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OPTICAL PROPERTIES OF SOME RECENTLY USED AESTHETIC VENEER MATERIALS

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ABSTRACT

Statement of problem: In making aesthetically restoration such as veneer and crown, it is necessary to duplicate the shape and color near to those of the natural teeth. The translucency of aesthetic restoration has been emphasized as one of the primary factors in controlling the esthetic outcome of restorations.

The aim: This experimental work aimed to evaluate the translucency of aesthetically veneer materials commercially available.

Materials and methods: Two types of dental ceramics and one composite material were evaluated. Zirkon Zahn, IPS e.Max Empress and .XHD (composite resin). All the experimental samples of laminate veneers (LVs) were prepared using ready made veneer mould (3M ESPE) to standardize the thickness and the dimension of the tested samples. The samples prepared following the manufacturers' instructions. Photodetector (Double Beam Method- with source Red Laser, λ=632.8 nm) was used to measure the translucency of the samples.

Results: The Zirkon Zahn samples showed slightly higher transparency value (82.4%) compared to other groups. Statistically, there was no significantly different between Zikcon Zahn and the e.max Press groups (P=.108). However, the translucency value of the XHD composite was significantly lower than that of two other groups (P<.020).

Conclusion: Light transmission through ceramic samples was significantly higher than composite resin samples. Different refractive indexes among the particles, and their chemical nature may result in light scattering and difference in translucency.

Keywords: Zirkon Zahn, IPS e.Max Empress, XHD Composite, Veneer Translucency

INTRODUCTION

All ceramic restorations commonly sued in dentistry to meet the requirement for both functional and aesthetically application [(1)]. Porcelain laminate veneers (PLVs) offer superior translucency and more conservative approach compared with all-ceramic restorations[(2,3,4)]. The aesthetically restoration such as veneer and crown, ideally have to dupli-

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cate the shape and color near to those of the natural teeth. However, the color shades of abutments might influence the color of the copings which are made of material with high transparency[5-9]. The human eyes are easily able to differentiate between a natural tooth and an artificial one, even when there are minute differences in color and translucency [10]. The aesthetic value of a ceramic crown is based on its ability to harmonize with the natural tooth. Key optical factors that permit a pleasing harmony are color, surface texture, and translucency[11]. Translucency occurs when a light beam, in passing through a material, is partially scattered, reflected, and transmitted through the object: the greater the quantity of light that passes through the object, the higher the translucency[10]. Translucency and color are highly correlated properties of a ceramic crown[12,13].

The core that shows more colors of the deepest layers of the tooth are the greater of the translucency of light to transmitted through the surface. Thus, in a sufficiently translucent ceramic crown used with a colorless cement, the reflected light contains the dominant color of the dentin, creating a natural-looking, esthetic restoration that blends harmoniously with the surrounding teeth and tissues. The translucency and color of a ceramic restoration depend on the various characteristics of the core and veneer ceramics[14].

Scattering of the light is generated by many factors, such as different reflect indexes among ceramic phases[14] voids and porosities, high crystalline content[15] and crystal number and size, especially when the crystal particles are slightly larger than the wavelength of the incident light [14]. Zirconia and alumina ceramics, with their high degree of crystalline content, have a maximum scattering effect. Thus, they appear relatively opaque to visible light. Dental professionals are now challenged to routinely produce restorations that duplicate form, function, and esthetics of the natural teeth. [16,17]. A challenge in the success of these restorations is color assessment and reproducibility[18-20].

The current study deals with evaluation of the translucency of veneer materials commercially available. It will provide a guide line for dentists to easily select and recommend the more suitable materials for their patients that need high aesthetically consideration.

