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# Shade Matching in Aesthetic Dentistry: An Overview

Medical Science

**KEYWORDS :** Porcelain Laminate Veneer, Resin Cement, Shade matching.

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## ABSTRACT

*In the recent year, marked raised in patients aesthetic expectations has been noted and in replicating the appearance & optical properties of tooth structure requires careful selection of dental materials & control over the form, surface texture, translucency, and colour of the restoration. With the availability of ceramic materials, a minimally invasive restoration such as porcelain laminate veneers (PLVs) can be prepared with adequate strength and can successfully be cemented with resin cements. Resin cements are generally used for the cementation of all--ceramic restorations. Since ceramic material and resin cements are produced by several manufacturers in varying shades, a marked effect is noticed on the final colour-match of the PLVs especially the high translucency ceramics. This paper discusses the various factors that finally modulate the colour-match of PLVs with adjacent natural teeth under individual clinical need.*

**Introduction**

In the field of aesthetic dentistry the most decisive parameter to create aesthetic restoration is based on characteristics like surface form, translucency and colour.[1] Restorations using porcelain laminate veneers (PLV), the porcelain shade need to be matched to the shade of the adjacent natural teeth.[2] Nowadays, the manufacturer has made available the different shades of resin cements to achieve clinically acceptable restorations with good colour matching to the adjacent natural dentition. However, the final colour of translucent ceramic restorations is determined by many factors such as the thickness of the porcelain veneer, the thickness and colour of the luting agents and the colour of the underlying tooth structure. The aim of this paper is to discuss the underlying factors that finally affect the shade of restorations under individual clinical need.

**Factors Affecting Ultimate Shade of the Ceramic Restoration**

Based on the available literatures, a myriad of factors were available that influences the assessment of colour of restoration. The factors under consideration are shade and optical properties of tooth structure, ceramic characteristics, shade and thickness of resin cement, interaction of resin cement and ceramic bonding, influence of polymerization, dental shade-matching devices.

**Substrate Characteristics (shade and optical properties of tooth structure):**

Effect of substrate or aesthetic restorative foundation should be consider during shade selection.[3] The translucency of ceramic add complexity to colour matching devices as it allow more light to enter and scatter, which means underlying tooth substrate has effect on final optical properties of ceramics.[4] This in turn influenced by the thickness of ceramic veneer used for restoration. As many studies showed that the underlying substrate has significant effect on the final shade of ceramic restoration of minimum thickness irrespective of ceramic shade.[5-9] To eliminate this undesirable effects primary considerations should be given to the ceramic thickness [10,11], ceramic type [12-13], shade of ceramic material and resin cement.[14-17]

**Clinical Implication:**

The supporting foundation may clinically influence the overall selected colour of thin, translucent ceramic laminate veneers, hence clinician should consider other factors to achieve good colour match.

**Ceramic characteristics:**

Ceramic laminate thickness has been reported to range between 0.3 to 1.5mm. The reported survival rate ranges from 84-97% over 5-14 years.[18,19] Ceramics are optically heterogeneous, showed reduced intensity of transmitted light. As it has been shown that with the increase in the ceramic veneer thickness, light transmission significantly reduced regardless of ceramic shades. The acceptable colour differences (ΔE) for dental professionals ranges 2.6 to 3.7[20-22] and the studies showed the 1.0mm and above ceramic thickness did not produce clinically detectable colour differences (ΔE< 1) on changing the colour of substrate. However, a significant colour differences were noted when ceramic thickness decrease below 1mm and ceramic thickness of 0.6-0.3mm i.e. ΔE of 5.5.[23,24]

**Clinical implication:**

The final colour difference (ΔE) of cemented ceramic veneers markedly affected by thickness, as ceramic thickness increases colour differences (ΔE) decreases.

**Resin cements:**

Currently the available resin cements are specifically used for luting ceramic veneers. However, literature found replete with articles for selecting appropriate resin cements. The light activated resin cements proved advantageous because of long working time, easier removal of excess material and reduce finishing time compared to chemically and dual-cured resin cements. Besides these, studies showed the excellent colour stability of light activated resin cements due to the absence of the aromatic amine as a self-curing catalyst, which cause colour changes over time.[25-29] Dual-cured resin cements had some of the desirable characteristics of light- and chemically cured resin cements. Dual cure resin cements proved advantageous in deeper areas where the light is attenuated, showed superior mechanical properties, such as flexural strength, elastic modulus, hardness and degree of conversion in comparison to light activated or chemical curing.[30-33] However, dual-cured resin cements formulation contains aromatic tertiary amine, which compromises the colour stability. The interaction between resin cement and overlying ceramic i.e the bonding also affect the shade of overall restoration. Many in vitro studies showed the accelerated ageing led to change in the colour of all the resin cements within clinically accepted level. The ageing process results in an increase in opacity of most of the materials.[34] Trial insertion paste which is used to evaluate colour matching of veneer restoration showed significant differences in final aesthetic outcome of trial insertion paste and resin cements. Hence, its usage is appears clinically insignificant. [35, 36]

**Clinical implication:**

With developments in new formulations and polymerization techniques, clinical longevity and colour stability of resin cements are expected to improve. It has been stated that careful selection of type and shade of resin cements is a critical factor in obtaining optimal aesthetics for laminates restoration. Resins cements affect the final colour of laminate restorations. However, this visually perceptible effect of resin cement shade on

ceramic restoration decreases when the ceramic thickness increases.

**Dental Shade-Matching Devices:**

Traditionally, the shade guide has been used for colour matching in dentistry. The use of colour measuring devices such as colorimeter and spectrophotometers was popularized because of accuracy, standardizations and numerical expression of colour. The CIE L*a*b* colour coordinates are used to calculate the magnitude of colour differences between the two objects or specimens, hence identify their clinical acceptability. Later, CIEDE2000 ($\Delta E_{00}$) was developed and presents improved reliability factors. It has been shown that the CIEDE2000 ($\Delta E_{00}$) provide high degree of fit than CIE L*a*b* when assessing both acceptability and perceptibility judgments. Although, the shade guides still has been preferred by many clinician as convenient and reliable indicators, as their accuracy ranges 67-93%. [37-40]

**Clinical implications:**

With technological advancement, different shade matching instrument has been developed to overcome imperfections and inconsistencies of traditional shade matching using shade guide. The clinician should considered colour matching devices as they are accurate and reliable indicator and rarely compromise with the final shade match of restoration.

**Conclusion**

Within the scope of this paper, there is no evidence that state the universal application of single ceramic material and resin cements for all clinical situations. Additional longitudinal studies are required to advances the development of ceramic materials and resin cements. Hence the successful application is dependent upon the clinician to match materials, manipulation technique, with the individual clinical situation.

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