TO CHART THE COLOR ACCURACY OF DSLR CAMERA IN CONJUNCTION WITH THE IMAGING SOFTWARE FOR EXCELLENCE IN FIXED PROSTHODONTICS

Dissertation submitted
in partial fulfilment of the requirements
for the degree of

MASTER OF DENTAL SURGERY

BRANCH – I
PROSTHODONTICS AND CROWN & BRIDGE

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ADHIPARASAKTHI DENTAL COLLEGE AND HOSPITAL

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DEPARTMENT OF PROSTHODONTICS AND CROWN & BRIDGE

CERTIFICATE

This is to certify that **Dr. A. MANIYARASAN,** Post Graduate student (2015-2018) in the Department of Prosthodontics and Crown & Bridge, Adhiparasakthi Dental College and Hospital, Melmaruvathur – 603319, has done this dissertation titled **"To chart the color accuracy of DSLR camera in conjunction with the imaging software for excellence in fixed prosthodontics"** under our direct guidance and supervision in partial fulfilment of the regulations laid down by the Tamilnadu Dr. M.G.R Medical University, Chennai – 600032 for MDS., (Branch-I) **PROSTHODONTICS AND CROWN & BRIDGE** degree examination.

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DECLARATION

TITLE OF THE DISSERTATION	To chart the color accuracy of dslr camera in conjunction with the imaging software for excellence in fixed prosthodontics
PLACE OF THE STUDY	Adhiparasakthi Dental College and Hospital, Melmaruvathur – 603319
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I hereby declare that no part of the dissertation will be utilized for gaining financial assistance or any promotion without obtaining prior permission of the Principal, Adhiparasakthi Dental College and Hospital, Melmaruvathur – 603319. In addition, I declare that no part of this work will be published either in print or in electronic media without the guides who has been actively involved in dissertation. The author has the right to reserve for publish work solely with the permission of the Principal, Adhiparasakthi Dental College and Hospital, Melmaruvathur – 603319.

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ABSTRACT

BACKGROUND:

The instrumental methods for analysing dental color have been introduced to practice in order to transform subjective analysis into an objective method that to in a cheaper way, which allows the numerical expression through different systems, of dental color parameters. As a result, variations induced by particularities of individual perception are avoided, as well as the errors generated by the phenomenon of metamerism. The recent technological improvements in computers, communication networks and the internet have greatly affected contemporary society. These improvements have translated also in the domain of dental medicine; a new generation of technologies focused on analysis, communication and color checking was developed in recent years. In this study the method used by DSLR is emphasized importantly as this the best localized method. The images produced via a DSLR are analysed using appropriate imaging software like Adobe photoshop and etc. This should be a much cheaper and easier process than the use of spectrophotometers or colorimeters. The objective of this study was to compare the digital imaging in guidance of appropriate imaging software with other instrumental methods.

AIM:

To Purpose of the study evaluate on color accuracy of DSLR camera in conjunction with the imaging software for excellence in fixed prosthodontics.

MATERIALS AND METHODS:

The digital camera used for the study was a Nikon D1500 series, single‑lensrefle (DSLR) camera. The camera settings was ISO 200, white balance AUTO, automatic flash mode off, expose of the camera AUTO, Resolution of the camera picture is RAW FINE aperture of the camera is AUTO, image size LARGE, camera should be on auto focus, temperature should be 4500 to 5000 kelvin, natural day light will be used .The object is placed 70 cm from the camera . The digital camera was connected with class 10 memory card and the image should copy analysing software (Adobe Photoshop CS software[Middle Eastern Version by Adobe® Version: 7.0].standard shade guide will be used for this study they are vita pan classic A1 to D4, and vita 3d master. They record a dimensionally accurate image. Vita pan and vita 3d master shade guide tabs should be captured by DSLR camera in daylight ,25 pictures will be taken of each tabs approximately 70 cm distance under the 16% grey card .Photos will separate three quadrants they are cervical third, middle third, Incisial third. The photos are under RAW FINE file and the photos are opened up with our photoshop. Click the window tab of photoshop menu and click color and then select the lab slider tab under the color and navigate to image, adjustment to color balance curves. Select the grey eyedropper and then pick a point in the grey card part of the image to serve as the grey anchor point and this will correct the white balance of the image. By using the eyedropper tool from the photoshop menu we get the LAB values and it will be calculated with shade guide recommended LAB values. The L*, a*, b*values obtained using Adobe Photoshop software as from the above CIEL* a* b*-derived a* and b* values, L a* b* values were thus recorded for each subject. The ΔE (difference in the shade) between the spectrophotometer derived L*b* values obtained by the digital photography technique which was calculated using the following formula

$$\Delta E = [(L1 - L2)^2 + (a1 - a2)^2 + (b1 - b2)^2]1/2$$

Therefore, for each subject, the delta E was determined with respect to the shade guide value and DSLR camera variation

