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Review Article

Mastering the Art of Esthetics Dentistry

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Abstract

The term "esthetics" is borrowed from the Greek word "aesthesia", which means sensation or sensibility. It can be defined as "belonging to the appreciation of the beautiful". The relation of this term to dentistry has been differentiated from the word "cosmetic", which is derived from the Greek word "kosmos", or adornment. It is further stated that esthetic dentistry enhances the natural beauty of the mouth and face and that the term is used specifically to imply an improved relationship rather than a superficial one. This article reviews about principles for anterior dentition esthetic treatments.

Keywords: Mastering, Esthetics Dentistry.

INTRODUCTION

In 1936, Pilkington defined dental esthetics as "the science of copying or harmonizing our work with that of nature, making our art inconspicuous". The search for beauty can be traced to the earliest civilization. Dental art has long been a part of the quest to enhance the esthetics of the teeth and mouth. The study of dental esthetics is a relatively new area of interest in dentistry. Dentistry has always been concerned with appearance-related treatment, but until recently, the necessary materials were simply not available easily. The extraordinarily rapid development of adhesive, tooth-colored restorative materials over the past two decades has established esthetic dentistry as the major driving force in the profession. This is not as radical a change as it might seem. After all, esthetic dentistry is simply traditional dentistry with an emphasis on appearance and conservation of healthy tooth structure. The patients demand for treatment of unaesthetic anterior teeth is steadily growing [1]. Accordingly, several treatment options have been proposed to restore the esthetic appearance of the dentition. For many years, the most predictable and durable esthetic correction of anterior teeth has been achieved by the preparation of full crowns. However, this approach is undoubtedly most invasive with substantial removal of large amounts of sound tooth substance and possible adverse effects on adjacent pulp and periodontal tissues. The most successful developments in dentistry have been the veneers and various veneering techniques, which have provided us with a conservative approach to improve the esthetics of the individual. Direct resin composite restorations are widely used because of their superior adhesion to tooth substrates, excellent aesthetics, acceptable longevity, and relatively low cost. The great progress in bonding capability to both enamel and dentin made with the introduction of multi-step total-etch adhesive systems, along with the development of high performance and more universally applicable small nanohybrid resin composites has led to more conservative restorative adhesive techniques to deal with unaesthetic tooth appearance [2]. Resin composite veneers can be used to mask tooth discolorations and/or to correct unaesthetic tooth forms and/or positions. However, such restorations still suffer from a limited longevity, because resin composites remain susceptible to discoloration, wear and marginal fractures, reducing thereby the esthetic result in the long term. Never before have continuing education and reviewing the literature been more important to the dentist than they are today. While these efforts may occasionally seem tedious, it is tru1ly an exciting time for the dentist.

Fundamentals of esthetics

The development of new materials and techniques in dentistry has required the enlightened practitioner to develop new artistic skills. The restorative dentist manipulates light, color, illusion, shape, and form to create an esthetic outcome. Expertise in these areas differentiates the technically proficient dentist from one practicing a higher level of care and artistry.

Principle of Colour

Sir Isaac Newton first observed that sunlight separates into bands of bright colors when projected through a prism. The white light was being "refracted" or separated into the colors of the spectrum [3]. Color is all about light. For color to be seen, light is reflected from an object and stimulates the neural sensors in the eye's retina to send a signal that is interpreted in the visual cortex of the brain. It is undoubtedly the most complex and least understood artistic element. It is an area in which numerous interdependent factors exist, all of which contribute to the final esthetic outcome of the restoration [4]. The physicist Young determined that there are three basic colors in the light spectrum (red, green, and blue-violet). These "primary colors" when mixed can reconstruct most other colors of the spectrum and when all three equally combined yield white [3]. Color, as the eye interprets it, is either a result of absorption or reflection. In absorption, a white light is passed through a filter. The colors that pass through the filter and reach the eye are perceived as the color of the filter. In reflection, as with solid objects, the perceived color is the portion of the spectrum that is reflected back to the eye [5]. Albert Munsell described color as a three dimensional phenomenon. He described the three dimensions as HUE, VALUE (brightness), and CHROMA (saturation)[3]. Light entering the eye stimulates the photoreceptor rods and cones in the retina. The energy is converted through a photochemical reaction into nerve impulses and carried through the optic nerve into the occipital lobe of the cerebral cortex. The rod cells are responsible for interpreting brightness differences and value. The cone cells function in hue and chroma interpretation [5].

