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Case Report

Aesthetic Approach By Hot Pressable Ceramic In got Veneer As a Treatment Modality, in Fractured Young Permanent Maxillary Central Incisor, As a Routine Dental Practice - A Clinical Case Report

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ABSTRACT:

This article describes the Complete case illustration and an overview of the chemical composition of ceramic materials, fabrication procedures and type of veneers used in dentistry.Its a restorative case of maxillary anterior teeth with ceramic porcelain veneers. Because building such treatment is usually elective, all precautions should be taken to ensure treatment is as conservative as possible.The uniqueness of this article is that veneers are fabricated by hot pressed ceramic technique which was introduced in 1980s based on the wax restorations built up by the technician before proceding to the final prosthesis manufacturing. Ceramic materials can be classified based on their sinterizationtemperature,composition or manufacturing technique. According to their manufacturing technique ceramics can be classified into:-

- Powder/liquid
- Slip casting.
- Hot pressed ceramic.
- CAD/CAM

Introduction: Aesthetics is the most important factor in the restoration of anterior teeth.Porcelain veneers (PVs) have replaced crowns made of thin bonded ceramic restorations and conventional porcelain which is fused-to-metal as the more aesthetically pleasing optionthat restores the facial surface , part of proximal surface of teeth and with minimumloss of tooth structure.Due to superior esthetic,mechanical and biocompatible properties,a porcelain veneer is the most reliable,durable and recommended restorative material for anterior teeth.Porcelain is generally a brittle material however,when it is firmly bonded to the tooth it becomes very strong and durable.Typically,veneers are made of chair side composite, processed composite, porcelain, or cast ceramic material.Perfect smile improves the self-confidence, personality, social life and have psychological effect on improving self-image and enhanced self-esteem of the patient. Improvement of smile makes us gratifying and opens door in the new dimension of dental treatment using veneers.

Aim of work: To understand the importance of porcelain veneers in dentistry

Keywords: Porcelianveneers, hot pressed ceramics,anteriorrestoration,esthetics in dentistry.

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DEFINITION

A thin sheet of material usually used as a superficial or attractive display in multiple layers, frequently termed a procelian veneer.[GPT 9]

INDICATION

- Diastema:single or multiple spacing between teeth[1]
- Extreme discoloration in anterior teeth due to tetracycline staining, fluorosis, teeth darkened with age.
- Small enamel defects such as enamel fractures[3]
- Congenital tooth malformation[8]
- Malpositioned teeth and abnormalities of shape:conoid teeth,rotated teeth[10]
- Attrition and root exposure[10]

- Repair of a functionally sound metal-ceramic crown or all-ceramic crown with unsatisfactory colorr

CONTRAINDICATIONS

- Diastema and multiple spacing between teeth[3].
- Fractured teeth with one-third loss of tooth structure are a poor case of the veneer.
- Actively erupting tooth
- Patients are having para functional habits such as bruxism
- In case of insufficient tooth structure, full coverage restoration is recommended.[3]

BASED ON CHEMICAL COMPOSITION OF CERAMIC MATERIALS

1. Silicon oxides ceramics

Silicon oxide ceramic have been widely employed in biomedical applicationsbecause its mechanical stability, biocompatibility, and high specific surface, whichcan be modified [1]. The silanol group on the support of the silicon atom canbe activated to make a chemical bond with organosilane, which can also lead toproviding various functional groups that can mediate a vast selection of particularbioconjugation strategies [2].Porous silicon (pSi) is a biocompatible and biodegradable material due to itshigh surface area, which induces a fast oxidation of silicon in aqueous solution Hence, it is shown that particles synthesized out of pSi are biodegradable inplasma, blood, and tissue and then stable.