RESULTS:

A score of "agreement" or "not in agreement" was given for delta E <2 and more than 2,respectively(Table – 47). This was done because the color difference between two objects (delta E) of <2 is not discernible to the human eye as suggested by Della Bona *et al*. Data were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS version 21.0, IBM Corporation, New York, USA). Coefficient of agreement was checked between reference values and values obtained from digital images of shade tabs. Percentage of samples with similar scores (accuracy) between reference values of shade tabs and values obtained from digital images was also checked.

CONCLUSION:

Within the limitation of the study,the digital photography method showed a high (statistically significant) percentage of agreement with the reference values for the shade tabs selected. So Digital photography can emerge as a viable alternative to the use of spectrophotometers for shade selection in a clinical setup. Further studies are needed to assess the various factors which can cause the variation in results such as the different set of digital camera or different lenses used or different types of sensors used in camera, which has to be further investigated.

KEYWORDS

DSLR Camera, Vita 3D master & Vita Classic Shade Guides, Adobe Photoshop Version 7.

CONTENTS

INTRODUCTION

The instrumental methods for analysing dental color have been introduced to practice in order to transform subjective analysis into an objective method that to in a cheaper way, which allows the numerical expression through different systems, of dental color parameters. As a result, variations induced by particularities of individual perception are avoided, as well as the errors generated by the phenomenon of metamerism. The recent technological improvements in computers, communication networks and the internet have greatly affected contemporary society. These improvements have translated also in the domain of dental medicine; a new generation of technologies focused on analysis, communication and color checking was developed in recent years. Color matching is an essential requirement of aesthetic dentistry and has been accentuated by the social emphasis. Color assessment is a result of physiological and psychological responses to radiant-energy stimulation in the field of dentistry as this is necessary for patient .It is a challenge for every aesthetician to determine and replicate the appearance of teeth as it requires humility, patience , time and perseverance to mimic nature to its closest sense and form. Color is well governed by visual and scientific components but in dentistry it is communicated on a regular basis which is often misunderstood, since every human eye is not capable of perceiving it in a standardized manner .Visual shade matching in daily clinical practice is still a challenging procedure for dental professionals due to the lack of knowledge in subjectivity of the process. As failure in providing a good light source and advance training may result in unsatisfactory results for both patients and as well as clinician. The recent improvements in technology, computers, communication networks and the Internet have greatly affected contemporary society by developing different instrumental methods such as Spectrophotometry, colorimeter and computer analysis of digital image are used in dental practice and in research. The instrumental methods of dental color selection require relatively expensive machines, sometimes difficult to use in the current dental practice; these techniques are mostly used in universities and research laboratories. Therefore some more instrumental methods were introduced to simplify this procedure and to provide better aesthetic outcome as patient are more conscious on this issue. Many researches have also been introduced in practice in order to transform a subjective analysis into an objective method, as to enable the numerical expression, through different systems, of dental color parameters. The development of easy to use open source software for dental color matching, aimed to generate predictable results, which can be helpful and improve the performances in color selection for both the clinicians and the dental technicians. DSLR (digital camera] is one of the easiest methods on shade selection with good results. Not only DSLR there are many other ways also. But in this study the method used by DSLR is emphasized importantly as this the best localized method. The images produced via a DSLR are analysed using appropriate imaging software like Adobe photoshop and etc. which enables the most accurate collection of color values from the images obtained from DSLR. Our major goals of this research are to develop the logistic aimed to support the clinical activity in a cheaper and easy stress-free process. This should be a much cheaper and easier process than the use of spectrophotometers or colorimeters. The objective of this study was to compare the digital imaging in guidance of appropriate imaging software with other instrumental methods such as spectrophotometer and colorimeter.

AIM AND OBJECTIVE

To evaluate the color accuracy of DSLR camera in conjunction with the imaging software for excellence in fixed prosthodontics.

