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An Overview on Prosthodontic Considerations for Esthetic Rehabilitation

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Abstract

Esthetics is the branch of philosophy dealing with beauty. Patients have become more concerned and demand natural tooth-like restorations and replacements for esthetics. Shade selection is an important procedure to provide patients with a natural restoration that harmoniously blends to the patients existing dentition. This article emphasizes about esthetics in dentistry and the various materials used in prosthodontics for the same.

Keywords: Fixed partial denture, Esthetics, Digital shade guide, All-ceramic, Zirconia.

Introduction

The need to look good and have a good smile has tremendously increased patient's need and demand. In Prosthodontics, where we deal with replacement of missing teeth, esthetics is one of the main aspects to achieve especially in younger patients. With development of new materials and techniques, there are now a wide variety of choices for patients to select [1]. This review article is an overview about concept of esthetics in dentistry, it's understanding in dental practitioners, the different types of fixed partial denture options and their role in esthetics.

Literature

A collection of 20 reference articles fom PubMed is used to give an insight on the concept of esthetics in dentistry and to compare the it's consideration in different fixed partial denture materials. The materials discussed are metal ceramic crowns, full ceramic crowns, veneers, resin bonded bridges, fibre reinforced composite, zirconia crowns, polyetheretherketone (PEEK) and implant supported fixed partial denture.

Shade Selection

Shade selection by the dentist becomes a key step in providing esthetics. This requires the understanding of colour and its manipulation. In dentistry, we usually follow Munsell colour system (Fig 1) for shade selection guide. According to this system, there are three components of colour, which are Hue, Value and Chroma [2]. The quality that distinguishes one colour from another is known as hue. The relative lightness or darkness of a colour or brightness of the object is known as value. Chroma is the saturation, intensity and strength of hue. Chroma and hue are inversely related. [3,4]

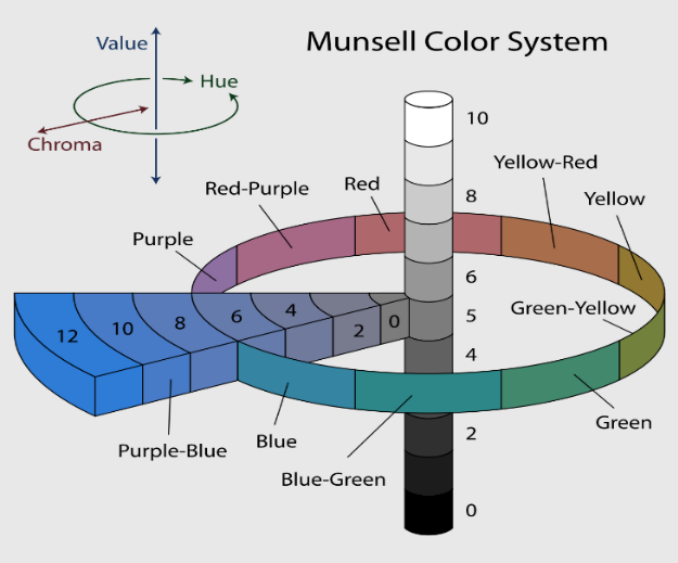

Fig 1: Munsell Colour System

There are two primary techniques for shade selection, manual and digital. **Traditional shade selection** involves the dentist matching one or more colours from a pre-formed commercially available shade tabs to the adjacent teeth to be restored. Earlier shade guides such as VITAPAN Classic shade guide (Fig 2), had minimal shades with not much varying tones. [5] The shade tabs were arranged according to the colour difference from light to dark which provides one dimensional colour. VITAPAN 3-D Master shade system (Fig 3) a much more advanced shade guide which was developed in 1998, had various incremental shades for better colour matching. It is divided into 6 series of tabs by value. Chroma is numerically added to hue. For e.g. A_3 shade. [2] The advantage of shade guides is it is less expensive and can be used anywhere. The major disadvantage is the varying colour perceptions. Optical illusions and contrast effects tend to differ in individuals. Environment under which colour selections is done also affects shade matching. The patient's clothing, dental chair light, dental room colour influence shade selection. Source of light has a major effect in shade selection, as tooth appears in different shades under different spectrum of light. This phenomenon is known as metamerism. [5]