Hue

Hue is the quality distinguishing one colour from another [6]. In Munsell words it is "that quantity by which we distinguish one colour family from another, as red from yellow from blue or purple [7]". It is specified as the dominant range of wavelengths in the visible spectrum that yields the perceived color, even though the exact wavelength of the perceived color may not be present.23The order of visible spectral hues is: violet, blue, green yellow, orange, and red[8]. In the younger permanent dentition, hue tends to be similar throughout the mouth. With aging, variations in hue often occur because of intrinsic and extrinsic staining from restorative materials, foods, beverages, smoking, and other influences [5]. In dental terms, hue is represented by the letter A, B, C, or D on the commonly used VitaTM Shade Guide [3].

Value

Value is the relative lightness or darkness of a color. A light tooth has a high value; a dark tooth has a low value. The value of colour is determined by that quality of gray with which its brightness can be matched [8]. Lowering value means diminished light returns from the object illuminated, thus, more light either is being absorbed, scattered elsewhere, or transmitted through [3]. We notice value in preference to hue because our eyes use approximately 120 million receptor rods to judge light value versus six-seven million cone-shaped receptors to distinguish hue, a factor of 20[6]. The use of value in restorative dentistry does not involve adding gray but rather manipulating colors to increase or decrease amounts of grayness [5].

Chroma

Chroma is the saturation, intensity or strength of the Hue. If any dye is added into a glass of water and the same dye is added again and again, the intensity increases, but the color remains the same (hue). It can be thought of as a measure of how different the colour is from gray [9]. As chroma is increased, the value is decreased. Chroma and value are inversely related. Chroma is represented by numbers on the VitaTM Shade Guide. The color of a tooth is determined by a combination of its optical properties. When light encounters a tooth, four phenomena associated with the interactions of the tooth with the light flux can be described.27 specular transmission of the light through the tooth, specular reflection at the surface, diffuse light reflection at the surface and absorption and scattering of light within the dental tissues. Tooth color has been shown to result from the volume scattering of light, i.e. illuminating light follows highly irregular light paths through the tooth before it emerges at the surface of incidence and reaches the eye of the observer [10, 11]. Vaarkamp *et al*. [12] measured the light propagation through 0.85 mm thick human enamel and dentine bars. For enamel it was found that the hydroxyapatite crystals contribute significantly to light scattering, whereas for dentine the optical anisotropy observed supported the idea that tubules are the predominant cause of scattering[13,14]. The optical scattering power of enamel blocks was measured as a function of the decrease in mineral content and found that demineralization increases the scattering coefficient by a factor of about three[15].

Metamerism

Metamerism occurs when restorations match in one light but display a different color in other light conditions [16]. One object may have the ability to reflect more red than another. However, if there is no red range in the light source, they will appear the same; when viewed under a light source containing red, they will appear different. The color seen depends on the

nature of the light source illuminating the object. The color of an opaque object is the sum of the wavelengths that reflect off it. Light spectrum reflectance graphs measure the percentage of reflectance of the entire near-UV and visible-light spectrum off of a material. Porcelain might reflect light off its surface exactly as enamel in one part of the spectrum, but under different illumination the two objects that previously looked identical might look different. The closer the curves of the two materials to be matched, the more successful the color match will be [17]. Use of opaque surface stains to correct mismatches will increase metamerism. When reconstructing a tooth with dental porcelain, mimicking the layers of the tooth employing materials with the same optical properties (spectral reflectance curves) will minimize metamerism.

Translucency/Opacity

The translucency/opacity of a tooth has been viewed as the important optical property due to its influence on the quality and quantity of light reflected back to the eyes and its role in the aesthetic vitality of the tooth. The structure and thickness of enamel and dentin, and the amount of light that penetrates the tooth or the restoration before being reflected, absorbed, and transmitted, determines the degree of translucency or opacity. Translucency plays a crucial role in light transmission. While dentin is translucent in natural teeth, enamel is almost transparent and colorless. Enamel and dentin have different optical densities and, when light passes through

Enamel and strikes the underlying color of the dentin; it is reflected in all directions [18]. The enamel is composed of rods that are surrounded by prismatic substances that are perpendicular to the dentin and act as conduits or transmitters of the underlying color reflected from the dentin. Therefore, translucency in teeth is affected by the way light is reflected and refracted by the enamel rods and the condition of the dentin. The thickness of the material is an important consideration, because the greater the thickness, the less the translucency and greater the opacity of the material [19]. In dental ceramics, we try to imitate the appearance of the tooth as a sum of all its visual dimensions. Human teeth are characterized by varying degrees of translucency, which can be defined as the gradient between transparent and opaque. Generally, increasing the translucency of a crown lowers its value because less light returns to the eye. With increased translucency, light is able to pass the surface and is scattered within the body of porcelain. The translucency of enamel varies with the angle of incidence, surface luster, wavelength, and level of dehydration. With a translucent enamel layer, the ceramist achieves color depth and the illusion of a vital natural tooth [20].

