International Journal of Advanced Research and Publications
ISSN: 2456-9992

Tooth Development And Colour - A Review

Dr. Aakash Shah

Post-graduate student, Department of Orthodontics and Dentofacial Orthopedics, K.M. Shah Dental College and Hospital, Vadodara, Gujarat, India
Aakashshah108@email.com

Abstract: This review article discusses about the formation of a tooth bud and various stages of tooth development. Apart from this, the development of tooth colour and various methods of measuring it are discussed in this article.

Keywords: Tooth eruption, root formation stage

1. Tooth development

Tooth color is dependent on the reflectance and absorbance properties of the tooth, which are influenced by the structures of the tooth (enamel, dentin, pulp). Any changes that effect these structures before or after eruption will result in tooth color change and hence tooth discoloration [1]. Tooth formation begins at the 37th day of development in which a continuous thickened band of epithelium is formed in the upper and lower jaws. This primary epithelial band will give rise to both the dental lamina and vestibular lamina. Dental lamina will appear as a thickening of the oral epithelium adjacent to the condensation of the ectomesenchyme. After that, 20 areas of enlargement will appear to form the tooth buds of the 20 primary teeth. The dental lamina begins to function at the 6th prenatal week and continues to the 15th year after birth, depending on which tooth it will form, since some teeth are predecessors to others. Even though tooth formation is a continuous process, it can be divided into three stages: Bud stage, Cap stage, and Bell stage. Bud stage is characterized by rounded, localized growth of epithelium surrounded by proliferating mesenchymal cells, which are packed closely beneath and around the epithelial buds. In the Cap stage, the ectomesenchyme will condense immediately subjacent to the tooth bud because of the lack of extracellular matrix secretion by the cells. Histodifferentiation begins at the end of this stage. Enamel will form through an epithelial outgrowth called the enamel organ. Moreover, the dentin and pulp will form through the dental papilla, which is a ball of condensed ectomesenchymal cells. The support structures of the tooth (cementum and periodontal ligament) will form through the dental follicle which is a condensed ectomesenchymal tissue surrounding the enamel organ and dental papilla. In the Bell stage, there is a continuation of histodifferentiation including the definition of ameloblasts and odontoblasts, and the beginning of morpho-differentiation in which the tooth crown assumes its final shape [1].

2. Tooth Color

A smile is considered one of the most interactive communication skills of a person [2]. As a result, the ultimate objective of esthetic dentistry is to create a beautiful smile with teeth that exhibit the correct form and shape, reflect the correct color, and to be in harmony with the surrounding gingiva, lips and face. These characteristics should be considered when teeth are being restored [3]. Color change is determined by the combined effects of intrinsic and extrinsic colorations. Intrinsic change is determined by the absorbance and reflectance properties of enamel and dentin [4], while extrinsic changes result from the absorption of materials (tea, coffee) into the outer surface of enamel [5].

3. Color Order System

Color is a psychophysical response to the physical interaction of the light energy with an object and the subjective experience of the observer. That being said, three factors affect the perception of color: the light source, the object, and the subjectivity of the observer. Color can be described according to a visual system called Munsell color space in terms of hue, value and chroma. Hue is the attribute of a color that enables one to distinguish between different families of color, for example, reds, blues and greens. Value indicates the lightness of a color ranging from pure black to pure white. Chroma is the degree of color saturation and describes the intensity of a color [6]. The Commission Internationale d el'E´clairage (CIE) is another color space instrumental system that gained its popularity by adapting the theory of the three colors receptors in the eye (red, green, blue). In this three-dimensional color space, the three axes are L*, b*, a*. The L* axis corresponds to the lightness of an object, with a value of zero presenting a black object and a value of a 100 presenting a perfectly reflecting object. The b* axis is the yellow to blue scale with the yellow representing a (positive b) and the blueness representing a (negative b). The a* value is the red to green scale in which a (negative a) corresponds to greenness and a (positive a) to redness [7]. The CIE color system is well suited for instrumental color analyses and research applications; it measures the reflectance of the object at each wavelength, and transforms the data into useful color descriptors in an appropriate color space [7].

4. Color Matching and Reproduction

Throughout history, advances in technologies and techniques to improve color- matching skills have been pushed even further by the stress on having the ideal restoration. Since the 1970s, companies have developed several shade guides with the ultimate goal of having one that encapsulates all existing natural tooth shades. The Vita Lumin classical shade guide offers ease of use and accuracy through its logical system of shade grouping. This guide consists of 16 hue tabs divided into four shade groups A, B, C, and D. Hues differ as groups change, wherein group A is reddish-brown, group B is reddish-yellow, group C is grey, and group D is reddish-grey. Within each group, lightness decreases and chroma increases as the number increases. The Vita classic is the most commonly used shade guide by dental practitioners. However, a logical and adequate distribution in the color

space as defined by the CIELab* was lacking. Therefore, a more comprehensive shade guide was needed to compensate of the shortcomings of the Vita classical. As a result, the Vitapan 3D master shade guide surfaced. This shade guide system provides a systemic organization of all existing natural tooth color as assumed by the manufacturer based on spectrophotometric measurements of natural teeth. The shade guide consists of 26 tabs and is arranged in a way that it covers natural tooth color space in a logical order; the tabs are organized in five value levels. Within each level are tabs that represent different chromas and hues. Tabs are arranged according to chroma vertically and hue horizontally. The sequence of shade selection is value, then chroma, followed by hue [8]-[10]. The use of the Vitapan 3D master was challenging when it comes to measure teeth undergoing tooth whitening. Thus, the vita bleach guide was designed to provide and simplify the visual evaluation of tooth whitening efficacy as compared to the other shade tabs. This 15-tab shade guide was re-designed to allow for a linear shade guide that is familiar to dental practitioners, along with decreasing the gap of ΔL among groups [11].