Fig 2: VITAPAN Classic

Fig 3: VITAPAN 3-D Master

Digital shade matching is much easier and more accurate than shade tabs as it is based on objective reading and accuracy. It tends to eliminate surrounding light and focus only on the target tooth thus avoiding any error in shade matching with naked eye. Spectrophotometer and

colorimeter are two devices commonly used in dentistry for shade matching. Colorimeter system is based on pre-loaded data related to a shade system, spectrophotometer on the other hand measures natural tooth colour in reference to any known shading system. Colorimeter gives less accuracy when compared with spectrophotometer. VITA Easyshade (Fig 4) is a hand-held spectrophotometer capable of selecting shades at the press of a button. The target tooth is selected, the handpiece held at the target tooth will indicate the shade in both VITA Classic and 3-D Master shade systems. VITA Easyshade Compact (Fig 5) is an advanced version of VITA Easyshade which is self-illuminating reducing environmental light errors, is cordless, portable and can be used anywhere.[5]

Fig 4: VITA Easyshade

Fig 5: VITA Easyshade Compact

MHT SpectroShade system (Fig 6) consists of dual cameras linked with optic fibres to a spectrophotometer, in reference to any shade system. With the dual lighting technology, it is possible to record surface translucency to make the shade selection as close as possible to natural tooth. [6] Cynovad ShadeScan (Fig 7) is connected to CAD/CAM technology. The software in ShadeScan generates a number map on the tooth with varying shades from a selected shade guide offering complete tooth translucency to fabricate restorations of superior esthetics.[7]

Fig 6: MTH SpectroShade system

Fig 7: Cynovad ShadeScan

Materials used in fixed prosthesis

Having advanced technology enables dentists to be accurate in shade selection. Esthetics is not only influenced by shade selection, but also by the materials used for replacement and their properties. There are many materials used for replacement purposes in fixed partial dentures.

Metal ceramics crowns (Fig 8a and b) have been in use for many decades as a fixed prosthesis. It has good mechanical properties with acceptable marginal adaptation and biocompatibility. Rare cases of adverse reactions have been mentioned to the use of base metal and noble metal alloys. It consists of a metal framework over which a layer of ceramic is masked. Fabrication of metal ceramic crown is highly technique sensitive, with multiple operative steps and might also result in poor esthetics in anterior region. This was due to the absence of translucency. Metals can only absorb or reflect light; hence it produces a greyish hue underneath the ceramic layer. [8] Because of these drawbacks, all – ceramic crowns were introduced.

Fig 8a: Metal ceramic crown

Fig 8b: Metal ceramic FPD placed in patient

All - ceramic crowns (Fig 9b) were introduced to overcome the issues faced in metal ceramics crowns. They provide full coverage with marginal fit and high level of aesthetics. Feldspathic porcelain, the earliest of all - ceramics material, provided excellent aesthetics with good biocompatibility, high compressive stress resistance but had low tensile strength making it vulnerable to fracture. Attempts to strengthen feldspathic porcelain was made by McLean and Huges, who reinforced aluminium oxide powder into it. Leucite reinforced glass ceramics provided high aesthetics but had low flexure strength and are only recommended in anterior zones (Fig 9a and c) Lithium disilicate glass ceramics veneered with fluorapatite-based ceramics, showed increased flexure strength and provided superior aesthetics due to its translucent nature. Lithium disilicate glass ceramics are recommended in posterior regions, due to increased flexure strength. [8] Glass-infiltrated high-strength ceramic core systems was developed with In-Ceram Alumina, In-Ceram Spinell and In-Ceram Zirconia which provided highly stable framework. [9] The esthetic veneering material is layered on the core surface. In-Ceram Spinell has lower mechanical strength than the other glass-infiltrated ceramics, but shows better optical properties, and used mostly in anterior regions. CAD/CAM manufactured all ceramic crowns had higher flexural strength than glass infiltrated pre-sintered alumina. [8]

