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DA LI JE BOJA MLEČNIH ZUBA ZNAČAJNA TEMA

COLOR OF PRIMARY TEETH

Jai Bum Kim, Rade Paravina

Former Resident and MS Candidate, Department of Pediatric Dentistry; University of Texas Dental Branch at Houston; Assistant Professor, Department of Restorative Dentistry
and Biomaterials; Scientist, Houston Biomaterial Research Center
University of Texas Dental Branch at Houston, USA

Abstrakt

U radu je dat kratak pregled vezan za boju i estetiku mlečnih zuba. Ukazanao je na želju dece i njihovih roditelja za postizanjem estetski privlačnog osmeha. Osnovne informacije o mehanizmima opažanja boje zuba, sistema boja i principima rada instrumenata za procenu boje zuba su dodatno obrađeni. Teme koje se odnose na opseg boja i raspored primarnih zuba su podvučene u poslednjem delu. Zaključeno je da je boja mlečnih zuba verovatno mnogo značajnija tema nego što se nego što to na prvi pogled izgleda. Dodatna istraživanja i njihova klinička primena si potrebni u cilju poboljšanja estetike nadoknada na mlečnim zubima.

Ključne reči:

Abstract

A brief overview on color and the esthetics of primary teeth has been presented. Young children and their parents' desire for an esthetically pleasant smile was pointed out. Basic information on mechanisms of tooth color perception, color notation systems, and working principles of instruments for tooth color measurement were subsequently provided. Issues related to color range and distribution of primary teeth were underlined in the last section. It was concluded that color of primary teeth appears to be much more important than traditionally believed. Additional research and its clinical application should be considered in order to improve the esthetics of restorations on primary teeth.

Key words:

Uvod

I mala deca i njihovi roditelji priželjkuju estetski privlačan osmeh. Već u trećoj godini deca su u stanju da razlikuju privlačno od neprivlačnog.[1] Spoljašnji izgled utiče na utisak deteta i njegovu reakciju na druge ljude.[2] Postoji predlog da potreba ili zahtev za estetskom stomatologijom budu široko bazirani i da prevaziđu stereotipne predstave.[3] U studiji koja je imala za cilj procenu zdravlja, estetike i tretmana gornjih mlečnih sekutića od strane stomatologa i roditelja, utvrđeno je da su sve grupe (stomatolozi i roditelji) smatrale da su čelične krunice na sekutićima estetski neprihvatljive i nezdrave,[4] premda su se pokazale kao vrlo efektivne.[5-6] U drugoj studiji, 83% stomatologa nije bilo za lečenje mlečnih sekutića sa prome-

Introduction

Young children and their parents alike desire an esthetically pleasant smile. In fact, children as young as three years of age are able to distinguish between attractive and unattractive peers.[1] Superficial attributes and appearance influence a child's impression of and reaction to others.[2] It was suggested that the need or demand for esthetic dentistry may be broad-based and transcend stereotypical perceptions.[3] In a study that assessed dentists' and parents' perceptions of health, esthetics, and treatment of maxillary primary incisors, all groups (dentists and parents) considered incisor steel crowns esthetically unacceptable and unhealthy,[4] although they have been shown to be effective restorations.[5-6] A total of 83% of dentists fa-

njenom pigmentacijom, dok je 71% roditelja bio za lečenje ovih zuba.[4] Loša estetika prednjih čeličnih krunica je dokazana metodama koje bi trebalo da poboljšaju izgled kompozitnih krunica.[7,8] Roditelji su izražavali zabrinutost zbog loše estetike, a deca su bila zadirkivana; među decom uzrasta 9-13 godina, stomatološki problemi su bili na četvrtom mestu kao razlog zbog koga su deca bila zadirkivana, odmah posle problema sa visinom, težinom i kosom.

