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Review Article

Importance of color stability of the esthetic restoration materials

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ABSTRACT

Color stability has a vital role in several factors. Including the cosmetic appearance, confidence while smiling, and facial emotions, and in some patients, it denoted healthy and vital dental health. Dental discoloration denotes the lack of dental care. This varies from excessive use of external artificial coloration materials such as coffee, tea, and fizzy drinks. Also, in some cases, the dental discoloration is due to internal pathological conditions or due to medical treatments usage. Radiation has been remarked as one of the causes that cause dental discoloration. In addition to that, chemotherapy was also associated with dental discoloration. Some medications, such as tetracycline and antihistamines, were linked to dental discoloration. The literature discussed in-vitro experiments for the substances affecting the teeth' color status. Coffee was the most significant cause for dental discoloration, either human use (*in-vivo*) or laboratory experiments (*in-vitro*). The sociodemographic status was linked to the variance of dental discoloration. Future recommendations are concerned about the public health sector. The WHO should offer comprehensive dental care for all people all over the world, and not exclusive for specific socioeconomic areas. Practical plans for screening dental pathologies should be investigated and for systematic pathologies that might be associated with dental issues.

Keywords: Color stability, Dental health, Restoration materials, Cosmetic dentistry

INTRODUCTION

Long-lasting color durability is essential for restorative construction materials, and an undesirable color match is a significant cause for the composite replacement.[1] Resin materials are frequently utilized in treatment as suitable aesthetic materials. Any regeneration should have twice the color appearance of a normal tooth, and the effectiveness of aesthetic restoration is determined first by color match and subsequently by the color stability of the object.[2] The most significant drawback is that the color of the regenerating item changes after extended contact with the mouth mucosa.[3] External color changes are due to the

accumulation of either transparent or superficial spots from exterior colors. The color change or foundation describes unhealthy damage or minimal penetration and reaction of staining agents within the superficial structure or as known as absorption of the body internally due to the physical and chemical reactions in the deep part of the restoration or the interior color.[4] Internal or external causes can induce color breaking in resin composites.[5] Colorants in drinks and meals are primarily responsible for external color changes. Few *in vitro* investigations have revealed that common beverages and dietary supplements can induce substantial variations in color overhead.[6,7]

The smoothness of the surface and the tendency of the tooth's external surface are directly affected by the composition of the resin matrix and the properties of the filler particles.[8,9] The staining propensity is determined by the type of resin matrix used, and it may also be connected to the size of the filler particles.[10,11] The resin dramatically influences the color stability of restorative construction materials. The degree of water spacing is essential in determining the density of the dot resin, which is influenced by the degree of modification and its chemical characteristics.[12] A few studies believe that a tiny number of chemical-containing resin particles can allow for low inclusions.[13]

Resin composites are classed based on various characteristics, including size, filling content, and kind, as well as the material and mechanical qualities of the construction components.[14] Nanotechnology, also known as molecular nanotechnology, produces materials and structures with dimensions ranging up to 100 nanometers using a variety of physical and chemical methods.[15] Nanohybrid is a composite resin composite that contains an unaltered nanofiller, whereas nanofiller is a composite resin comprised of nanomers and nanoclusters.[16] With all of the given evidence, the importance of teeth color stability is both cosmetic and functional. All people around the world favor bright white teeth. Secondly, the functional correlation between the whiteness of a tooth and its vitality is positive in various populations. Therefore, this article aims to review the importance of the color stability of esthetic restoration materials.

METHODS

This literature review is based on an extensive literature search in Medline, Cochrane, and Embase databases which was performed on 4th November 2021 using the medical subject headings (MeSH) or a combination of all possible related terms, according to the database.

To avoid missing potential studies, further manual search for papers was done through Google Scholar, while the reference lists of the initially included papers. Studies discussing importance of color stability of the esthetic restoration materials were screened for useful information, with no limitations posed on date, language, age of participants, or publication type.

DISCUSSION

Factors affecting color stability

Factors affecting color stability are either intrinsic factors or extrinsic factors. The intrinsic factors are those which are related to the body, as in some pathologies. In contrast, external factors come from outside the body, such as drinks and food. Also, daily habits affect the color stability of the teeth. Foods and drinks are concerning a significant cause of teeth discoloration changes. Coffee, tea, and fizzy drinks are among the significant causes of teeth staining around the world. In addition to that, smoking has also been counted as a factor.[17]

Several pathologies have either direct or indirect affection on the color of teeth. As in some diseases, the enamel is being affected, causing it to lose its whiteness. In addition to that, some medications and interventions have an impact. Radiations and chemotherapy were proved to have a direct staining effect on teeth.[18] Some medications like tetracycline are reported to affect teeth staining, especially for children under the age of eight years old. In addition to that, anti-allergic drugs such as antihistamines or some psychiatric drugs and blood pressure drugs affect teeth discoloration.[19] Aging and genetics are among the factors which affect teeth vitality and discoloration. As in the elderly, the enamel and dentin are getting weaker and easily infected by bacterial organisms such as staphylococcus, which has a role in tooth color changes.[20] In addition to age and genetics, people might be affected by dental color changes more than other people in some geographical areas. For example, people who live in low-income and middle-income countries have a higher incidence of decreased dental care. Therefore, the increased incidence of unhealthy tooth discoloration in underrepresented groups is not uncommon.[21]