2. Aluminium oxide

Bioceramics (like alumina, zirconia, etc.) are mainly orthopedic and dental reparation. Alumina (aluminum oxide) is the only solid oxide form of (Al2O3). Thus, corundum is the crystalline form of alumina. Alumina was employed in first used since the 1970s and its clinical results revealed a fracture rate greater than 13% [4]. However, the disadvantage of these materials was reduced to the fact that they could not be processed to full final density. In the late of 1980s, a second generation ceramic materials, with a smaller grain sizes and higher density, was developed. The fracture rate of these materials was less than 5%[5]. Today, a third generation ceramic materials, characterized by high purity, full density, and finer microstructure was appeared. Additionally, it is shown that the degree of tensile bending strength of ultrafine Al2O3 particles is remarkably over that of all other ceramics [7]. The ceramics forsubstructures of "jacket crowns" enriched by alumina (up to 60% of weight) of different grain size (10–30μm) have been used to increase the stability. Hence, intense refraction of light takes place at the alumina (in the feldspar) due to the difference in the refraction index between feldspar and corundum.

3. Aluminum oxide ceramics reinforced with zirconium oxides

Mechanical properties of alumina were improved by addition of ceramiccomposites, as reinforcing agents, like zirconia. Generally, these ceramic–ceramiccomposites present a great hardness as compared to the all composites. Althoughmost ceramic second phases improve strength and hardness they modestly improvefracture toughness [28, 29]. Al2O3-SiC nanocomposite has been reported to have theSurface Dominating surfacegroup.The propreties of biomedical grade alumina is illustrated in table 1[6]

Property	Value
Density (g/cm3)	3.96–3.98
Fracture toughness (MPa.m1/2)	3.4–4
Bending strength (MPa)	550–630
Hardness (GPa)	19-20
Young's modulus (GPa)	380

Table 1

most improved properties [8]. However, the zirconia system uses a mixture of zirconium oxide and aluminumoxide as a framework to achieve a marked increase in the flexural strength. Aluminaconstitute approximately two third of the structure and the remaining structure was composed of tetragonal zirconia. Thus, it has been shown that SiC increases significantly the wear resistance of aluminum oxide.

4. Zirconium oxides ceramics

Zirconia (ZrO2) is a ceramic material which has been applied in the health field and distinguished by its high mechanical properties, biocompatibility, and chemical stability [9]. The polycrystal tetragonal zirconia, stabilized with yttria (3Y-TPZ) contains 3 mol% yttria oxide (Y2O3), was first applied in the field of medical. The 3Y-TPZ has been the most studied and utilized in dentistry [11]. Thus, the 3Y-TPZ was fabricated in small grains (0.2–0.5 mm in diameter), which minimizes the phenomenon of structural deterioration or destabilization in the presence of saliva, decreasing the subcritical crack growth [12]. Figure 2 shows the SEM micrograph of the powderafter sintering.Similar to that of stainless steel, zirconia is characterized by good chemical stability, good biocompatibility, mechanical strength, toughness, and Young's modulus. No adverse reactions have been found, when osteoblasts were seeded on zirconia and were able to proliferate and differentiate on it. Zirconia ceramics are becoming a prevalent biomaterial in dentistry and dental implantology[13]

5. Hybrid ceramics

In recent years, all ceramic and composite restorations have been widely used because of their biocompatibility and esthetic features compared with metal ceramic restorations (MCR) [14]. A range of ceramic systems are commercially available like leucite, alumina, zirconia, and feldspar based ceramics

.Thus, many indirect composites categories, with various size of filler particles, are also used .New hybrid ceramics filled and un-filled polyamide 12 (PA 12) were developed by a fused deposition modeling framework [15]. The proprieties of hybrid ceramics filled and un-filled polyamide 12 are summarized in table 2. The highest tensile strength was recorded at 40% filled PA 12 as compared to un-filled PA 12. The highest tensile modulus was recorded at 35% filled PA 12 as compared to un-filled PA 12.Indeed, the highest impact strength was recorded at 35% filled PA 12 as compared to un-filled PA 12.2.2 Based on processing methods .In the last few decades, there have been remarkable advances in the mechanical[16]

Samples	Tensile strength (Mpa)	Tensile modulus(Mpa)	Impact strength (kJ/m2)
Un-filled PA 12	41.38 ± 2.93	1006.28±101.66	6.02± 2.51
30%filled PA12	36.82 ± 1.61	1087.08±126.89	11.92±1.49
35%filled PA12	36.71±1.81	1382.34±89.21	16.96±7.01
40%filled PA12	36.99 ±1.41	1327.06 ±157.62	12.42±2.96

