ejpmr, 2020,7(4), 674-679

SJIF Impact Factor 6.222

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

CHANGE IN INCSIOR INCLINATION AND PERCEIVED TOOTH COLOUR CHANGE IN MALE AND FEMALE SUBJECTS

Dr. Mahendra Kondle*[1], Dr. Pravinkumar Marure[2], Dr. Suresh Kangane[3], Dr. Anand Ambekar[4], Dr. Yatish Joshi[5], Dr. Sujit Zadake[6]

[1,6]Post Gradution Student in the Department of Orthodontics and Dentofacial Orthopaedics MIDSR Dental College, Latur, India.

[2,5]Reader in the Department of Orthodontics and Dentofacial Orthopaedics MIDSR Dental College, Latur, India.

[3]Professor and HOD in the Department of Orthodontics and Dentofacial Orthopaedics MIDSR Dental College, Latur, India.

[4]Professor in the Department of Orthodontics and Dentofacial Orthopaedics MIDSR Dental College, Latur, India.

***Corresponding Author: Dr. Mahendra Kondle**

Post Gradution Student in the Department of Orthodontics and Dentofacial Orthopaedics MIDSR Dental College, Latur, India.

Article Received on 19/02/2020 **Article Revised on 09/03/2020** **Article Accepted on 29/03/2020**

ABSTRACT

Introduction: Attractiveness of person is influenced by a variety of different smile-related factors. We evaluated whether the degree of upper central incisor proclination can result in tooth colour change. **Methods:** Forty young adult subjects (20–25 years, 20 Males and 20 females) in good health with a complete sound dentition were selected. The subjects were seated in standardized light conditions with an above-directed light source. Their natural head position was stated as 0 degrees using NHP device. To mimic the range of possible anterior torque movements they were asked to tilt their heads upward +20 degrees (upward tilting) and downward −20 degrees (downward tilting). Frontal macro photographs of the patient's natural head position were taken at the three head angulations (+20, 0, and −20 degrees). Photographs were analysed for colour differences at the centre of the incisor clinical crowns with a CIE L*a*b* colour model based software. A paired *t*-test was used to test for significance between each value for each inclination. **Results:** Differences were found between the CIE L*a*b* colour values for: upward tilting, downward tilting, and −20 to +20 degrees (total tilting) except for b* values for downward tilting. As the inclination of the subject's head changed downward, the upper incisors were retroclined and the CIE L*a*b* values indicated a darker and less green but redder colour component. As the inclination of the subject's head changed upwards the upper incisors were proclined and the L*a*b* values indicated a lighter and less green and yellow but redder and bluer colour component. **Conclusions:** Proclination of upper incisors caused lighter tooth colour parameters compared to retroclined incisors and colour changes. Orthodontic change of upper incisor inclination may induce alterations on how tooth colour is perceived.

KEYWORDS: Attractiveness of person is influenced by a variety of different smile-related factors.

INTRODUCTION

Smile aesthetics has become a major concern among patients and orthodontists. It is one of the main reasons why patients seek orthodontic treatment.[1] Social attractiveness is influenced by a variety of different smile-related factors and reflect a harmonious interplay between the teeth and gums including, size, shape, visibility of the teeth and gums, as well as tooth colour.[2] The phenomenon of colour is a response to the physical interaction of light energy with an object, and the subjective experience of an individual observer. Three factors can influence the perception of colour, namely, the light source, the object being viewed, and the observer viewing the object.[3]

The colour of the teeth is determined by the combined effects of intrinsic and extrinsic colourations.[4] Intrinsic tooth colour is associated with light scattering and absorption properties of the enamel and dentine.[5] Extrinsic colour is associated with the absorption of materials, for example, tea, red wine, chlorhexidine, and iron salts onto the surface of enamel, and in particular the pellicle coating, which ultimately cause extrinsic stain. The colour of a tooth is determined by a combination of its optical properties. Colour can also be described according to the Munsell colour space in terms of hue, value (lightness), and chroma.[6]