Fig 9a: Crown preparation

Fig 9b: All ceramic crown

Fig 9c: Crown placement

Veneer is a layer or shell-like tooth coloured material, which is placed over the tooth with minimal tooth preparation. These are a conservative alternative to full coverage crowns to enhance aesthetics. Laminate veneers (Fig 10) are used in anterior regions over localised discolorations, fractures and tooth developmental defects such as amelogenesis imperfecta. Tooth preparation in enamel is one of the crucial factors which increases the bonding strength of veneer to tooth surface. After tooth preparation tooth surface is etched with hydrofluoric acid and made to bond with veneer. Felspathic porcelain is commonly used porcelain for manufacturing veneers. Resin based or composite veneers (Fig 11) are used in cases of correction of midline diastema, root closure and tooth with large pulp. It requires minimal preparation; thus, enamel can be preserved for good adhesion. The main advantage of composite veneer is that it can be used directly, resulting in less chair time with good initial aesthetic. [10]

Fig 10: Before and after of porcelain veneer

Fig 11: Before and after of composite veneer

Resin bonded bridges (Fig 12b) initially were used as a short term or interim replacement option. The early RBB's were made with no preparation of the abutment teeth, but nowadays minimal tooth preparation has been recommended for resistance of the prosthesis. [11] Because RBB's are minimally invasive and cost efficient, it gained wide patient preference. After various methods to improve the quality, and has now become a permanent replacement

option. Metal RBB's are made of non-perforated, non-precious metal, cemented with a chemically active resin cement. Metal RBB's posed aesthetic problems due to greying of the meal framework and supposed allergic reaction from the metal. To overcome esthetic concerns, all ceramic RBB's were introduced (Fig 12a and c) Kern et al. were the first to describe resin-bonded bridges made from glass-infiltrated aluminium oxide ceramic framework in 1991. The aesthetic properties were further improved by addition of apatite crystals, increasing translucency, brightness, and light scattering of the material. [12] Though ceramic RBB's are aesthetic and biocompatible, it does not have a long-life span and has lesser success rates compared to conventional metal RBB's. [11] The most common reason for failure was debonding of the prosthesis. Another factor is difficulty in maintaining adequate oral hygiene and gingival health around the restoration, due to the connector dimensions to provide strength and retention to the prosthesis. [12]

Fig 12a: Before placement

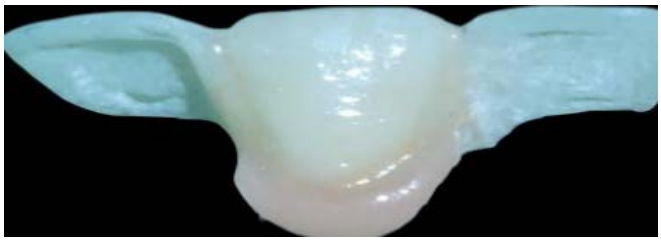

Fig 12b: Resin bonded bridge

Fig 12c: After placement

Fibre reinforced composite bridges (Fig 13 a and b) is another minimally invasive replacement option. Having acceptable aesthetics, being relatively inexpensive and immediate placement in single session are some factors which have made this popular among patients. Being preferably simple and quick, it is a useful option for elderly patients. Fibre reinforced composites consist of silanated glass fibres impregnated with a polymethylmethacrylate polymer and BisGMA matrix. This results in each fibre bundle being surrounded by a PMMA outer layer. This forms a bond with the abutment teeth for the composite restorative material to create the desired pontic. The pontic should be created so that it will be smooth and easy to clean. Pontics can also be constructed by indirect technique, by manufacturing it in the laboratory. [12] This offers ease of working, better polymerisation and good surface finish, but results in increased cost and multiple visits causing inconvenience to patients. Studies reveal better esthetics was offered by direct technique. [13] One disadvantage seen in this material is the colour change and the life span. Composite gets stained from extrinsic factors like consumption of coffee, tea and alcohol. [13]