Table 2: Proprieties of hybrid ceramics filled and un-filled polyamide 12

FABRICATION PROCEDURE

Based on processing methods In the last few decades, there have been remarkable advances in the mechanical properties and methods of fabrication of ceramic materials.However,in this article, hot isostatic pressable method have being used.[17

1. Casting

Casting is based on the solidification of a fluid that has been poured or injected into a mold. The final product is also known as a casting. Thus, casting process consists of three steps: melting, casting, and recovery. The biocompatibility effects of indirect exposure of base-metal dental casting alloys were analyzed[17,18]

2. Sintering

Sintering is a heat treatment under pressure applied to a solid material compact without melting. The final product is a solid or porous mass which is durable,stronger, and harder mass due to pressure and high heat that forces the atom to bond more tightly with each other with excellent properties.It is one of the essential processes applied by ceramic component manufactures.

3. Partial sintering

Partial sintering is lowering the processing temperature and/or pressure during consolidation results in a increase in porosity, interconnectivity and pore size as well as decrease in young module.However pore size tend to swift from a more round to a more irregular shape.

4. Glass infiltration

The glass infiltration processing is a powerful technique for the fabrication of ceramic/glass composite with exceptional mechanical properties and low shrinkage

5. Slip casting and sintering

In-Ceram zirconia bulk composites were synthesized via slip casting of alumina or zirconia. Slip was a dispersion of particles of ceramic powders in a liquid (such as water). Thus, the pH of water was then regulated to the desired value to charged particles

6. CAD/CAM milling and copy milling

CAD/CAM milling and copy milling is an important field of dentistry and prosthodonticsusing CAD/CAM (computer-aided design and computer-aided manufacturing) to improve the design and creation of dental restorations.[17]

7. Hot isostatic pressing

For a decade, hot isostatic pressing (HIP) has been used successfully by manufacturers around the world to increase productivity. HIP was used to eliminate pores and remove casting defects (such as oxides and carbides) to dramatically increase the material properties. Gionea et al. synthesized zirconia powders by HIP at 500 °C for 2 h. The results showed that a pure cubic phase, with average particle dimension about 70 nm, was obtained[33]. Thus, the obtained samples presented a mixture of monoclinic-tetragonal or monoclinic-cubic phases. Final dense ceramic materials (relative density of 94%) were achieved. However, ZrO2-CaO ceramics have high biocompatibility and excellent mechanical properties characterized by strength of 500–708 MPa and Young's modulus of 1739–4372 MPa. Hu et al. synthesized tetragonal zirconia polycrystalline (3Y-TZP) ceramics by HIP. The grain size of the final products reached about 138 nm. This fine grain size leads to an increase in Vickers hardness to achieve 13.79 MPa. These materials also revealed an elevated transmittance (in the range of 76–78%). The result showed that HIP was an effective process to prepare infrared-transparent 3Y-TZP ceramics with small grain size and with good optical and mechanical properties. Similarly, Klimke et al. fabricated ZrO2 ceramics by HIP. They demonstrated that the particle size, determined by TEM, was less than 50 nm (Figure 8) and the maximum in-line transmission was about 77%, which observed at IR wavelengths in the range of 3–5 μm[19,17,28].

Veneers are fabricated from a quartz-type porcelain on a platinum foil or refractory die. Ceramicists use a wet brush and a jar of porcelain powder to essentially paint layers onto a model and then bake it in a porcelain oven[33]. Since each application of porcelain is very thin and shrinks when heated, the process is repeated many times to obtain the proper contour. Ceramicists can lay in different colors at each stage to create the patient's desired look.[11]

Technicians fabricate pressed ceramic veneers by waxing a tooth to the desired contour, investing it, and melting out the wax[10]. They then inject a leucite-based molten porcelain and apply constant hydraulic pressure to press in additional material as the porcelain cools and shrinks. The process is very similar to fabricating gold, and results in a porcelain ingot that fills [8]out the desired contour in a single color. Ceramicists then can create more natural, less-uniform coloration by cutting back the ingot and painting different colored porcelains in various areas of the tooth.[6,23,31]