OBJECTIVES

- To list the original colour of the shade tabs
- To measure the colour of the DSLR image of the shade tab
- To compare the original colour to the measured colour of the shade tab

REVIEW OF LITERATURE

1. Alvin G WEE and Delwin (2006)[8] studied the color accuracy of commercial digital camera for dental applications. They used three types of camera Nikon d100 canon d60 and sigma sd9 camera. Pictures were in raw format and they converted into the "TIFF" via the converting software which evaluated the CIE LAB values are obtained and compared with the calibration models. The authors concluded that these cameras when combined with the appropriate calibration protocols shows potential for use in the colour replication process of clinical dentistry

2. B. Culic and V. Prejmerean at (2014) [9] evaluated anew computer software (Toodent) aimed to calculate tooth color parameters from digital images. In order to evaluate the accuracy of the program, dental shade tabs were used as samples. The tabs were initially measured with a spectrophotometer and then photographed and assessed by using the experimental software. The results were also automatically expressed in the dental shade tab code. The CIE L*, a*, b* values of the same shade tab obtained by using the software and the spectrophotometer were compared. A statistical indicator was created in order to evaluate the accuracy of the program. It was concluded that further evaluation of the program is needed, in order to be applied in routine clinical color selection

3. Alper Caglar & KivancYamanel[10] on (2010) This study evaluated the colour parameters ofcomposite and ceramic shade guides determined using a colorimeter and digital imaging with illuminants at different colour temperatures. This study concluded that Digital imaging method could be an alternative for the colorimeters unless the proper object–camera distance, digital camera settings and suitable illumination conditions could be supplied.

4. Christopher IGIEL, Michael WEYHRAUCH[12] (2016) the agreement rate (%) and color difference (ΔE^*ab) of three dental color-measuring devices, with the visual shade identification. The Shade pilot (SP), Crystal Eye (CE) and Shade Vision (SV) were used to measure tooth color. The SP had an agreement of 56.3% with the visual shade determination, the CE 49.0% and SV 51.3%.ΔE^*ab of the visually and instrumentally selected shade tabs and natural teeth were frequently above the threshold for acceptability. Comparing both methods, for SP ΔE^*ab values differ in a range of clinical acceptability.

5. B.T. Xu & B. Zhang in (2012)[14] investigated the applicability of color-difference formula (CIELAB or CIEΔE2000) in visual color assessments of metal-ceramic specimens in small color-difference ranges. Metal-ceramic specimens using mixture of gradient ratio porcelain powders were fabricated to create a color

pool. Color differences of specimen pairs were calculated using the CIELAB (ΔE_ab) and CIEΔE2000 (ΔE00).Regression analysis was used to determine the correlation between ΔE_ab and DE00 values.CIE color-difference formulas were not applicable for visual color assessments of metal-ceramic specimens within the color-difference range of ΔE_ab<2:0.

6. Oscar E. Pechoa, in (2015)[15] compared visual and instrumental shade matching performances using two shade guides and three color difference formulas. They are using extracted upper incisor and vita classic and vita 3d master. 100 Dental Students used Vita Classic and 3D master shade guide to visually select the best shade match for each Upper Central Incisor under same experimental conditions used for the Spectrophotometers evaluation. Three color difference metrics (CIELAB, CIEDE2000(1:1:1) and CIEDE2000(2:1:1)) were used to calculate the best instrumental shade matching based on minimum color difference. Instrumental shade determination should be accompanied by experienced human visual assessment color difference formula was 100% efficient. Yet, the use of CIEDE2000(2:1:1) and Vita Classical shade guide most closely represented the visual perception of dental students. It is recommended that instrumental color determination be always accompanied by experienced human visual perception.

7. Fabiana Takatsui Marcelo Ferrarezi de Andrade[17] in (2012) study this study was to analyse the color alterations performed by the CIE L*a*b* system in the digital imaging of shade guide tabs which were obtained photographically according to the automatic and manual modes. Four Vita LuminVaccum shade guide tabs were used and the images were processed using Adobe Photoshop software. The color difference (ΔE) between the modes was calculated and classified as either clinically acceptable or unacceptable. It was concluded that the B1, B3 and C4 shade tabs can be used at any of the modes indigital camera (manual or automatic), which was a different finding from that observed for the A3.5 shade tab.