Hue is the attribute of a colour that enables one to distinguish between different families of colour, for example, reds, blues, and greens. Value indicates the luminous intensity of a colour ranging from pure black to pure white. Chroma is the degree of colour saturation and describes the strength, intensity, or vividness of a colour. Chroma is also known as saturation. Lightness can be described as the brightness of an area or object judged

relative to the brightness of a similar area or object.[7] Therefore, lightness is a relative term and should not be confused with brightness which is the amount of light an area or object emits or how 'white' an area or object is. It can be evoked that in a dental situation, specifically a CI II division 2 malocclusion, having retroclined incisors, may result in a darker smile, as less light is reflected off the surface of the central incisors.[8] Our hypothesis is that proclining the teeth in these situations will alleviate the malocclusion but may also create a 'brighter smile' as more light will be reflected of the incisors enamel making the teeth appear lighter. Different tooth positions may change perceived colour. It has been shown that differences in seating position while determining tooth shade result in different measurement values.[9]

In order to test our hypothesis, we implemented an immediate change of the amount of proclination of the upper incisors in relation to an external source of light by changing the head position upwards or downwards with the help of natural head positioner with different angulation and any difference in males and females. Therefore, the aim of this study is to evaluate whether the degree of inclination of the upper central incisors in relation to an external light source can result in tooth colour changes. The null hypothesis is that there is no difference between the amount of inclination of the upper central incisors and their colour change and difference in males and females.

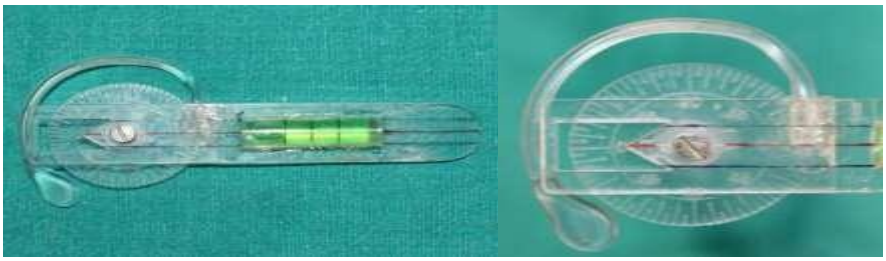
MATERIALS AND METHODS

Forty young adult subjects in good health and with a complete sound dentition were selected on a voluntarily basis. The subjects were between 20 and 25 years old. Dental exclusion criteria for the participants were: previous restorations on anterior teeth, active hard and soft tissue diseases, inadequate oral hygiene, and crowding of the 2 central incisors. Dental and skeletal malocclusion were not cause for exclusion as measurements were made only on the upper incisor clinical crows. Each subject was asked to clean his or her teeth and rinse thoroughly prior to data collection. The power analysis showed that 40 patients were needed for the study. The sample size was calculated in RGB integers as it was the raw data obtained from the colour analysis.

The subjects were seated on a stool in a standardized area in respect to an above- and forward- directed light source in a roomwith no windows.

The NHP device used in order to determine their natural head position and was stated as the level plane at 0 degrees. In order to mimic the range of possible upper anterior teeth torqueing movement the subjects were asked to tilt their heads upward 20 degrees and downwards 20 degrees stated +20 (upward tilting) and −20 degrees (downward tilting), respectively with help of NHP device. Angulation changes of head posture correspond geometrically to the same changes in upper incisor angulation changes. These 20 degrees simulate a large torqueing movement reasonably acheived during orthodontic correction.

When smiling there is partial exposure of the teeth with high individual variation due to soft tissue placement. In order to remove the lips from the field of view, cheek retractors were placed in the mouth of the participants to control this factor which could have influenced our results. The subjects were asked to be in maximum intercuspidation. Excess saliva was removed but the teeth were not dried in order not to be desiccated. Frontal macro photographs, parallel to the Frankfort plane at the patient natural head position without the use of a flash were taken. The photographs were taken at the 3 angulations (+20, 0, and −20 degrees).



''Figure 1: NHP device.''

''Figure 2:'' Frankfort horizontal plane. Schematic representation of the Frankfort horizontal plane as well as the upper and lower plane tilting used for the angulation of the head and thus upper central incisors prior to cheek guard placement and photographs. The first diagram depicts an upward inclination of -20 degrees, the second at 0 degrees, and the last a downward inclination of +20 degrees.