MATERIALS AND METHODS

Two types of dental ceramics and one composite material were evaluated. Zirconia (Zirkon Zahn – Italy), IPS e.Max Empress (Ivoclar. Viadent, Swissland), and Esthetic.XHD, high definition micro matrix composite resin (Densply Caulk-USA). All the experimental samples of laminate veneers (LVs) were prepared using readymade veneer mould (3M ESPE, Seefeld, Germany) to standardize the thickness and the dimension of the tested samples. Zirconia samples preparation; First the veneer was prepared by light cure composite. The composite was filled in the veneer mould and cured by light cure for 20 seconds, then finished and polished. The final thickness was measured to be about 0.3mm. After that the composite veneer was fixed to a plate index in one side and zirconia block fixed in another side, then the block ground sequentially by milling machine to duplicate it to zirconia veneer. After that the milled veneer was immersed in colouring liquid (A1 shade) for 5 second, then drying it under drying lamp for 10 minutes. The final sintering of zirconia veneer was done in sintering furnace for 9 hours. The glaze layer was done at a temperature of 910^0C.

IPS e.max empress samples were prepared using ingot medium opacity A1. The veneer was prepared first from wax pattern and invested with refractory material. Then the wax pattern was burnout as in conventional procedure. The ingot of porcelain was milt and injected using Ivoclar furnace (E.P. 300 Swiss). After that the veneers tried on the cast. Then facial surface was cutback (Remove thin layer from facial surface). The colored layer was applied onto one side of the specimens and fired at 765°C.

Aesthetic composite resin (XHD) samples were prepared using the same readymade mould that was used to prepare the ceramic LVs. One increment of about 2mm. thickness of the composite resin was packed and adapted into the mould using special type of instrument provided from the same manufacturer. Then the transparent coverage of the mould was applied and held under light finger pressure to keep the coverage firm in its proper position. After that, the specimen was exposed to blue visible light at zero contact for 20 seconds with light intensity of 500mW/cm^2 using LED curing unit (SDI radii Plus Australia). Another 1mm was added and cured in the same way. Each specimen was exposed to additional curing for another 60 seconds from the fitting surface after its removal from the mould. All the specimens were examined under magnified lens to exclude any specimen that showed any surface defects. Meanwhile, the thickness was measured at three central points located at each quadrant in the cervical, middle, and incisal thirds of the labial surface of the laminate veneers to be 0.3mm for all samples.

MEASUREMENT OF TRANSLUCENCY

Photodetector (Double Beam Method) with Source: Red Laser, λ=632.8nm (Manufactured by Leybold -UK) (0.5mW red He-Ne laser-) was used as the light source to test and measure the transmission/translucency of the samples. To measure the light power before and after inserting each sample we used a circular photodetector (Phywe –Germany) with a light attenuator cabled to an optical power meter, with the ambient room lighting subtracted. Each sample was measured twelve times in different areas of the sample.

STATISTICAL ANALYSIS

Data analysis was performed in several steps. Initially, descriptive statistics for each group results. One way ANOVA followed by pair-wise Tukey's post-hoc tests were performed to detect significance between groups. Statistical analysis was performed using SPSS V.17. P values ≤0.05 are considered to be statistically significant difference between groups.

RESULTS

The translucency values obtained from each group are shown in Table 1. The zircon zhan showed slightly higher absolute translucency (82.4 ±6), while e.max samples showed (76.8 ±3.3), whereas the composite samples XHD displayed the lowest value (73.4± 3.2). The averages of absolute translucency were depicted in Figure 1. The relative translucency was displayed in Figure 2. The Zircon Zhan samples showed (0.86 ±0.03), whereas the IPS e.max samples were (0.87 ±0.03), where the composite resin samples XHD showed (0.89 ±0.04). Statistically, there was no significantly different between Zirkon zahn and the IPS e.max empress groups (*P*=.108). However the translucency value of the XHD composite was significantly lower than that two other groups (P<.020). In addition there was no significant difference between all the experimental groups in the contrast ratio of relative translucency (*P*=.617).