ADVANTAGES OF PRESSED CERAMICS

Why might ceramic restorations be considered a better choice? Here's a list of major advantages:

1. Strength - Pressed ceramic porcelains are at least two times stronger than feldspathic. This is because the material is cast under heat and constant pressure, which increases the tightness of the particles and makes the material much denser. Hence, pressed ceramic restorations are far more durable and resistant to fracture.[13]
2. Versatility - The inherent strength of pressed ceramic porcelain supports a much larger range of treatments and restorations than feldspathic material. For example, dentists can use it, as well as Zirconia materials, in bridges without a metal substructure[14,15,33]. Indeed, whereas feldspathic porcelain usually requires a metal substructure for posterior restorations, dentists can use pressed ceramic material in full-mouth reconstruction without any metal at all.
3. Wearability - Pressed ceramic porcelain is less abrasive to opposing teeth than traditional feldspathic porcelain. Numerous studies show that many feldspathic materials are far more aggressive against natural dentition and causes far more wear and damage. Pressed ceramic restorations which utilize lower-fusing porcelains are much closer in abrasiveness to natural tooth enamel.[15]
4. Fit- Pressed ceramic veneers generally fit better than feldspathic.Whenfabricating a feldspathic veneer, the technician repeatedly adds layers and fires it in the oven, which causes the porcelain to shrink and often warp. On the other hand, pressed ceramic veneers are waxed to ideal at the very beginning and then pressed, so it is easier to obtain a much tighter marginal integrity and fit.[16]
5. Predictability of results - Technicians trained in ceramic waxing, pressing, and cut-back techniques can apply their skills with very consistent results. However, feldspathic methods can be less predictable and more susceptible to human error. The results depend largely on the artistic abilities of the ceramicist and can be less precise. (In either case, it is very important that dentists choice[15,32]

DISADVANTAGES OF PRESSED CERAMICS

1. 1The veneers can be quite a bit darker than what most patients envision
2. One should distinguish between the initial results of veneer placement, and what those results might look like in five years. Insofar as a feldspathic placement lets the color of an existing tooth shine through, the veneer is subject to a "shade shift" as time passes.[18]

CASE ILLUSTRATION

First visit

A25- year-old patient visited at MAXDENTTRICITY DENTAL HOSPITAL ZIRAKPUR [CHANDIGARH] with chief complain of aesthetic issues associated with ellis class 2 fractured tooth with respect to maxillary left central incisior [21] followed by sensitivity.[17][figure 1]