Opažanje boje zuba

Boja je psihofizički odgovor na fizičku interakciju između svetlosne energije, objekta i subjektivnog doživljaja individualnog posmatrača.[10] Tri faktora utiču na opažanje boje: svetlosni izvor, objekat koji se posmatra, i posmatrač koji gleda objekat.[11]

Boja i izgled zuba su složeni fenomen sa mnogo faktora koji utiču na kompletno opažanje boje zuba. Neki od njih su svetlosni uslovi, translucentnost, opacitet, propagacija svetlosti, sjajnost i interpretator (ljudsko oko i mozak). Boja zuba je određena kombinovanim efektima ekstinsicne (površinske, spoljašnje) i intrinsicne (dubinske, unitrašnje) obojenosti.[12] Intrinzična boja zuba je povezana sa refrakcijom svetlosti i apsorpcionim svojstvima gleđi i dentina.[13] Ekstrinzična boja se dovodi u vezu sa apsorpcijom materijala (npr. čaj, hlorheksidin, soli gvožđa) na površinu gleđi, naročito na njenoj površini, što u krajnjem dovodi do ekstrinzične prebojenosti.[14] Boja zuba se takođe određuje kombinacijom njegovih optičkih svojstava. Kada svetlost dođe do zuba, jedan deo se prenosi (transmituje), a drugi deo odbija (reflektuje: površinska i volumenska refleksija; spekularna i difuzna refleksija)[15-17] Boja različita od bele je prevashodno rezultat apsorpcije ovih talasnih dužina i apsorpcionog koeficijenta zubnog tkiva.

Sistemi za obeležavanje boja

Komunikacija o boji je ponekad kompleksna i problematična. Brojni sistemi boja su dizajnirani u cilju redukovanja ovog problema. U Munselovom kolor prostoru, boja se može opisati preko osnovne boje ili nijanse (H, hue), svetline (V, value), i zasićenosti (C, chroma).[18] Hue je osobina boje koja omogućava da se

vored no treatment of discolored primary incisors, while 71% of parents favored treatment.[4] The poor esthetics of anterior steel crowns is evidenced by methods to improve their appearance with composite veneering.[7,8] Parents expressed concerned about poor esthetics, and children reported being teased; among children aged 9 to 13 years, dental features were the fourth most common reason for teasing after height, weight, and hair.

Tooth Color Perception

The phenomenon of color is a psychophysical response to the physical interaction of light energy with an object, and the subjective experience of an individual observer.[10] Three factors influence the perception of color, namely, the light source, the object being viewed, and the observer viewing the object.[11]

The color and appearance of teeth is a complex phenomenon, with many factors such as lighting conditions, translucency, opacity, light scattering, gloss, and the human eye and brain influencing the overall perception of tooth color. The color of a tooth is determined by the combined effects of intrinsic and extrinsic colorations.[12] Intrinsic tooth color is associated with the light scattering and absorption properties of the enamel and dentin.[13] Extrinsic color is associated with the absorption of materials (e.g. tea, chlorhexidine, and iron salts) onto the surface of enamel, and in particular the pellicle coating, which ultimately cause extrinsic stain.[14] The color of a tooth is also determined by a combination of its optical properties. When light encounters a tooth, part of it is transmitted and another part is reflected (surface and volume reflection; specular and diffuse reflection).[15-17] Non-white color is predominantly a result of absorption along these path lengths and the absorption coefficient of the tooth tissues.

Color Notation Systems

A major problem often arises when attempting to communicate colors to others. To this end a number of color scales have been developed. Color can be described according to the Munsell color space in terms of hue, value, and chroma.[18] Hue is the attribute of a color that enables one to distinguish between different

napravi razlika između različitih porodica boja, na primer, crvene, plave i zelene. Value je svetlina boje i kreće se od crne do čiste bele. Chroma opisuje zasićenos, intenzitet ili živost boje.