Opalescence

Opalescence, another optical characteristic, is defined as the milky, white-blue iridescent appearance of a dense, transparent medium or colloidal system when illuminated by visible light. Opalescence is the phenomenon in which a material appears to be one color when light is reflected from it and another color when light is transmitted through it[20, 21]. A natural opal is an aqueous disilicate that breaks transilluminated light down into its component spectrum by refraction. Opals act like prisms and refract (bend) different wavelengths to varying degrees. The shorter wavelengths bend more and require a higher critical angle to escape an optically dense material than the reds and yellows. The hydroxyapatite (HA) crystals of enamel also act as prisms. Wavelengths of light have different degrees of translucency through teeth and dental materials. When illuminated, opals and enamel will transilluminate the reds and scatter the blues.

Within its body; thus, enamel appears bluish even though it is colorless [22-24]. Opalescence is the light effect that occurs in the tooth when visible light is dispersed and refracted by microcrystals or colloidal inclusions that result in a reflection of the shorter, 0.4 to 0.5 wavelengths of light (bluish tones), the transmission of longer, 0.58 to 0.73 wavelengths (yellow-orange), and the absorption of medium, 0.5 to 0.57 wavelengths (greenish tones). This light scattering is caused by particles dispersed throughout the translucent material that are smaller than the wavelength of the visible light and have much higher refractive index than the matrix material [25]. Therefore, opalescent characteristics impart a yellow/orange appearance under transmitted light from the inside of the mouth and a bluish appearance under reflected light from the facial aspect of the tooth or restoration. This effect can be seen in the incisal third of teeth and is predominant in adolescents. This effect is known in optical physics as the tyndall effect, is called the opalescence of natural teeth [19]. Opalescence is primarily observed in the essentially colorless and transparent enamel. Since the color of dentin is dominated by light absorption and reflection creating a yellow-orange appearance and masking opalescent effects, opalescence is not readily discernible in dentin structures. Opalescence in teeth appears as a light scattering effect that is associated with the diameter of enamel rods. In posterior teeth, these characteristics are exemplified on cusp tips and marginal ridges. In anterior teeth, this effect is observed in the incisal edges and proximal incisal surfaces. The opalescent effects of enamel brighten the tooth and give it optical depth and vitality. Opalescence is responsible for intrinsic brilliance of the natural teeth that clinicians and ceramist try to imitate when fabricating artificial restorations [26, 27].

Fluorescence

Fluorescence is an optical characteristic in which absorption of ultraviolet (UV) rays of light and the subsequent emission of blue or white visible light occur. It is the absorption of light by a material and the spontaneous emission of light in a longer wavelength [20, 25]. In a natural tooth, Fluorescence primarily

occurs in the dentin because of the higher amount of organic material present [22, 23, 28, 29]. After penetrating the enamel and reaching the dentin, the UV light rays excite the photosensitive dentin. For the fluorescence to occur, the emission must take place within 10-8 seconds of activation [29]. The emitted light enhances the brilliance and vitality of teeth, causing both dentin and enamel to fluoresce, further increasing the whiteness or value of the dentition. The more the dentin fluoresces, the lower the chroma. Fluorescent powders are added to crowns to increase the quantity of light returned back to the viewer, block out discolorations, and decrease chroma. This is especially beneficial in high-value shades, as it can raise value without negatively affecting translucency when placed within the dentin porcelain layers [20, 30]. In nature, this effect is created by the UV rays of sunlight (i.e., short wavelengths), which are invisible to the human eye. Natural teeth exposed to UV light rays exhibit fluorescence with an emission spectrum that varies from intense white to blue, and is observed in the yellow-orange spectrum and detected in the middle third of anterior teeth.

Surface Gloss

Like color gloss has physical, physiologic, and psychological aspects. Gloss is defined as "angular selectivity of reflectance, involving surface reflected light, responsible for the degree to which reflected highlights or images of the objects may be seen as superimposed on a surface. [19, 31, 32]". The surface morphology of natural teeth influences their surface gloss as well. A coarse tooth allows diffused reflection, whereas a smooth surface facilitates specular reflection.