Fig 13 a and b: Placement of Fibre reinforced bridges

Zirconia is a polymorphic material having three allotropes; monoclinic, tetragonal, and cubic phases. Each are stable at different temperature ranges. Three types of zirconia are used in dentistry, they are; yttrium stabilised tetragonal zirconia, magnesium partially stabilised zirconia, zirconia toughened alumina. Magnesium partially stabilised zirconia possess weak mechanical

properties due to large particle size. Yttrium stabilised zirconia (Fig 14 a and b) is most commonly used as framework for all ceramic crowns and fixed partial dentures. Zirconia toughened alumina is manufactured by incorporating ceria-stabilized zirconia to In-Ceram alumina. The mechanical strength is less compared to yttrium stabilised zirconia. When compared to all ceramics, zirconia offers better esthetics in all zone with good marginal adaptation and higher mechanical properties. Due to increased mechanical strength and toughness, zirconia can be used even in premolar and molar regions. This property also leads to a disadvantage which is uneventful chipping of zirconia. [14]

Fig 14 a and b: Zirconia fixed prosthesis

Polyetheretherketone, shortly known as PEEK was introduced to dental applications in 1992, initially in the form of esthetic abutments. After many researches, it has found its way in many restorative treatments including intracoronal restorations, fixed bridges and implants. Being highly inert, it has shown resistance to most organic and inorganic chemicals and to thermal degradation. Also possess excellent mechanical properties in comparison to other materials in dentistry. [15] Physical properties such as the elastic modulus of PEEK is 3.6 GPa. When incorporated with carbon fibres, it can be increased up to 18 GPa, making it in par with cortical bone. Reinforcing with carbon fibres also reduces stress shielding when compared with traditional titanium implants, offering an alternative implant option with better biocompatibility, antibacterial activity and better osseointegration. PEEK reinforced with other inorganic fillers can be potentially used as crown and bridge material (Fig 15a and b) Bioactive nanocomposites can be used as indirect intracoronal or extracoronal restorations. Low specific weight produces very lightweight prosthesis providing patient satisfaction and comfort. Despite many features making it a very promising material of choice in replacement cases, when esthetics are considered due to the greyish brown colour, it is not suitable for monolithic esthetic restorations on anterior teeth. Composite should be used over it for a better esthetic outcome. Surface conditioning is done to improve bonding of composite to PEEK. [16]

Fig 15 a: Pre-Operative

Fig 15 b: PEEK post cementation

Implant supported prosthesis (Fig 16 a to d) are fixed appliances wherein, implants are connected to the natural teeth for partially edentulous patients who have been edentulous for a long span of time leading to limitation of space for implants. In last generation a demand for metal free restoration has increased the search for a new implant and restorative material. The physical properties of

zirconia implant have good mechanical strength and wear in comparison to titanium alloy. [17] Implant supported prosthesis are expensive, time consuming to fabricate, difficult to repair and technique sensitive. [18] Prosthesis related complications include fracture of acrylic resin veneer, prosthetic screw loosening\fracture of resin denture teeth, fracture of prosthesis framework and poor gingival esthetics have been reported in short and long period of time. [19] Majority of zirconia implants have been produced as one-piece implants. Two-piece implant is preferable to one-piece implant when initial stability is not optimized at implant placement. Replacing a missing tooth in anterior zone with implant supported restoration is demanding because of biological, mechanical and especially esthetic consideration. Zirconia abutments with a titanium base have high survival rate and show no difference over metal after a mean observation period of 5 to 7 years. [20] Monolithic zirconia complete arch implant prosthesis with a felspathic porcelain veneer in the gingival region have been documented with a very low implant failure. [18] Regarding biocompatibility concerns titanium plasma sprayed implants have shown accumulation of titanium particles in regional lymph nodes as well as lungs and bones after implant placement. In addition, when titanium is placed in contact with fluoride or low pH in a saliva, a tribocorrosion process is initiated. [17] Zirconia prosthesis did not show chipping of veneered gingival porcelain. [20]

Fig 16 a: Pre-operative

Fig 16 b: Implant

Fig 16 c: Placement of implant

Fig 16 d : Post operative

Conclusion

Esthetic replacement offers better appearance and oral hygiene maintenance. [1] There are many materials used for replacement of tooth which provide a good degree of esthetics such as all-ceramic crowns, laminate veneers and zirconia. A good prosthodontist must have an understanding about the concept of colour and light to produce excellent esthetic replacements similar to natural tooth to improve the oral health quality of life of a patient. [5]

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