TABLE (1) Display the mean and standard division of translucency

Samples	Transmission % (Absolute Translucency)	Contrast Ratio Relative Translucency
Zirconia	82.4 ±6	0.86 ±0.03
e.max	76.79 ±3.3	0.87 ±0.03
XHD	73.35± 3.2	0.89 ±0.04

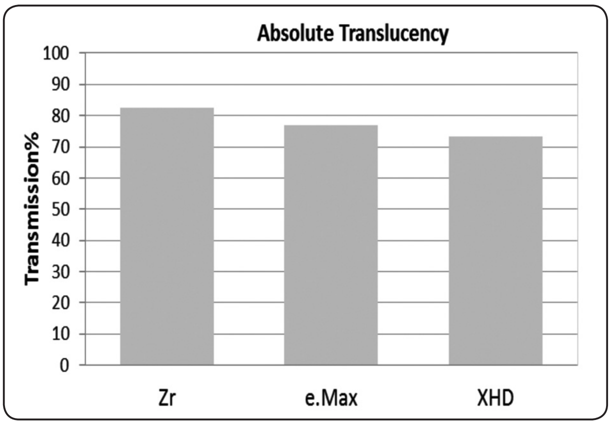

Fig. (1) Shows the average of absolute translucency of tested groups.

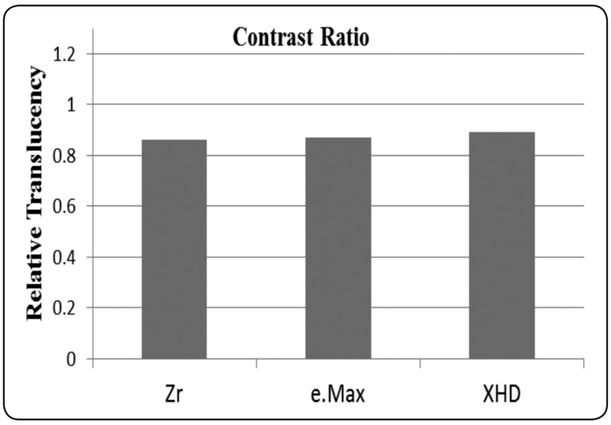

Fig. (2) Shows the average of relative translucency of test groups.

DISCUSSION

The aesthetic appearance of an aesthetic restoration is a multifactorial phenomenon. The effect of the framework translucency can be altered by the thickness, color, and surface texture of the veneering materials[11,15] and framework coloring technique [21,22,23] and opacity and color of the luting cement [1]. As suggest by Heffernan et al [15], it would be interesting to know if the differences in translucency found in in-vitro studies have clinically perceptible effects on the aesthetics of the restoration. Only the materials with the greatest differences in translucency values would likely demonstrate differences in the definitive restoration that are perceptible to the human eye. Zirconia can be colored by infiltration, precolored at the microcrystalline powder state, or surface colored. The coloring techniques may reduce the translucency and the mechanical properties of the zirconia [13].

Zirkon zahn veneer samples demonstrated the highest translucency value, probably due to the thin ceramic walls and the intrinsic optical properties of the material. Zirkon zahn showed slightly higher translucency value, which was significantly higher than XHD composite. This can be explained by slight differences in the ceramic structure and chemistry of the material and by the effect of different milling and processing methods on the crystalline structure of the ceramics. In fact, necessary conditions for a translucent ceramic are that it does not absorb radiation in the visible spectrum. There are various causes of diffusion within polycrystalline ceramic materials [9,10]. Irregularities in the distribution of the phases, defects and voids at grain boundaries, optical anisotropy of the grains, grain size larger than the light wavelength, different refractive indexes among the particles, and their chemical nature may result in light scattering [9]. Further clinical studies are necessary to determine the effect of the optical properties of the ceramic core on the aesthetic appearance of veneer materials.

CONCLUSIONS

Within the limitations of this study, the following conclusions were drawn. Light transmission through zirconia was significantly higher than composite resin samples, whereas no significant difference with IPS e.max empress samples. The relative translucency showed no significant differences in between all groups. Irregularities in the distribution of the phases, defects and voids at grain boundaries, different refractive indexes among the particles, and their chemical nature may result in light scattering and difference in translucency

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