''Figure 3:'' Sample photographs. Sample of the photographs taken with the use of standard lighting and cheek guards taken at angulations of 0, +20 and −20 degrees.

The photographs at each orientation of each test subject were sorted on a computer and were analysed for colour differences using a specific software (Adobe photoshop 7.0). The colour of the two central incisors at the centre of the clinical crown were taken.

A major problem often arises when attempting to communicate colours to others. To this end, a number of colour scales have been developed. Initial data was collected as RGB integers. This colour model is an additive colour model in which red, green, and blue lights are added together in various ways to reproduce a broad array of colours. The name of the model comes from the initials of the three additive primary colours, red, green, and blue. The main purpose of the RGB colour model is for the sensing, representation, and display of images in electronic systems but is machine dependent. To eliminate this downside, conversion from RGB values to the CIE L*a*b* space with a CIE standard observer of 2 degrees was performed with an algorithm.

Means for the central incisors of each subject at each of the three inclinations were calculated. A paired t-test was used to test for significant differences between each value for each inclination as well as the colour change. The significance level was stated at $P > 0.05$.

RESULTS

As a general finding, upward head tilting in relation to the natural head position resulted in more proclined teeth positions causing, lighter tooth colour parameters different colours compared to downward head tilting in relation to the natural head position which resulted in more retroclined positions and darker tooth colour parameters and different colours. Therefore, the null hypothesis that there is no difference between the amount of inclination of the upper central incisors and their colour can be rejected.

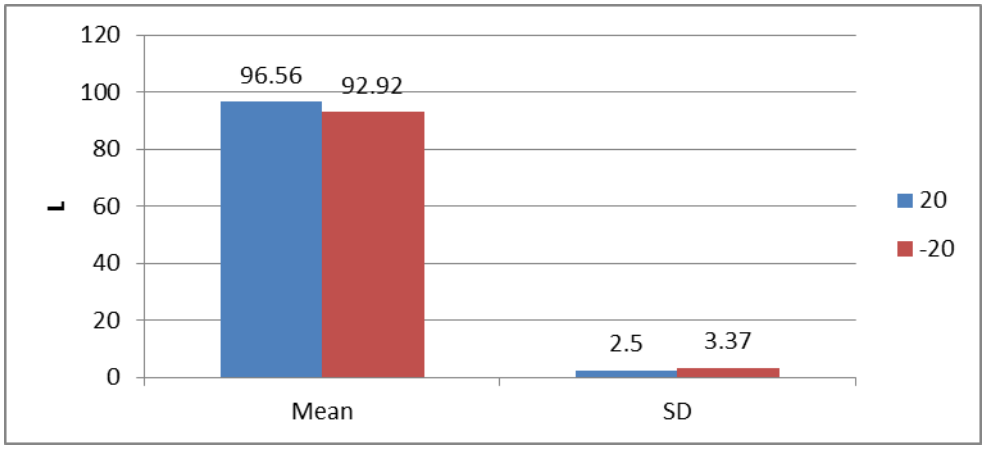
A sample of the clinical photographs used in our study are shown in figure. The photos were taken at +20, 0, and −20 degrees relative to the 0 degrees Frankfort reference plane. It can already be noted by simply looking at the photographs that the incisors at +20 degrees appear to be lighter than the ones inclined at −20 degrees.

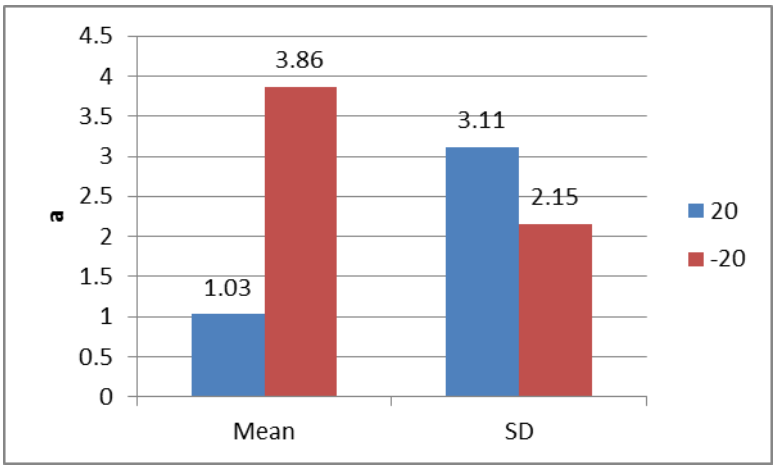
Comparison between boys and girls (table 1).