8. Kivanc Yamanel & Mutlu Ozcan in (2010)[18] This study evaluated the color parameters of resin composite shade guides determined using a colorimeter and digital imaging method. Ten shade tabs were selected (A1, A2, A3, A3,5, A4, B1, B2, B3, C2, C3) CIE *Lab* values were obtained using digital imaging and a colorimeter. Overall the mean DE values from different composite pairs demonstrated statistically significant differences when evaluated with the colorimeter but there was no significant difference with the digital imaging method. With both measurement methods in total 80% of the shade guide pairs from different composites. When proper object-camera distance, digital camera settings, and suitable illumination conditions are

provided, digital imaging method could be used in the assessment of color parameters.

9. Punit RS Khurana, P VivekThomas in (2013)[19] studied the Correlation between Maxillary Anterior Natural Teeth with that of the Commercially Available Acrylic and Porcelain Shade Guides. This study is planned to perform visual shade selection in standardized conditions to correlate the shades of the maxillary anterior natural teeth, Vitapan 3D master tooth guide, Vitapan classic shade guide, Ivoclar Chromoscope shade guide, Acrylux V acrylic shade guide. From this study it was concluded that the Davangere population had more prevalence of higher value(brighter) shades in all the three different age groups studied. The Vitapan 3D master shade guide was easiest to correlate to the population sample studied in this study.

10. Karl Martin Lehmann Christopher Igiel (2009)[20] compared the L*C*h color coordinates of dentalcolor-measuring devices with those of a spectrophotometric reference system. Matching the colors of the VITA Linearguide, were recorded using fourcolor-measuring devices (VITA Easyshade (A), VITA Easyshade compact (B), DegudentShadepilot (C), X-Rite Shadevision (D) and a spectrophotometric reference system understandardized test conditions. The electronic dental color-measuring devices tested showed excellent repeatability, but some devices showed

substantial deviations in color coordinate values from the spectrophotometric reference system.

11. Welson Pimentel in 2015[20]Compared the difference between visual and instrumental methods for natural tooth shade matching. Visual shade matching was performed by 4 dentists using a classic shade guide; instrumental shade matching was performed with aspectrophotometer by a previously calibrated examiner. No significant differences between the consecutive instrumental measurements were found and the agreement between measurements was determined to be significant and this study design was based on the results that were not found. So the study concluded that dental shade matching using an instrumental method was more reliable and repeatable compared to the visual method. The use of an instrumental method is therefore recommended for adequate tooth color selection.

12. Jon Gurrea, August Bruguera in (2016)[21] This study evaluated (color variability in the A hue between the VITA Classical (VITA Zahnfabrik) shade guide and four other VITA-coded ceramic shade guides using a Canon EOS 60D camera and software (Photoshop CC, Adobe). A total of 125 photographs were taken, 5 per shade tab for each of 5 shades from the following shade guides: Vita Classical (control), IPS e.max Ceram (Ivoclar Vivadent), IPS d.SIGN (Ivoclar Vivadent), Initial ZI (GC), and Creation CC. The VITA-coded shade guides

evaluated showed an overall unmatched shade in all tabs when compared with the control, suggesting that shade selection should be made using the guide produced by the manufacturer of the ceramic intended for the final restoration.

13. karl Glockner and Bernd Haidererin (2015) [22]describe about Visual vs. Spectrophotometric Methods for Shade Selection .This study was to determine the tooth colour using visual methods under natural light and Easy Shade device. Five hundred patients of Dental Clinic Graz Austria were selected for this study. Vita shade key (Vita Bad Säckingen Germany) and spectrophotometric method for match shades were analysed. The data obtained for both experimental groups were analyzed using the ANOVA test. The level of significance was set at 5%.No statistically significant difference was found in the ANOVA test between visual method and Easy Shade device shade determination. Based on these clinical findings we can conclude that both, the visual and digital tested methods were similar accurate in the shade determination.