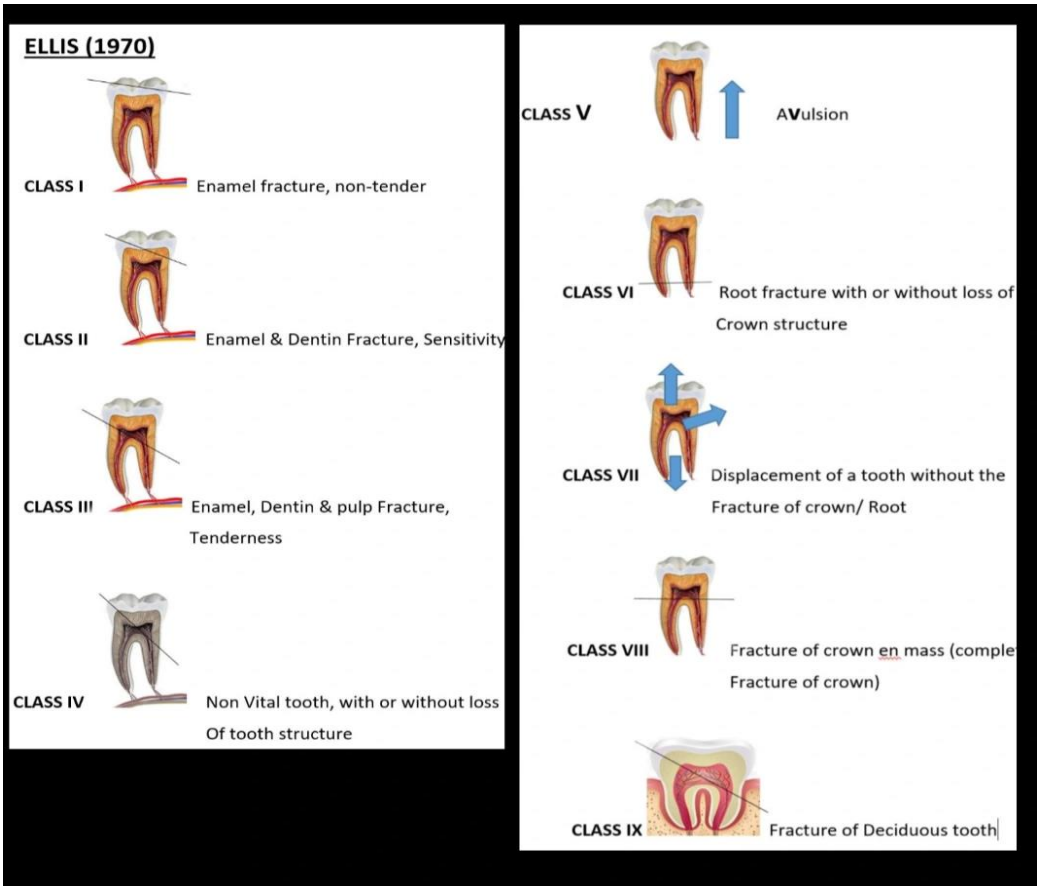

Figure 1

Treatment planning: On first visit,a thorough case history of the patient was recorded. Preopretiveintraoral and extraoralphotographes [figure 2] were taken.Diagnostic study models were preprared[figure 3].After the evaluation of study models, radioghrapic evaluation was carried out [figure 4].Various treatment plans were designed and discussed with the patient.The patient wasadviced for hot pressed veneers.A proper consent were taken from the patient before commencing the procedure[1,4].

Figure 2

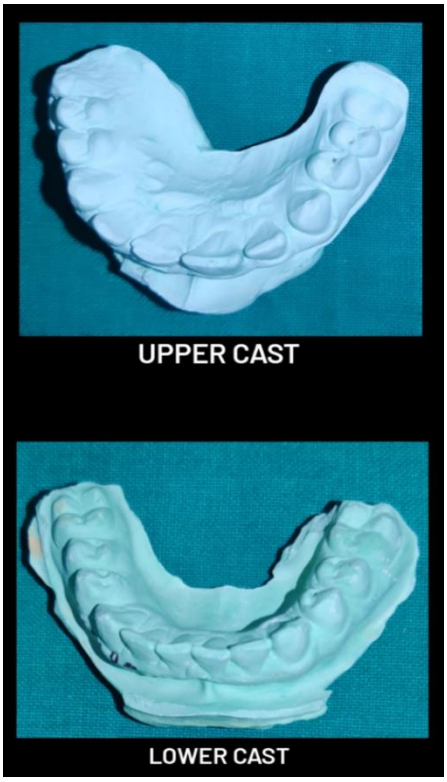

Figure 3

Figure 4

TYPES OF TOOTH PREPARATION

A. Window preparation. This method preserves the functional palatial and incisal surfaces of the tooth.

B. Feather preparation. This method prepares the incisal edge of the tooth but preserves the incisal length.

C. Bevel preparation. This method prepares the incisal edge of the tooth and reduces the length of the incisal edge slightly (0.5–1mm).

D. Incisal overlap preparation. This method prepares the incisal edge of the tooth and reduces the length of the incisal edge (about 2mm) so the veneer is extended to the palatal aspect of the tooth.[14,18]

The tooth preparation can be seen in [figure 5]

The preparation method of choice will vary depending on the material of the veneer as well as the shape and size of your teeth. The decision is generally left to the discretion of the dentist[4]