Several studies have been conducted to study the extent and distribution of tooth color and variables such as location, gender, age, and country. Front maxillary teeth are somewhat yellower than anterior mandibular teeth, and upper medial incisors and canines are more critical than lateral incisors and canines.[22,23] Although some studies have shown no difference in tooth color between men and women, many other investigations have found gender variances.[24-26] Women are shown to have brighter and yellower lower incisor teeth than men.[27] All of the genetic dental implants became black over time.[28] Indeed, several studies have demonstrated that the color of the teeth is darker and more yellow in the subject matter.[29] In a study of 180 adults and adolescents in the United States, it was discovered that the standard tooth color falls by L* 0.22 units each year of life and rises by b* 0.10 units per year of life when measured with the incisor central incisor by spectrophotometer.[30]

Studies on the connection between skin color, tooth color, and color are inconsistent.[31] The majority of studies show no relationship.[32,33] However, studies reported by

Jahangiri et al and Sharma et al show a reversible relationship in which people with medium and medium skin tones were more likely to have a higher value in dental color compared to people with fair and medium/medium skin tones regardless of age or gender.[24,34] Haralur et al examined the color connections of maxillary incisors and face skin in four distinct groups.[35] They discovered that the L* value of tooth color positively correlates with the L* value of skin color in participants from Saudi Arabia, India, and East Asian backgrounds. This is consistent with the findings of Lagouvardos et al who discovered that the lightness of the skin in the malar and earlobe areas was connected to the light intensity of the Caucasian population's maxillary incisors.[36]

Color stability, importance, and experiments

Color, texture, and facial emotions are crucial to the aesthetics, matching, and customization of beauty. Even though aesthetic dentistry was one of the most sought-after dental services, a broad understanding of dentistry did not follow.[1,2] When it comes to the 'art of invisibility', color intensity might be the difference between success and failure. Burke et al discovered that dental dissatisfaction impacts color in 38% of patients.[3]

Internal color changing and outward counting are two of the numerous purposes of combination color combinations. However, a connection between color (color change) and the conversion rate was discovered, with partial polymerized composite frames exhibiting worse mechanical characteristics and a higher potential for color conversion.[4] However, because cosmetic aids vary in texture, texture, and chemical strength, the goal of this study was to assess the influence of coffee solution on color stability and make further observations regarding the therapeutic and durability of the regenerative materials investigated.

Experiments from the literature

The coffee solution's discoloration is caused mainly by a color change, but internal color change may occur. Marketing and positioning of pigments are examples of external influences.[15,16] Coffee pigmentation results from both surface removal of colorant and absorption in the underground layer, which is presumably related to the polymeric phase of the resin's compliance with a yellow-colored compound present in coffee, which may explain the increase in b* yellow-yellow concentrations.[17,18] The effectiveness of polymerization may affect discoloration because the higher the degree of conversion, the fewer residual monomers are available to create colored degradation products. According to the manufacturers' statistics, complementary polymerization conducted by light and heat (Targis) and heat, pressure, and vacuum (belleGlassTM) increase the conversion rate of both materials by 80% and 98.5%, respectively, which is consistent with our results. According to specific research, doing a second cycle of polymerization increases the conversion rate, microhardness, texture smoothness, flexure resistance, and, as a result, color stability. Peres et al discuss how heat is used to the extra wood structure of the mixed resins to improve physical characteristics, including color stability.[21] This extra polishing can relieve existing tension on the interface matrix/filler particles, which is responsible for reducing the subsurface layer, making microcracks and gaps more visible, and allowing color penetration.[17]

Leinfelder et al mentioned heat, pressure, and vacuum as variables that contribute to polymerization efficiency.[22] The Targis and belleGlassTM results indicated a considerably less color shift than the Tetric Ceram® and Resilab results. Assaf et al and Fonseca et al on the other hand, demonstrated that extra polymerization does not apply to all objects and may be compensated for by a prolonged communication that lasts one week after the first scanning.[17,19] In second-generation composite resins, the inclusion of more active monomers can change the polymerization reaction, enhancing the kinetics of the cross-linking process. Regarding material characteristics related to total color variation, Tetric Ceram® and Resilab Master did not exhibit statistical differences, with significant E values However, compared to other direct restorative materials, the composite resin Tetric Ceram showed outstanding color stability in earlier tests, demonstrating the advantages of second-generation indirect composites.

Tetric Ceram (E=8.34) and Resilab Master (E=8.86) were not clinically acceptable, with E values more than the maximum limit E=4.4, 17 or E=3.7, 12, or more acceptable E=3.3.18. Even though their findings were over the well-known limit, they were still within the maximum limit indicated by Assaf et al after two weeks of experimental therapy.[17] Indirect Composition Targis (E=3.85) and belleGlass (E=3.40) may be regarded clinically appropriate. However, second-generation particles behaved differently, making a general response to color stability impossible, which may explain the conflicting results reported in earlier research.[12,22] Targis and belleGlass, two sub-microhybrid compounds with a very complimentary composition of between 75% and 85%, exhibit outstanding results with the addition of further polymerization. Furthermore, the Resilab Master indirect resin, a combination of tiny particles and conventional photopolymerization, caused a significant color shift.

CONCLUSION

Color stability has a vital role in several factors. Including the cosmetic appearance, confidence while smiling, and facial emotions, and in some patients, it denoted healthy and vital dental health. Dental discoloration denotes the lack of dental care. This varies from excessive use of external artificial coloration materials such as coffee, tea, and fizzy drinks, and also, in some cases, the dental

discoloration is due to internal pathological conditions or due to medical treatments usage. Radiation has been remarked as one of the causes that cause dental discoloration.

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