Tooth components

Midline position, Incisal length**,** Zenith points**,** Tooth axis**,** Individual and collective tooth dimensions - single tooth proportion**,** Golden proportion**,** Tooth surface texture and contour**,** Shape and position of the teeth**,** Color of teeth**,** Sex, personality and the age factor. Tooth discoloration associated condition are Yellow Aging, Tetracycline ingestion, Amoxicillin syrup, Stannous fluoride, Amelogenesis imperfect, Opaque Fluorosis, Sickle cell anemia, Osteogenesis imperfect, White Fluorosis, Chronic kidney failure, Hypomineralization, Brown Fluorosis, Smoking, Coffee, Tea, Calcific metamorphosis, Loss of vitality, Chlorhexidine ingestion, Iron, Tetracycline ingestion, Osteogenesis imperfect, Chlorhexidine glucamate (Hibitane) disinfectant, Dental materials, Black Occupational: glass blowers, Betel nut chewers, Pipe/cigar smokers, Dental materials (pins), Caries, Blue Tetracycline ingestion, Osteogenesis imperfect, Green, Hyperbilirubinemia, Congenital biliary atresia, Occupational: brass factory, Marijuana smoking, Orange Poor oral hygiene, Chromic acid fumes, Red Internal resorption, Congenital erythropoietic porphyria, Periapical granuloma in lepromatous leprosy, Gray Tetracycline ingestion for cystic fibrosis, Minocycline for acne in adults, Dentinogenesis imperfect, Amalgam restorations, Cyclosporine. Modern dental practices frequently encounter patients who exhibit various forms of wear to the dentition. The wear may present as abfraction, abrasion, attrition, and/or erosion. The etiologies of abfraction, abrasion, attrition, and erosion may be interrelated. Therefore, multiple conditions may be seen in a single patient. Genetic defects, midline diastema, chipped, fractured, orendodontically treated teeth and sports injuries are also indicative factors.

Guide Lines for Shade Selection

A precise color match between artificial color samples and a natural tooth can best be approximated if strict conditions are followed. Several guidelines which need to be kept in mind are: Lightening of the operatory The traditional light source considered optimal for color matching is - Northern exposure sunlight in the middle of the day i.e. noon, with a slightly overcast sky (intensity-1500 Lux): light type D65. This exposure contains an almost equal blend of all wavelengths of light compared to morning and evening exposures which are rich in reddish yellow wavelengths. Early morning sunlight is rich in blue wavelength of the spectrum [33]. Unfortunately, all clinics may not have access to natural sunlight and even if available, it may not have the suggested intensity of 1500 lux because daylight intensity varies greatly during the course of the day, with the time of the year, conditions of the sky, geographical location of the place etc. To overcome these shortcomings and provide consistency in the lightening environment, artificial systems that have the same spectrum as natural daylight have been proposed. No lamp is able to duplicate the light type D65 exactly, but is sufficient for most practical applications. The capacity of an artificial light to reproduce natural light is measured by using color temperature and color rendering index (CRI). White light which is considered the best source for color comparison is assigned a Color Rendering Index (CRI) of 100. This light is constituted of equal energies from all the three primaries of the spectrum — red, green and blue. Any light source used for color matching should match this assigned CRI, but rarely is any artificial light available with this range. Hence, artificial sources with an index over 90 are considered adequate.

Techniques

In recent years numerous materials and methods have been introduced for the correction of esthetic problems of anterior teeth. The rate of development of materials and application techniques has enabled the dentist to fulfill the highest esthetic requirements of the patients, i.e. to place invisible or imperceptible restorations. An ideal anterior restorative method should allow chairside fabrication, be easy to apply and be time and cost effective. An ideal restorative material should be stain and abrasion resistance, compatible with soft tissue, have high

compressive strength and have a life like shades. At present no single material or method can address to these requirement. All restorations offer advantages and limitations, whether direct or indirect, one should evaluate all the factors and choose the one most likely to attain the desired goals[34].

Failures maintanance and repair

With the increasing use of composites, it is important for dentists to be aware of the probable longevity and likely modes of failure of esthetic restorations. Many steps go into the placement of a successful and long-lasting composite restoration. When a restoration fails, understanding the cause of the failure is an important first step in preventing a similar problem from occurring in the future [35]. Failures in anterior esthetic restoration may manifest as Discoloration, Postoperative sensitivity, incorrect shade, Poor retention, Gap formation, Wear, Voids, and Fracture of tooth.

CONCLUSION

Esthetic procedures have the ability to alter theentire appearance of an individual by providing them a beautiful smile. The person gains notonly a positively improved appearance, but also apotential moral "boost" that acts positively on their mental health and self-esteem. Any restoration tobe performed must take into account the personalityof the patient, and interpret and integrateit into the procedure. The importance of psychologicalfactors that may enhance or affect theesthetic appearance should never be underestimated. Although the dentist should always have a solidknowledge of the parameters that set a beautifulsmile, they must also interpret and apply their ownartistic skills in order to obtain a pleasing smilethat is facially integrated. In a society where optimal achievement inesthetic restorations is expected from the clinician,the arrival of these new systems and materialsis a boost for the dentist.

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