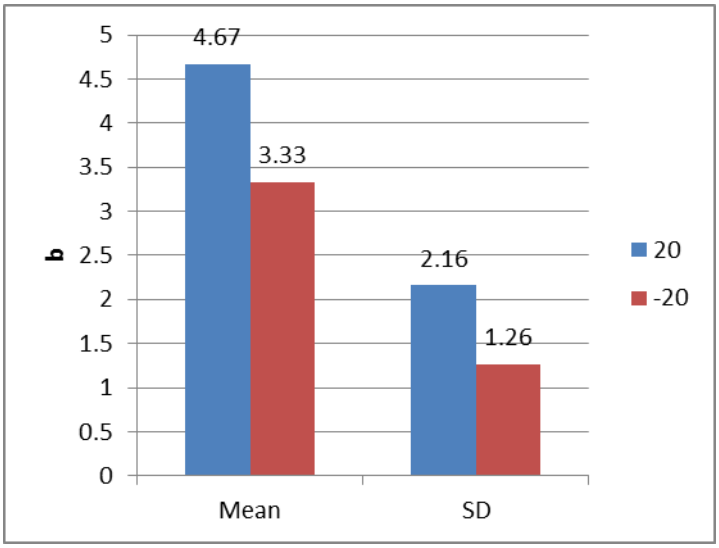
	GP	N	Mean	SD	t	p	Inference
L +20	Boys	18	96.89	2.25	.796	.432	Not significant
	Girls	18	96.22	2.76		(>0.05)	
a +20	Boys	18	.83	3.01	-.370	.714	Not significant
	Girls	18	1.22	3.28		(>0.05)	
b+20	Boys	18	4.78	2.21	.304	.763	Not significant
	Girls	18	4.56	2.18		(>0.05)	
E+20	Boys	18	103.11	3.53	.346	.732	Not significant
	Girls	18	102.72	3.21		(>0.05)	
L -20	Boys	18	93.39	3.29	.838	.408	Not significant
	Girls	18	92.44	3.47		(>0.05)	
a -20	Boys	18	3.78	2.16	-.229	.820	Not significant
	Girls	18	3.94	2.21		(>0.05)	
b-20	Boys	18	3.22	1.11	-.522	.605	Not significant
	Girls	18	3.44	1.42		(>0.05)	
E-20	Boys	18	99.83	1.34	.767	.448	Not significant
	Girls	18	99.39	2.06		(>0.05)	

Comparison of variables between +20 and -20 (table 3).

	GP	N	Mean	SD	t	p	Inference
L	+20	36	96.56	2.50	5.21	.0001	Highly significant
	-20	36	92.92	3.37		(<0.001)	
A	+20	36	1.03	3.11	-4.49	.0001	Highly significant
	-20	36	3.86	2.15		(<0.001)	
B	+20	36	4.67	2.16	3.19	.0021	Significant
	-20	36	3.33	1.26		(<0.05)	
E	+20	36	102.92	3.33	5.28	.0001	Highly significant
	-20	36	99.61	1.73		(<0.001)	







Statistical analysis and methods

Data was collected by using a structure proforma. Data entered in MS excel sheet and analysed by using SPSS 19.0 version IBM USA. Quantitative data was expressed in terms of Mean and Standard deviation. Comparison of mean and SD between two groups was done by using unpaired t test to assess whether the mean difference between groups is significant or not Descriptive statistics of each variable was presented in terms of Mean, standard deviation, standard error of mean. A p value of <0.05 was considered as statistically significant whereas a p value <0.001 was considered as highly significant.