14. DeğerÖngül, a Bülent Şermet in (2012)[23]evaluated the influence of 2 shade guides on color match, and to evaluate the relationship between color difference (ΔE) values and examiner assessments of the color match in ceramic crowns. Thirty-three subjects were selected for a ceramic crown restoration of the maxillary central incisor. Two crowns were fabricated with

selected shades from Vitapan Classical and Vita Tooth guide 3D-Master shade guides for each subject. The color values of maxillary central incisors, selected shade tabs, and corresponding crowns were measured with a spectrophotometer. The ΔE values between the natural teeth and the crowns and between the selected shade tabs and the corresponding crowns were calculated. The ceramic crowns fabricated with the Vita Tooth guide 3D-Master shade guide resulted in a closer color match to the natural teeth than those of the Vitapan Classical guide. However, the ΔE values and the examiner scores were within the clinically acceptable range for both shade guides.

15. P. Gehrkea U. Riekebergbin (2015)(24) evaluated the reliability and re-producibility of digital shade selection devices and to correlate the results with conventional human visual shade assessment of two different digital shade selection instruments (Shade Pilot, Degudent; Hanau, Germany, Software V.2.41) and a colorimeter (ShadeVision, Ammann Girrbach; Pforzheim, Germany; Software V. 1.20). The devices were compared with three human examiners with a negative history of visual color deficiency, looking at 40 subjects under clinical conditions. Computer-based readings across the regions (incisal, middle, cervical) were recorded two consecutive times for each of the 20 teeth and implant supported crowns. The results of the present study suggest that spectrophotometric shade determination is

more reproducible compared to conventional visual shade assessment.

16. Shruti Lakhanpal (2016)[25] assessed the shade-matching ability of three shade matching devices such as spectrophotometer, digital camera, and Polarization Dental Imaging Modality in the accuracy of replication of metal ceramic restorations. The study sample consisted of 20 freshly extracted non carious premolars. The Commission Internationals de l'Eclairage (CIE) $L^*a^*b^*$ values of the tooth were obtained through a spectrophotometer, digital camera, and digital camera with a polarizer. Shade selection was carried out using VITA 3D Master and calculating the Euclidian distance. The fabricated metal ceramic crowns were then evaluated to check the shade replication by comparing the CIE $L^*a^*b^*$ values of the crowns with the reference shade tab images. The three-way analysis of variance (ANOVA) and comparative analysis using Bonferroni test reveals that the difference in the mean L^*a^*b values between spectrophotometer and polarization dental imaging modality (PDIM) was insignificant. Statistically significant correlation was found to exist between the spectrophotometer and PDIM for all CIE L^*, a^*, and b^* color coordinates.

17. William D. Browning in (2009)[26]compared newer composite resin restorative materials to the Vitapan Classical tabs they purported to represent. Five Vitapan Classical tabs were studied:

A3.5, B2, C1, C3, and D2. Intraoral spectrophotometer was used to capture CIELAB color coordinates. The inter-tab color differences were also calculated. The average was compared to five Vitapan Classical shade tabs to calculate the color differences using both CIELAB and CIEDE2000 color difference formulas. None of the materials proved an acceptable CIELAB color match to any of the shades tested. Various shade tabs of Vitapan Classical shade guides were compared with correspondent tabs made of direct restorative composites, no material/shade combination resulted in an acceptable mismatch relative to the used standard of acceptability. The evaluated resin composites exhibited poor match compared to target Vitapan Classical tabs.

18. Martinez CIE, Vasconcellos DK, (2014)[(27)]evaluated the Influence of Illumination during Visual Shade Matching .This study evaluated the influence of ambient light and a D65 standard light source during visual shade matching for natural teeth. The shade of a maxillary incisor was initially determined using an intraoral spectrophotometer (Vita Easy shade Compact, VITA Zahnfabrik, Bad Säckingen, Germany) and acted as the reference values (A1 and 1M2) for the subjects. After calibration of the students, the shade of a maxillary central incisor was determined visually for three times using two shade guides, the Vita Classic (VC) and Vita 3D Master Line arguide (VL3D), with and without the aid of a standard light source (D65). The

obtained results were compared to the reference value. The use of a D65 light source increased the probability of correct visual shade matching, Standardized lighting with a D65 light source may improve the correct choice of tooth shade by students although errors in shade matching were not completely eliminated.

19. Juzer S. Miyajiwala & Mohit G. Kheur[(28)] in (2017) they compared the photography and other conventional method for shade selection. They used visual, spectrophotometer and photography method. In visual method the Vitapan classic shade guide was used. In spectrophotometer the Vita easy shade device was used. In photography method the Canon500 D single lens reflex camera with Image resolution high iso125 was used. The spectrophotometer reported the L*, a*, and b* values along with the actual shade whereas the digital photography method reported only the L*, a*, and b* values. The agreement between the readings obtained by the three different methods was compared and subjected to appropriate statistical analysis. The percentage of agreement between shades obtained by the visual and spectrophotometric method showed maximum agreement with A1 shade. It was concluded that the digital photography method emerged as a reliable method for shade selection in a clinical setup.