Commission Internationale de L'Eclairage (CIE), organizacija posvećena standardizaciji u oblastima kao što su boja i izgled je 1931. godine definisala standardni izvor svetlosti, razvila koncept standardnog posmatrača i omogućila izračunavanje tristimulusnih vrednosti, što u stvari opisuje kako vizuelni sistem čoveka odgovara na datu boju. [18] CIE je kolor prostor dalje definisala 1976. godine, kroz CIE L*a*b* sistem, koji je u baziran na teoriji suprotnih procesa. Teorija suprotnih boja ukazuje da postoje tri suprotna kanala: crvena nasuprot zelenoj, plava nasuprot žutoj i crna nasuprot beloj. Odgovori suprotnih kanala su antagonistički u odnosu na one koji odgovaraju na drugu boju.[19]

CIE L*a*b* sistem boja predstavlja uniformni prostor boje sa jednakom udaljenošću koja odgovara jednako uočenim razlikama u boji. U ovom trodimenzionalnom prostoru boja, tri ose/koordinate su L*, a* i b*. L* vrednost je mera svetline objekta: savršeno crna ima L* = 0, dok savršeno reflektujući difuzor ima L* = 100. Koordinata a* je crveno (pozitivna a*) - zelena (negativna a*), a koordinata. b* je žuto (pozitivna b*) plava (negativna b*). Vrednosti koordinata a* i b* se približavaju nuli kada su u pitanju neutralne boje (bela, siva) i povećavaju svoju vrednost za boje koje su hromatičnije/ intenzivnije. Prednost CIE L*a*b* sistema je da se razlike u boji mogu izraziti u jedinicama koje su u korelaciji sa vizuelnim opažanjem i klinički su značajne.[20,21]

Merenje boje zuba

Merenje boje zuba je moguće uraditi pomoću brojnih metoda, uključujući i vizuelnu procenu pomoću ključeva za određivanje boje zuba, spektrofometriju, kolorimetriju i kompjutersku analizu digitalizovan slika.[21] Instrumenti poput spektrofometara i kolorimetara se koriste u industrijskom i istraživačkom radu za merenje boje širokog spektra materijala i substrata.[22] Spektrofometri su u širokoj upotrebi za merenje boja različitih površina.[23] Spektrofometri, talasnu dužinu po talasnu dužinu, mere svetlast reflektovanu sa- ili transmitovanu kroz objekat i koriste se za merenje vidljivog spektra ekstrahovanih ili vitalnih zuba. [24,25-30]

families of color, for example, reds, blues, and greens. Value indicates the lightness of a color ranging from pure black to pure white. Chroma describes the strength, intensity or vividness of a color.

The Commission Internationale de L'Eclairage (CIE), an organization devoted to standardization in areas such as color and appearance, defined in 1931 a standard light source, developed a standard observer, and enabled the calculation of tristimulus values, which represent how the human visual system responds to a given color.[18] In 1976, the CIE further defined a color space, CIE L*a*b*, that supports the accepted theory of opponent process. The opponent color theory suggests that there are three opponent channels: red versus green, blue versus yellow, and black versus white (the latter type is related to rods, achromatic, and detects light-dark variation). Responses to one color of an opponent channel are antagonistic to those to the other color.[19]

The CIE L*a*b* color space represents a uniform color space, with equal distances corresponding to equal perceived color differences. In this three-dimensional color space, the three axes are L*, a* and b*. The L* value is a measure of the lightness of an object and is quantified on a scale such that a perfect black has an L* value of zero, and a perfect reflecting diffuser an L* value of 100. The a* value is a measure of redness (positive a*) or greenness (negative a*). The b* value is a measure of yellowness (positive b*) or blueness (negative b*). The a* and b* coordinates approach zero for neutral colors (white, grays), and increase in magnitude for more chromatic or intense colors. The advantage of the CIE L*a*b* system is that color differences can be expressed in units that can be related to visual perception and clinical significance.[20,21]

Measurement of Tooth Color

The measurement of tooth color is possible via a number of methods including visual assessment with shade guides, spectrophotometry, colorimetry, and computer analysis of digital images.[21] Instruments such as spectrophotometers and colorimeters have been used in industrial and research settings for the measurement of color of a wide range of materials and substrates.[22] Spectrophotometers are most

