47)

Schestatsky et al (2019) (48) evaluated the fatigue failure load, number of cycles for failure and survival probabilities of lithium-disilicate monolithic crowns manufactured by two processing techniques (pressing vs. CAD/CAM) adhesively cemented to a dentin-analogue material, Pressed lithium-disilicate monolithic crowns showed better fatigue performance in comparison to CAD/CAM milled crowns.

Clinical evidence shows that IPS e.max Press has a survival rate of 96.6% over 3 years for single crown restorations. (49) A study that evaluated fixed partial dentures fabricated from monolithic IPS e.max Press and observed them for a mean period of 121 months found the survival rate to be 100% after 5 years and 87.9% after 10 years. The success rate was 91.1% after 5 years and 69.8% after 10 years. (50) A clinical evaluation of single IPS e.max CAD crowns showed 100% success after 2 years. (51)

Bonding to lithium disillicate

The clinical success of ceramic restorations depends on a number of factors, such as the cementation procedure and composition of the ceramic material. Different ceramic surface treatments have been introduced to improve resin bonding to ceramic.[52]

Lithium disilicate (IPS e.max Press, Ivoclar, Vivadent, Schaan, Liechtenstein) bonding technique takes advantage of the formation of chemical bonds and micromechanical interlocking at the resin-ceramic surface. Etching with hydrofluoric acid is used to create micro irregularities on the bonding surface of the ceramic material to enhance bonding between the ceramic and resin cement. Hydrofluoric acid removes the glass matrix and the second crystalline phase, thus creating irregularities within the lithium disilicate crystals of the IPS e.max Press for bonding. [52, 53, 54] Another treatment recommended for ceramic surfaces involves airborne particle abrasion with 50-micron aluminum oxide (Al_2O_3) particles to aid in mechanical retention. [55] After air abrasion, the ceramic surface must be coated with a suitable silane coupling agent, which forms chemical bonds between the inorganic phase of the ceramic and the organic phase of the resin cement. [56, 57]

Zirconia based ceramic

Zirconium (Zr) is a metal with the atomic number 40 that has been oxidize to form zirconia. which is white crystalline of zirconium dioxide (ZrO2).[58]

The first use of zirconia in the medical field was total hip replacement in orthopaedic surgery as it has superior mechanical properties and excellent biocompatibility [58]. In dental field, it has been first used in root canal dowels in 1989, fabrication of orthodontics brackets in 1994, and implant abutment in 1995.[58]

Zirconia had three different phases according to the temperature, named monoclinic (m), tetragonal (t) and cubic (c). At room temperature pure zirconia has monoclinic crystalline structure up to 1170^0 C. when the temperature is above 1170^0 C. the monoclinic crystalline phase turn to tetragonal phase and if the temperature reach 2370 it becomes in a cubic phase. on cooling the transition from the tetragonal phase to the monoclinic is associated with about 4.5% volume expansion which is responsible for catastrophic failure, to over come this some oxides were added to zirconia to stabilize the tetragonal or the cubic phase and inhibit crack propagation and increase fracture toughness. [59]

Yttria-stabilized tetragonal zirconia polycrystalline (Y-TZP) show the best mechanical properties and superior fracture resistance, It has high fracture toughness (5-10MPa) and (900-1200 MPa) flexural strength. It has good clinical performance when it use as a framework for long span fixed partial denture [60, 61]. On the other hand Y-TZP has drawback of being opaque material has greyish white colour with very poor translucency. [62] To enhance the esthetic and translucency of Y-TZP it should be veneered with porcelain which has poor mechanical properties causing chipping of the veneering material over the zirconia framework[63, 64]

Recently, zirconia ceramics have undergone many changes in microstructure and composition to eliminate the chipping of veneering material. Monolithic translucent zirconia restorations were introduced in the dental market, allowing minimal occlusal and axial tooth reduction of 0.5 mm and minimal material thickness compared to conventional zirconia restorations, which require reduction of 1.5-2mm. (65)

In addition, fast easy method of fabrication by using computer aided dsign– computer aided manufacturing (CAD/CAM) technology, this made the manufacturing cost of the monolithic zirconia less than the cost of porcelain veneered zirconia. (58, 66)

Ultra translucent zirconia

The latest generation of zirconia materials has a significantly higher degree of translucency, providing greatly improved esthetics. The use of multilayer high-translucent zirconia materials, in particular, provides a great range of esthetic possibilities, specifically for anterior teeth. (67) The higher translucency is achieved by slight changes of the yttria (Y_2O_3) content (5 mol% or more instead of the conventional 3 mol%), which is used to stabilize the tetragonal zirconia phase, causing a higher amount of cubic phase particles. Cubic zirconia offer significantly greater light transmission but lower physical strength. High-translucent zirconia has flexural strength values between 550 MPa and 800 MPa, Depending on the degree of