For the overall sample, as the inclination of the Frankfort horizontal of the subject changed from 0 to −20 degrees (downward tilting) the average L* values decreased plane indicating a darker colour. The average a* value increased indicating a redder (less green) colour component compared to the initial position. The average b* value was not statistically significantly different compared to the value at 0 degrees. As the inclination of the Frankfort horizontal of the participant's changed from 0 to +20 degrees (upward tilting) the L* values increased indicating a lighter colour. The average a* value also increased indicating a redder (less green) colour component and b* values decreased indicating a bluer (less yellow) colour component. This is shown graphically in figure for each of the L* a* b* coordinates. Overall, there was a statistical difference between the L*a*b* values between upward tilting and downward tilting and the total tilting (−20 to +20 degrees) for each parameter except for b* values for downward tilting. For each inclination, the L*a*b* values were also compared to each other and statistical significant differences were found between all L*a*b* values.

The correlation between value changes: L*, a*, b*, respectively, for total tilting are positive. The L*, a*, b* value had the highest correlation coefficient and was the only one that showed statistical significance.

DISCUSSION

It was found as a general finding that upward head tilting caused more protruded teeth and lighter and different tooth colour compared to downward head tilting resulting in more retroclined teeth and darker and different colours. The initial null hypothesis stating that that there is no difference between the amount of proclination of the upper central incisors and their colour can be rejected. Regarding the different tilting orientations downward tilting resulted in smaller tooth lightness values. The lightness values changed from 71 to 64 which can be extrapolated as a subject aging from 30–50 years to above 50 years.[10] It has already been determined that the progressive darkening of teeth occurs with age.[11]

The lightness values probably decreased due to the teeth being brought back into the oral cavity and less light being able to reach them. Regarding absolute value change retroclination of the incisors caused in a decrease in the green colour but an increase in the red colour component. This finding is in concordance with a previous study which indicated that teeth from a population of more than 50 years of age had a greater reddish but also yellowish component in tooth colour.[10]

No difference in males and female in term of colour change.

Incisor proclination caused a greater change in the blue colour component compared to the other values and a decrease in the yellow component of colour. At the incisal edge of an incisor as more light passes through the enamel, a blue shade can sometimes be seen. It could be hypothesized that when incisors are proclined an increased amount of light reaches the tooth and more light could pass through the dental tissues resulting in a more observable blue component. Even though the colour measurements were taken at the centre of the clinical crown, the blue component could be more pronounced than the others. There was also an increase the red colour component but which was less pronounced than with downward tilting. This finding was supported by study done by Ciucchi P, Kiliaridis S.[15]

It should be noted that upward and downward tilting did not result in similar increases or decreases of the colour values. These differences are probably due to the internal structure of the the teeth as the width of the layers of enamel and dentin are not consistent from the crown to the root. The amount of saliva on each tooth surface was tried to be kept as uniform as possible, subjects with thicker and more abundant saliva rates might have different light reflective properties at different angles.

The conclusions also have to take into account that the pool of subjects were dental students and may not reflect the average person in respect his oral health and prevention. Laypeople can exhibit major extrinsic tooth staining which could reduce the changes observed in this study. Ideally an orthodontic treated sample of initially CI II division 2 cases could have been used for this study. Nevertheless, different active treatment times, not being able to standardize final tooth positions and the alteration of the tooth surface after the use of bonded brackets and different oral hygiene measures could have made the data inconclusive and not prone to generalization. As we were not able to physically move the incisors as with an orthodontic treatment, head tilting was used to mimic the possible range of orthodontic tooth displacement. With this method, we had no way of determining the initial inclination of the incisors and how much more or less they were inclined from their ideal position. We could only measure the change. It is not known if the initial incisor inclination could play a role in the amount of colour change observed. It would have been possible to study this factor with lateral cephalograms; however, this was not possible due to

ethical concerns. Nevertheless, as only the change of inclination was needed for this study true initial or final tooth angulation values were not necessary. It was therefore easier to change the inclination of the subject's tooth by altering the head posture in the standardized method described before.