Često se koriste u kontroli kvaliteta i formulaciji receptura boje. Koriste se i u ispitivanju metamerizma (boja para uzoraka izgleda isto pod jednim uslovima, a različito pod drugačijim uslovima, koje čine izvor svetlosti i posmatrač). Kolorimetri imaju filtere koji određuju spektralnu funkciju standardnog posmatrača i generalno su projektovani da mere boju u X; Y; Z tristimulusnim ili CIE L*a*b* vrednostima. [16,31] Veliki broj stomatoloških istraživanja boje prirodnih zuba *in vitro* i *in vivo* je urađen pomoću kolorimetara. [15,31-42] Kolorimetrijska merenja su upoređivana sa spektrofometarskim očitavanjem i ocenjena su kao pouzdana i tačna za merenje razlike u boji.[16,37,38,43] Generalno, kolorimetri su laki za upotrebu i jeftiniji nego spektrofometri. Međutim, inter-instrumentalni rezultati i ponovljivost rezultata ovih uređaja su loši zbog starenja detektora (filtera) i loše reproducibilnosti filtera u smislu slaganja sa CIE funkcijama boja. Pored toga, kolorimetar se ne može upotrebiti za kvantifikovanje metamerizma.[23] Merenje boje zuba se može izvršiti i kompjuterskom analizom digitalnih slika.[44-48] Ovaj pristup se uspešno koristi za procenu efekata beljenja zuba pomoću proizvoda koji sadrže peroksid i izražavanje promena boje pomoću CIE L*a*b* vrednosti. [44,45]

Boja primarnih zuba

Premda je više istraživača izučavalo boje stalnih zuba,[49-50] još uvek nema pouzdanih podataka o boji mlečne denticije. Clark je objavio prvu studiju o opsegu boje stalnih zuba sa pratećim H/V/C vrednostima: 6YR do 9,3Y, 4 do 8, i 0 do 7, za svaku od ovih vrednosti.[49] In vivo merenja stalnih frontalnih zuba maksile kolorimetrom su pokazala sledeće: 1) boja zuba je bila najbolje reprezentovana njihovom srednjem trećinom, 2) generalno zubi kod žena su bili svetliji, manje hromaticni i manje crvenkasti nego kod muškaraca, 3) starenje je prouzrokovalo promenu boje zuba ka tamnijim i crvenkastijim oblastima, 4) bočni zubi su bili tamniji nego centralni ili lateralni sekutići, i 5) centralni sekutići su bili najsvetliji među ispitivanim zubima.[50]

Mlečni zubi se generalno smatraju svetlijim u odnosu na trajne zube, iako je do sada objavljeno samo nekoliko studija o boji primarnih zuba. U studiji mlečnih frontalnih zuba kod šezdesetoro japanske dece pomoću različitim

widely used for measuring surface colors.[23] Spectrophotometers measure one wavelength at a time from the reflectance or transmittance of an object, and have been used to measure the visible spectra of extracted and vital teeth.[24,25 – 30] They are frequently used for quality control and recipe formulation. They can also evaluate metamerism (a pair of specimens match under one set of illuminant and observer conditions, but mismatch under another set of conditions). Colorimeters have color filters that approximate the spectral function of the standard observer's eye and are generally designed to measure color in X; Y; Z tristimulus terms or in CIE L*a*b* values.[16,31] Much of the dental research on the natural color of teeth in vitro and in vivo has been conducted with colorimeters.[15,31–42] Colorimeter measurements have been compared with spectrophotometer readings and deemed reliable and accurate for color difference measurements.[16,37,38,43] In general, colorimeters are easy to use and less expensive than spectrophotometers. However, the instrumental agreement and repeatability of the instrument is poor due to the aging of the detectors (filters) and poor reproducibility of the filters to agree with CIE color matching functions. In addition, the colorimeter cannot be used to quantify metamerism.[23] Another approach for measuring tooth color is via computer analysis of photographic images.[44–48] This approach has been successfully used to evaluate the bleaching effects of peroxide-containing products over time and expressing the color changes in terms of CIE L*a*b* values.[44,45]

