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Evaluation of transparence and translucency of laminate veneer materials

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ABSTRACT

The aesthetic value is one of the criteria that effects selection of a veneer material and their ability to harmonize with the natural tooth. The important optical factor that gives a pleasing harmony is translucency. Translucency occurs when a light beam is passing through a material, the greater the quantity of light that passes through the object, the higher the translucency will be. This study aimed to evaluate the translucency and transparency of some aesthetically veneer material recently introduced into dentistry. The materials were used Zirkon Zahn, IPS e.Max empress and XHD composite resin. All the experimental samples of laminate veneers (LVs) were prepared using readymade veneer mould (3M ESPE) to standardize the thickness and the dimension of the tested samples. The samples were prepared following the manufacturer's instructions. Spectrometer (Visible and UV/Visible Spectrometer) was used to measure the absolute and relative translucency of the samples. The Zirkon Zahn samples showed slightly higher transparency value (72.4%), while IPS e.max empress showed (64.7%), whereas the composite samples XHD displayed the lowest value (60.3%). Statistically, there was no significance difference between groups in absolute translucency ($P<0.058$). The relative translucency showed no significant differences between all groups ($P<0.190$). However, there was significant difference in reflection values ($P<0.014$). Irregularities in the distribution of the phases and voids at grain borders, different refractive indexes among the particles, and their chemical nature may result in light scattering and differences in translucency.

Keywords*: IPS e.Max, Zirkon Zahn, XHD Composite, Absolute, Relative Translucency*

INTRODUCTION

Veneers are thin bonded restorations that restore the facial surface and part of proximal surfaces of the teeth requiring aesthetic restoration. It is used to reconstruct the natural appearance of the teeth, enhancing the smile and aesthetic.[1] There are two main types of material used to fabricate a veneer: composite and dental porcelain. A composite veneer may be directly placed (built-up in the mouth), or indirectly fabricated by a dental technician in a dental lab, then bonded to the tooth using a resin cement.[1] With the advances in dental materials and new techniques in restorative dentistry, the demand for aesthetic restorations has increased extremely. Dentists and dental technicians are now challenged to routinely produce restorations that duplicate form, function, and aesthetics of the natural teeth.[2,4]

The aesthetic value of a ceramic restoration is based on its ability to match with the natural tooth. Main optical factors that permit a pleasing harmony are colour, surface texture, and translucency.[5] Translucency occurs when a light beam passing

through a material, is partly scattered, reflected, and transmitted through the object; the greater the quantity of light that passes through the object, the higher the translucency.[6] The human eyes are able to easily distinguish between a natural tooth and an artificial one, even when there are minute differences in colour and translucency.[7,8] Translucency is inversely related to the thickness of the ceramic layer to be traversed by the light beam and is strongly influenced by light scattering. Scattering of the light is generated by many factors, such as different refractive indexes among ceramic phases, voids and porosities, high crystalline content, and crystal number and size, especially when the crystal particles are slightly larger than the wavelength of the incident light.[9,10]

The current study deals with evaluation of the transparency and translucency of veneer materials commercially available (Zirconia, IPS e.Max empress and Esthetic (XHD) high definition micro matrix composite resin) suing colour-measuring devices, spectrophotometers. The study 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

The materials used in this study are Aethetic XHD high definition micro matrix composite resin (Densply Caulk-USA), Zirkonia (Zirkon Zahn-Italy), and IPS e.Max Empress (Ivoclar. Viadent, Switzerland). The specimens of laminate veneers (LVs) were prepared using readymade veneer mould (3M ESPE, Seefeld, Germany) to standardize the thickness of the dimension of the tested samples. Zirconia samples were prepared as following; first the veneer was prepared by light cure composite. The composite was filled in the veneer mould and cured by light for 20 seconds, then finished and polished. The final thickness was measures to be about 0.3 mm. After that the veneer composite was fixed to a plate index in one side and Zircinia block (provided by Zirkon Zahn manufacturer) in another side, then the block ground sequentially by fixed milling machine to duplicate it to zirconia veneer. After that the milled veneer was immersed in colouring liquid (A1 shade) for 5 seconds, then drying it under drying lamp for 10 mins. The final sintering of zirconia veneer was done in sintering furnace for 9 hours. The glaze layer was done at a temperature of 9100°C.

IPS e.max empress samples were prepared from ingot of medium opacity A1 via ceramic injection molding. The veneer wax pattern was fabricated 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). The coloured 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 2 mm thickness of the composite resin was packed and adapted into the mould as recommended by the manufacturer. Then the transparent coverage of the mould was applied and held under light finger pressure to keep the coverage film in its proper position. After that, the specimen was exposed to blue visible light at zero contact for 20 seconds with light intensity of 500 mW/cm^2 using LED curing unit (SDI radii Plus Australia). Another layer of 1 mm composite 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 third of the labial surface of the laminate veneers to be 0.3 mm for all samples.

Measurement of the transparency and translucency

The measuring device used in this study is spectrophotometers due to fact, the availability and more popular device used to measure the colour properties.[11] A calibrated spectrophotometer (Visible and UV/Visible Spectrophotometer-Shimadzu mini 1240-Japan) was used for measurement of the translucency and transparency of test samples. Each sample was measured three times in different areas of the sample, incisal, middle and cervical.