5. Color Measuring Devices

Tooth color matching has always been a stressful decision making process undertaken by dental practitioners, due to the subjectivity, lack of control and lack of an ideal environment while attempting tooth shade matching. The introduction of new technologies in tooth color matching with the sole purpose of analyzing and verifying tooth color has advanced the dental profession [9]. Shade measuring devices have eliminated the difficulties associated with the subjective shade matching technique, such as metamerism, suboptimal color matching conditions, tools and method as well as the receiver's age fatigue, mood and medication [12]. Shade measuring devices can be divided into three categories; spectrophotometers, colorimeters and digital imaging. Spectrophotometers are one of the most popular, accurate and easy to use shade- measuring devices for overall color matching. They measure the amount of light energy reflected from an object at 1-25nm along the visible spectrum [13]. They contain a source of optical radiation, a means of dispersing light, an optical system for measuring, a detector and a means of converting light obtained to a signal that can be analyzed [13]. Data obtained from the devices are translated into more simple information resembling shade tabs, which are more readily perceived by dental practitioners and lab technicians. A huge advantage of this system is the virtual shade tab in which the shade taken by the device can be superimposed over a clinical tooth image to aid the dental practitioners in a more precise shade selection. In fact, these devices were proved to be 33% more accurate than subjective shade matching [13]. Different models of spectrophotometers are available; EasyShade (VITA Easyshade®) ShadeX (X Rite, Grand Rapids, Michigan, and SpectroShade Micro (MHT, Verona, Italy) are the most common. EasyShade is a cost- efficient, cordless, tooth contact device that aids in the analysis and verification of tooth shade color. Different modes are available, such as tooth single mode, tooth area mode, restoration color verification, and shade tab mode. ShadeX closely resembles EasyShade because it's cordless and easy to use, but differs in the interface because it has two databases in which it can detect the color of the dentin and incisal color. SpectroShade Micro is an imaging spectrophotometer that uses a digital camera-LED spectrophotometer combination [9].

References

[1] James, A., Essentials of Oral Histology and Embryology, ed. J. Avery. Vol. 2nd. 2000.

[2] Hattab, F.N., M.A. Qudeimat, and H.S. al-Rimawi, Dental discoloration: an overview. J Esthet Dent, 1999. 11(6): p. 291-310.

[3] Mayekar, S.M., Shades of a color. Illusion or reality? Dent Clin North Am, 2001. 45(1): p. 155-72, vii.

[4] ten Bosch, J.J. and J.C. Coops, Tooth color and reflectance as related to light scattering and enamel hardness. J Dent Res, 1995. 74(1): p. 374-80.

[5] Joiner A, J.N., Raven SJ, Investigation of factors influencing stain formation utilizing an in situ model. Advances in Dental Research 1995. 9: p. 471-476.

[6] R, M., Colour physics for industry. 1987: Huddersfield: H. Charlesworth & Co Ltd.

[7] O'Brien, W.J., et al., Color distribution of three regions of extracted human teeth. Dent Mater, 1997. 13(3): p. 179-85.

[8] Rodrigues, S., S.R. Shetty, and D.R. Prithviraj, An evaluation of shade differences between natural anterior teeth in different age groups and gender using commercially available shade guides. J Indian Prosthodont Soc, 2012. 12(4): p. 222-30.

[9] Chu, S.J., R.D. Trushkowsky, and R.D. Paravina, Dental color matching instruments and systems. Review of clinical and research aspects. J Dent, 2010. 38 Suppl 2: p. e2-16.

[10] Brewer, J.D., A. Wee, and R. Seghi, Advances in color matching. Dent Clin North Am, 2004. 48(2): p. v, 341-58.

[11] Paravina, R.D., W.M. Johnston, and J.M. Powers, New shade guide for evaluation of tooth whitening-colorimetric study. J Esthet Restor Dent, 2007. 19(5): p. 276-83; discussion 283.

[12] Ahmad, I., Three-dimensional shade analysis: perspectives of color-Part II. Pract Periodontics Aesthet Dent, 2000. 12(6): p. 557-64; quiz 566.

[13] Khurana, R., et al., A clinical evaluation of the individual repeatability of three commercially available colour measuring devices. Br Dent J, 2007. 203(12): p. 675-80.

Author Profile

Author[1] completed BDS from College of Dental Science, Bhavnagar in 2014 and MDS in Orthodontics and Dentofacial Orthopedics from K.M. Shah Dental College and Hospital, Vadodara in 2017 and presently a private practitioner.