MATERIALS AND METHODS

This study was approved by the Institutional Review Board (IRB).IRB/IEC Reference N0: 2015-MD-BrI-PRB-02/APDCH.

OVERALL VIEW OF THE PROCEDURE

Step 1:	Camera settings
Step 2:	Environment settings
Step 3:	Photography of the Shade tabs.
Step 4:	Color assessment of Color of the Shade tab images using Photoshop 7.
Step 5:	Comparing the Color of the shade tab images to that of the Original values of the Shade tab Color.
Step 6:	Analyse the data thus obtained.

In this study Nikon D 1500 series DSLR camera is used. The digital camera is connected to a class 10 memory card and the image analysing software (Adobe Photoshop CS software[Middle Eastern Version by Adobe® Version: 7.0]. Standard shade guides vita pan classic A1 to D4, and vita 3d master is used. . Shade guide tabs are placed over the 16% grey card. The distance between the shade guide tab and the camera is maintained at 70 cm. Image of the shade guide tabs are captured by DSLR camera in daylight with around 4500 to 5000 K light temperature. 25 pictures of each shade guide tabs are captured. The images are viewed in Adobe Photoshop. Image of each shade guide tab is divided into three quadrants, cervical third, middle third and incisal third. Only the middle third of the shade tab is analysed for lab values. By using the eyedropper tool from the Photoshop menu, the L*, a*, b* values are calculated. The ΔE (difference in the shade) between the Original L*, a*, b* values and the digital photography technique is calculated using the following formula

$$\Delta E = [(L1 - L2)^2 + (a1 - a2)^2 + (b1 - b2)^2]1/2$$

SAMPLE SIZE CALCULATION

Using data from a similar study, the sample size was calculated using online sample size calculator, https://www.dssresearch.com. The α error was set at 5% and the β error was set at 85%. The number of samples was calculated to 25 samples each.

CAMERA SETTINGS

The digital camera used for the study is a Nikon 500D series, single-lens reflex (SLR) camera with a Harison tripod stand. Camera settings Parameters are as follows;

Selected Magnification - 1:1 ratio

Exposure mode - Automatic

White balance - Automatic

Aperture - Automatic

Flash - TTL flash metering

Manual flash mode - Off

Fixed white balance - Off

Image resolution - “High” image resolution selected

File type - JPEG with the same degree of image compression

ISO value - 125 selected

Memory Card – Class 10

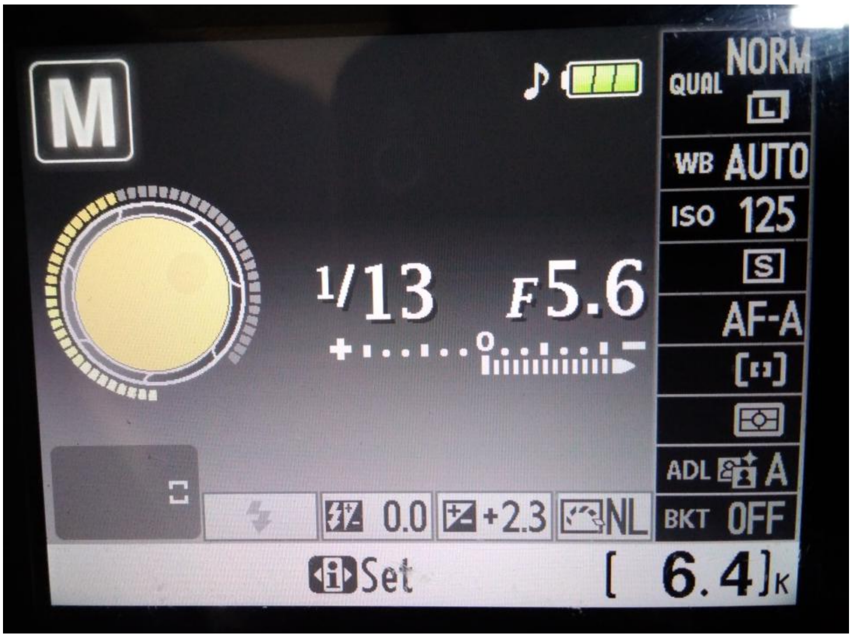


Fig 1

PHOTOGRAPHY

The shade tab is placed over the grey card and the set up is placed in an area with good natural sunlight. The light temperature was measured and position adjusted till it was around 4500 to 5500 K. The camera was set up on a tripod and the distance maintained at 70 cm. the settings of the camera were set at the values already described. Then 25 images were clicked. This is repeated for all the rest of the shade tabs.