In this study, only the central incisors were measured for colour differences. For a more complete interpretation of the smile, lateral and canines should also be tested. However, as there is greater variation in the position of these teeth than incisors they were not included in this study. Also, as the laterals and canines are placed at the beginning of the catenary arch curve the photographs would not have been perpendicular to their vestibular surface. Further testing should be conducted to investigate these points.

To put this study in perspective, in terms of clinical significance, it is possible that orthodontic treatment may result in changes in the perceived colour of the incisors. The change in incisor colour in CI II division 2 cases and anterior crossbite (changing from −20 to 0 degrees) can be an additional beneficial effect in the treatment of this malocclusion. However, it should be noted that albeit tooth colour changes detectable electronically, the changes were small to the eye. It is known that the colour of the oral tissues and skin plays a role in the perception of tooth colour as well as the illuminant.[12-14] These factors may enhance or mask tooth colour changes induced by change in inclination.

CONCLUSION

Proclination of upper incisors caused a lighter tooth colour parameter compared to retroclined incisors and colour changes. Orthodontic changes of the upper incisor inclination may induce alterations on how tooth colour is perceived. Thus, apart the functional and structural indications, correct incisor inclination after orthodontic treatment is necessary for optimal aesthetic results.

No any difference in male and female in colour change.

Conflict of Interest: None to declare.

REFERENCES

1. Springer, N.C., et al. (2011) Smile esthetics from the layperson's perspective. American Journal of Orthodontics and Dentofacial Orthopedics, 139: 91–e101.
2. Newton, J.T., Prabhu, N. and Robinson, P.G. (2003) The impact of dental appearance on the appraisal of personal characteristics. The International Journal of Prosthodontics, 16: 429–434.
3. Chalifoux, P.R. (1996) Perception esthetics: factors that affect smile design. Journal of Esthetic Dentistry, 8: 189–192.
4. Watts, A. and Addy, M. (2001) Tooth discolouration and staining: a review of the literature. British Dental Journal, 190: 309–316.
5. Ten Bosch, J.J. and Coops, J.C. (1995) Tooth color and reflectance as related to light scattering and enamel hardness. Journal of Dental Research, 74: 374–380.
6. McLaren, K. (ed.). (1987) Colour Physics for Industry. Dyers Company Publications Trust, Bradford, West Yorkshire, UK.
7. Jameson, D. and Hurvich, L.M. (1964) Theory of brightness and color contrast in human vision. Vision Research, 4: 135–154.
8. Bicakci, A.A., Cankaya, O.S., Mertoglu, S., Yilmaz, N. and Altan, B.K. (2013) Does proclination of maxillary incisors really affect the sagittal position of point A? The Angle Orthodontist, 83: 943–947.
9. Oilo, M. (2010) Repeatability of electronic shade determination and the influence of differences in patient's sitting position. The European Journal of Prosthodontics and Restorative Dentistry, 18: 171–175.
10. Haralur, S.B. (2015) Effect of age on tooth shade, skin color and skintooth color interrelationship in Saudi Arabian subpopulation. Journal of International Oral Health: JIOH, 7: 33–36.
11. Zhao, Y. and Zhu, J. (1998) In vivo color measurement of 410 maxillary anterior teeth. The Chinese Journal of Dental Research, 1: 49–51.
12. Ma, J.F., Du, R.X., Wang, S.Q. and Li, Y.M. (2010) Effects of background, direction and intensity of ambient light, measuring position, and adjacent teeth, on anterior tooth colour measurement in vitro. The Chinese Journal of Dental Research, 13: 147–152.
13. Lee, Y.K., Yu, B., Lim, J.I. and Lim, H.N. (2011) Perceived color shift of a shade guide according to the change of illuminant. The Journal of Prosthetic Dentistry, 105: 91–99.
14. Niaz, M.O., Naseem, M. and Elcock, C. (2015) Ethnicity and perception of dental shade esthetics. The International Journal of Esthetic Dentistry, 10: 286–298.
15. Ciucchi P, Kiliaridis S. Incisor inclination and perceived tooth colour changes. European journal of orthodontics, 2017 Jan 25; 39(5): 554-9.