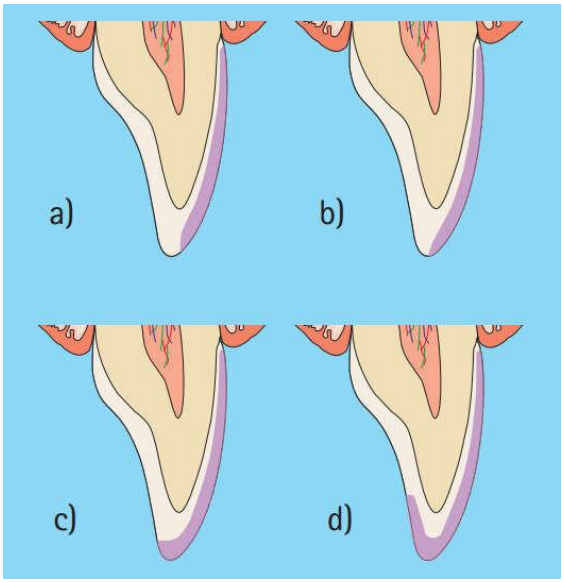

Figure 5

TYPES OF VENEERS

1. Porcelain is the most esthetic and least harmful material available for dental restorations. It's also the strongest and longest-lasting of all veneer materials.Porcelain laminate veneers are extremely biocompatible, so they rarely injure the gum tissues and surrounding soft tissues in the mouth.
2. Composite veneers are made of composite resin, a mixture of inorganic and organic materials[15]. The natural materials include the initiator, the resin, and the coupling agent. The primary inorganic material in composite resin is the filler. The bonding material used to make composite resin veneers is the same as tooth-colored dental fillings. While strong, composite veneers are not as durable as porcelain.Composite veneers are less expensive than porcelain veneers.[25]
3. Lumineers are a brand of veneers. They are made of ultra-thin porcelain laminate material and require minimal preparation before placement. Unlike porcelain veneers, less natural tooth structure is removed before placing a lumineer over your tooth enamel.Lumineers are commonly used to treat discolored and irregularly shaped teeth. They are smooth to the touch, so they also look and feel natural.
4. Removable veneers are also called snap-on or temporary veneers. There are two types of removable veneers:

A. Instant veneers
B. Custom-made clip-on veneers

Instant veneers from companies such as Instant Smile are cheap cosmetic teeth. You fit them into your mouth by placing them in hot water and pressing your teeth into the soft-fitting material. Instant veneers are not recommended for daily use or as a long-term dental solution[20,26]

TOOTH PREPARATION AND ARMAMENTARIUM

Armanentarium

Figure 6

1.Probe, mirror, twezzer
2.Cheek retractor and retraction cord
3 Putty material
4.Ligh body material
5.Mixing pad and spatula
6. Trays

BURS USED IN TOOTH PREPARATION
1.A flat end taper bur
2.A yellow line finish bur
3. Round end taper bur.
4.Tri-wheel depth cutting bur.

Figure 7

Second visit
On the second visit tooth preparations were carried out. By setting a cervical step without obstructing the natural gingival contour, the preparations' cervical borders were positioned right at the gingiva's level (equigingival). The chamfer finish line was preferred for the preparation.the finishing line may be at one of the threelacations;supra-gingival,at gingiva,or sub gingival.[19] Care was taken to round off all the internal line angles toreduce stresses in the margins of the veneers. Incisal overlap preparation was performed and the teeth were polished and smoothed.[21,27][figure 8]

Labial reduction
It is commonly seen that the cervical portion is over-prepared, causing dentin exposure, compared to the under-prepared mid-incisal portion. Therefore, different depth isobtained at different planes[16]. The key to success in tooth preparation is controlled depth of preparation.The labial surface is given three horizontal depth cuts with three-tiered depth cutting a diamond, 0.3 mm at the gingival finish line (since the amount of enamel is less at this area) while 0.5 mm at the incisal end.[22,28] In standard preparation, with the tip of the diamond, a supragingival chamfer finish line is placed at gingival crest because it allows easy access, increases the area of enamel, provides better visuality, and helps in maintaining better hygiene. The subgingival line is preferred in severe discoloration to provide the bulk of veneer thickness[3][21]