RESULTS AND DISCUSSION

The translucency values obtained from each group are shown in Table 1. The Zirkon Zahn showed slightly higher absolute translucency (72.4±8), while e.max samples showed (64.7±1.3), whereas the composite samples XHD displayed the lowest value (60.8±1.8). Statistically, there was no significantly difference between all the tested groups (P>.058). In addition there was no significant difference between all the experimental groups in the contrast ratio of the relative translucency (P>0.190). Zirconia samples showed lower reflection rate (0.117±0.018), while e.max samples (0.174±0.006), where XHD showed lightly higher reflection rate (0.198±0.009). There was a significant difference between groups in their reflection (P<.001), post hoc HSD tukey test (multi comparison between groups) shows significant difference between Zircon Zahn and IPS e.max and XHD composite samples (P<.003 and P<.001) respectively. While showed no significant differences between IPS e.max and XHD composite samples (P<.128).

Table 1: Shows mean values and standard deviation of translucency and transparency of veneer material

Samples	Transmission % (Absolute translucency)	ρ-value	Reflectivity	ρ-value	Contrast ratio (Relative translucency)	ρ-value
e.max	64.7±1.3		0.174		0.90	
Zr	72.4±8.1	.058	0.117	.001	0.83	.190
ZHD	60.3±1.8		0.198		0.93	

Many factors influence the esthetic appearance of esthetic restoration include the framework thickness, colour, and surface texture of the veneer materials.[5,8] The materials with the greatest differences in translucency values would likely show differences in the final restoration that are perceptible to the human eye.[12] The optical behavior of a restorations needs to be similar to that of the replaced natural tooth.[13] By controlling light absorption, reflection and transmission of the dental restorative materials could be ideally matching translucency found in natural tooth.[14] Translucency is reported to be important factor in clinical selection of restorative materials. [5,12,15]

In the current study zircon zahn veneer samples demonstrated the slightly higher translucency value, probably due to the thin ceramic walls and the intrinsic optical properties of the material. This can be explained by slight differences in the ceramic structure and chemistry of the material and by the effect of the different milling and processing methods on the crystalline structure of the zirconia samples. In fact, necessary conditions for the translucent ceramic are that it does not absorb radiation in the visible spectrum. There are various causes of diffusion wuthin polycrystalline ceramic materials.[8,9] 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.[16] Further clinical studies are necessary to determine the effect of the optical properties of the ceramic core and cement materials on the esthetic appearance of veneer materials.

SUMMARY

Within the limitation of this study, it can be concluded that the light transmission through zirconia was slightly higher than other tested samples. However, there was no significant differences between them. The nature of the material and the irregularities in the distribution of the phases, defect and voids at grain boundaries, affect the translucency of the esthetic restoration, in addition the different refractive indexes among the particles, and their chemical nature may result in light scattering and difference in translucency.

REFERENCES

1. Dhir. LCV, Porcelain laminate veneers for a conservative aesthetic enhancement of smile IJRID 2015;(5)4:96-101
2. Wee AG, Monaghan P, Johnson WM. Variation in color between intended matched shade for fabricated shade of dental porcelain. J Prosthet Dent 2002; 87:657—66
3. Tung FF, Goldstein GR, Jang S, Hittelman E. The repeatability of an intraoral dental colorimeter. J Prosthet Dent 2002; 88:585-90
4. Lee YK, Cha HS, Ahn JS. Layered color of all-ceramic core and veneer ceramics. J Prosthet Dent 2007; 97:279-86
5. Baldissara P. Llukacej, A., Ciocca, L, Valandro, FL and Roberto R. Translucency of zirconia copings made with different CAD/CAM systems. J Prosthet Dent 2010; 104:6-12
6. O'Brein WJ. Double layer effect and other optical phenomena related to esthetics. Dent Clin North Am 1985; 29:667-72
7. Llie N, Hickel R. Correlation between ceramics translucency and polymerization efficiency through ceramics. Dent Mater 2008; 24:908-14
8. Heffernan MJ, Aquilino SA, Diaz-Arnold AM, Haselton DR, Standford CM, Vergas MA. Relative translucency of six all-ceramics systems; Part I: core materials. J Prosthet Dent 2002; 88:4-9
9. Antonson SA, Anusavice KJ, Contrast ratio of veneering and core ceramics as a function of thickness. Int J Prosthodont 2001; 4:316-20
10. Brodbelt RH, O'Brein WJ, Fan PL. Translucency of dental porcelains. J Dent Res 1980; 59:70-5
11. Chang J, Da silva JD, Sakai M, Krstiansen J, Ishikawa-Nagai S. The optical effect of composite luting cement on all ceramic crowns. J Dent 2009; 37:937-40
12. Shah K, Holloway JA, Denry IL. Effect of coloring with various metal oxides on the microstructure, color, and flexural strength of 3Y-TZP. J Biomed Mater Res B Appl Biomed Mater 2008; 87:329-37.
13. Pecho OE. Ghinea R, Ionesco AM, Cardona JDL, Paravina RD, and Pe'rez MD. Color and translucency of zirconia ceramics, human dentine and bovine dentine. J of dentistry, 2012; 40:e40-e43
14. Raptis NV, Michalakis KX, Hirayama H. Optical behavior of current ceramic systems. International Journal of Periodontics & Restorative dentistry 2006; 26: 31-40
15. Shiraishi T, wppd DJ, Shinozaki N, van Noort R. Optical properties of base dentin ceramics for all-ceramic restorations. Dental materials; 2011: 27:165-72
16. Heffernan MJ, Aquilino SA, Diaz-Arnold AM, Haselton DR. Standford CM, Vargaz MA. Relative translucency of six all-ceramic systems. Part II: core and veneer materials. J Prosthet Dent 2002; 88: 10-5