Color of Primary Teeth

Although color range of human teeth has been reported by several investigators,[49-50] no reliable database of tooth color currently exists for the primary dentition. Clark published the first study on color ranges of natural teeth, with the following Munsell H/V/C values: 6YR to 9.3Y, 4 to 8, and 0 to 7 respectively.[49] In vivo measurement of maxillary anterior teeth with a colorimeter showed that; 1) tooth color was best represented by its middle third, 2) women's teeth in general were lighter, less chromatic, and less reddish colored than men's, 3) aging produced darker and more reddish teeth, 4) cuspid teeth were darker than central or lateral

instrumentima, zaključeno je da je njihova boja vrlo svetla.[51] Ograničen broj nijansi je dostupan za restauraciju mlecnih zuba. [52] Komatibilnost ovih nijansi sa bojom prirodnih zuba predstavlja dodatni prolem – analiza je pokazala da su se boje White Steel Crown i Kinder Krown Pedo I suštinski razlikovale od boje prednjih mlečnih zuba japanske dece.[53] Analiza boje mlecnih zuba tri različite etničke grupe (crnci, belci i hispanici) u Sjedinjenim Državama je pokazala da ju najizraženija kompativilnost sa nijansama dentalnih materijala bila prisutna kod crnaca i hispanika. Poređenje četiri nijanse iz četiri različita ključa za određivanje boje zuba sa bojom mlečnih zuba crne, bele i dece hispano porekla je pokazalo značajnu razliku između nijansi i značajnu razliku između etničkih grupa.[54]

Zaključak

Boja mlečnih zuba je verovatno mnogo značajnija tema nego što to na prvi pogled izgleda. Dodatna istraživanja i njihova klinička primena su potrebni u cilju poboljšanja estetike nadoknada na mlečnim zubima.

incisors, and 5) central incisors had the highest lightness.[50]

Primary teeth are generally considered lighter than permanent teeth, but only a few studies on color of primary teeth have been reported. Color of primary anterior teeth of 60 Japanese children was evaluated by various measuring devices. Based on these results, the primary anterior tooth surface color was found to be very light.[51] A few shades of are available for restoring primary teeth. In a study measuring parental satisfaction with bonded resin strip crowns, parents' dissatisfaction was most often related to the color of the restorations.[52] Color analysis revealed that the colors of the White Steel Crown and Kinder Krown Pedo I was substantially different from the color of the primary anterior teeth of Japanese children. Color analysis also revealed that the colors of esthetic anterior primary crowns were substantially different from the color of the primary anterior teeth of Japanese children.[53] Evaluation of primary teeth color for three different ethnic groups (AA, C, and H) in the United States showed that best matches to shade guides were among African-American and Hispanic patients. A comparison of four shades from four different shade guides with primary teeth color of African-American, Caucasian, and Hispanic children revealed significant differences among both shades and ethnic groups.[54]

Conclusion

Color of primary teeth appears to be much more important than traditionally believed. Additional research and its clinical application should be performed in order to improve the esthetics of restorations on primary teeth.

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Adresa za korespondenciju:

Rade D. Paravina, DDS, MS, PhD
Assistant Professor, Department of Restorative Dentistry and Biomaterials
University of Texas Dental Branch at Houston
6516 M.D. Anderson Blvd., Room 493
Houston, TX 77030-3402
Phone: 713-500-4482

Address of correspondence:

Rade D. Paravina, DDS, MS, PhD
Assistant Professor, Department of Restorative Dentistry and Biomaterials
University of Texas Dental Branch at Houston
6516 M.D. Anderson Blvd., Room 493
Houston, TX 77030-3402
Phone: 713-500-4482