Figure 8

Proximal and incisal reduction
Proximal reduction is in continuation of labial reduction using round end tapered diamond. Bur is kept parallel to the long axis of teeth to avoid any undercuts. The incisal reduction is made on the basis of whether the preparation is terminating at the incisal edge (feather type) or including the incisal edge (wrap around or incisal overlap preparation). Porcelain under compression is stronger and wrap-around preparation place veneers under compression, thus

give a better result. A 0.5 mm orientation grooved is made for incisal reduction using multi wheel diamond burs and the excess removed using round end trapered bur.[23,29]

Palatal reduction

The finish line at the palatal aspect is made using a round end tapered diamond, holding it parallel to the palatal surface. A provisional restoration can be given depending on the tooth preparation done, whether the proximal contacts have been broken and the timing of try-in veneer. After the laboratory procedure using different techniques, the patient is recalled for the try-in procedure to check the marginal fit, proximal fit, and any other specific changes to be done by patients or clinicians. The veneer is restored after an appropriate selection of resin cement .[17,24]

The shade was selected with VITA 3D master shade guide under natural light. Using shade tabs,we carried out shade selelction ,a crucial step in treatment protocol[figure 9]

Figure 9

Further final impression with polyvinyl siloxane as a wash impression was made after gingival retraction [figure 10]using double step impression technique[figure 11][30]

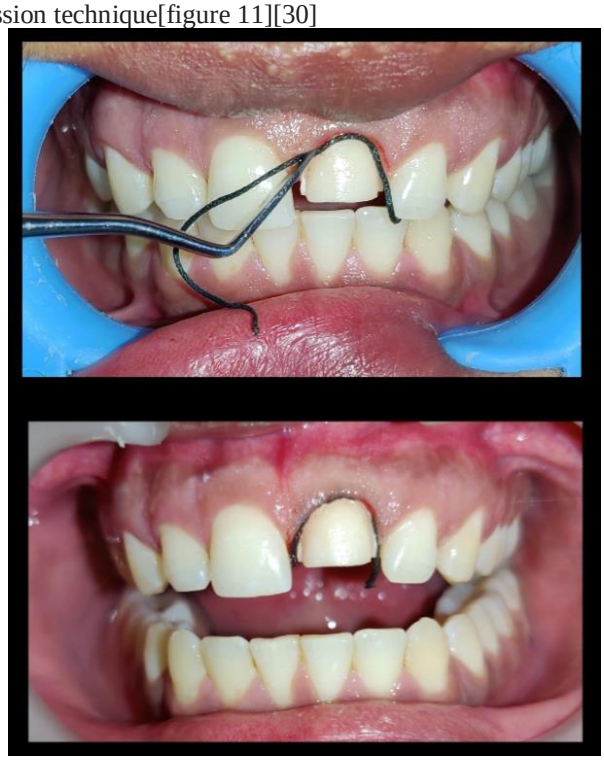

Figure 10

Figure 11

CEMETATION PROCEDURE

On third visit, patient came to the hospital for the quality of fit,gingival extension and color match of the veneers .The veneer was tried by placing it on the teeth.

Figure 12

The intaglio surface of the hot pressedceramic veneer was etched using 30% hydrofluoric gel, rinsed and coated with a silane coupling agent[figure 13]. The prepared tooth was well isolated and etched with 30% hydrofluoric gel acid, rinsed and Prime & Bond with silane coupling agent was appliedfollowing the manufacturer's instructions[figure13][31]. Allcem dual curing resin luting cement was used for the cementation of the porcelain laminate veneers. The luting resin was then cured using a visible light activation device for 40 seconds each after all gross surplus had been eliminated. PLVs were finished using rotating abrasive disks (Soflex discs). The patient was given oral hygiene and home care instructions for adequate care. [31][18]

Figure 13

After completion of cementation,a successful result was obtained and both the clinician and patient were extremely satisfied[FIGURE 14 ,15,16,17]

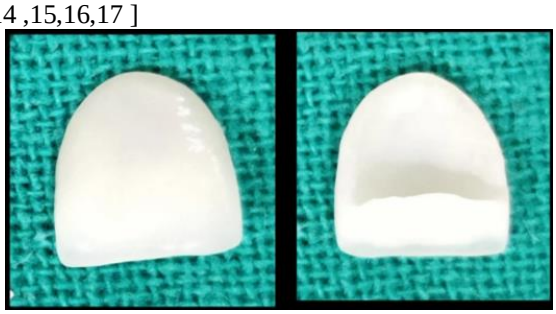

Figure 14

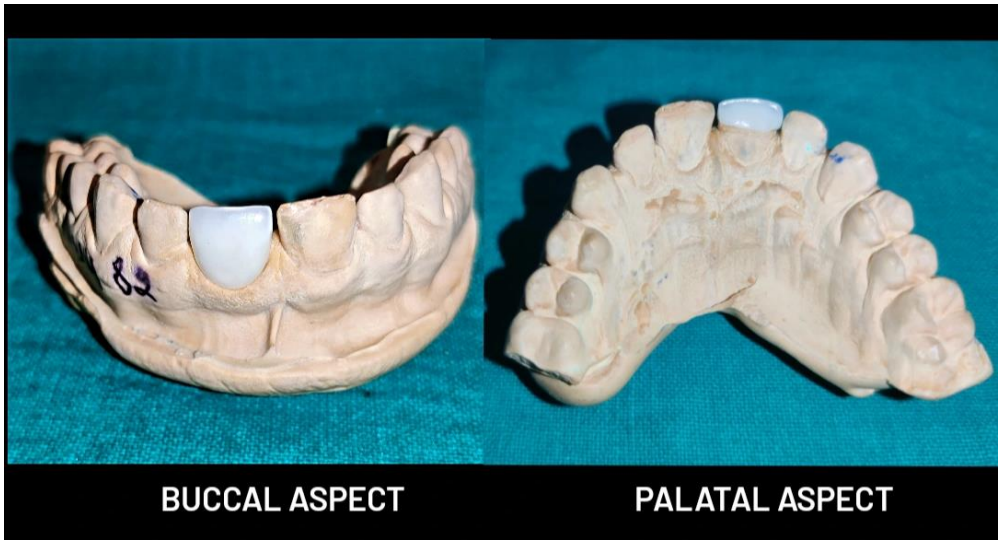

Figure 15

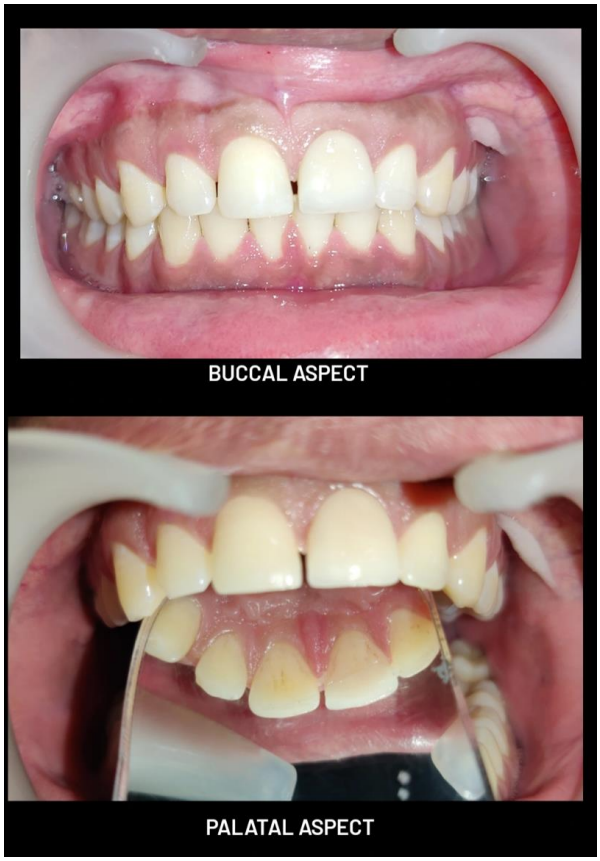

Figure 16

Figure 17

CONCLUSION

Porcelianveneers are indicated in cases of teeth needing alterations in color and shape and with extensive restorations. This treatment presents advantages, such as a minimum thickness of tooth reduction, bonding between ceramic and enamel and dentin, and a satisfactory esthetic result due to the inherent properties of the ceramics.[7]Care should be taken during tooth preparation and lutting phase to ensure maximum results.[6][19]

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