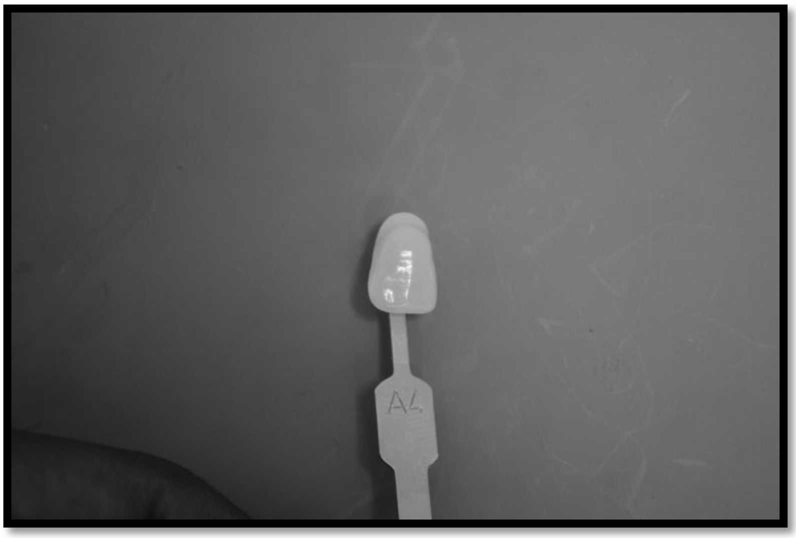


Fig 2

Fig 3

VITAPAN CLASSIC SHADE GUIDE

Fig 4

VITA 3D MASTER

IMAGE PROCESSING

The image is processed as per the protocol described by Bengel.

1. In the Adobe Photoshop software, the selected image of the shade tab is opened.
2. Under the Window tab, click on Color to get the color window.
3. Click on the options in Color window and select Lab slider and RGB spectrum.
4. Press "CTRL + L" to get the Levels window.
5. In this Levels window select the middle eye dropper tool and click on the grey card portion of the image.
6. This procedure will neutralize the color with reference to the grey card.
7. Using the "Eye dropper" tool of the Adobe Photoshop tools, click on 5 random areas on the image.
8. Note the L, a and b values in each of the 5 areas.
9. This is repeated for all of the 25 images of each shade tab.

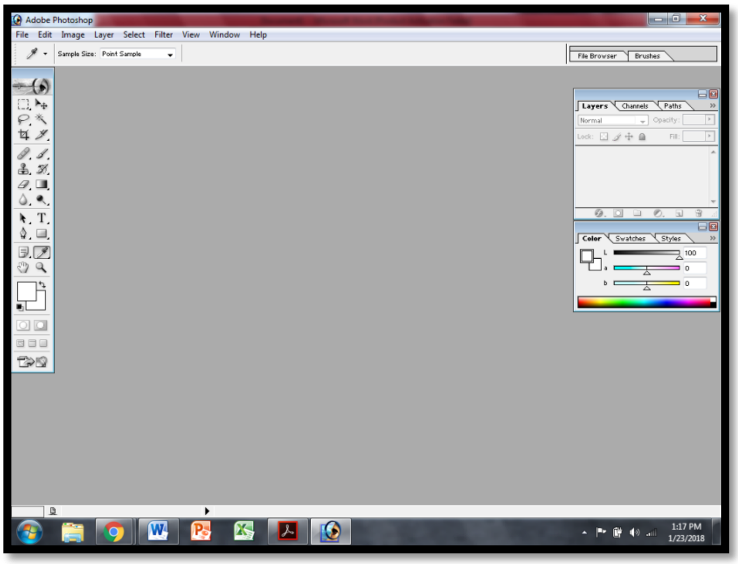


Fig 5

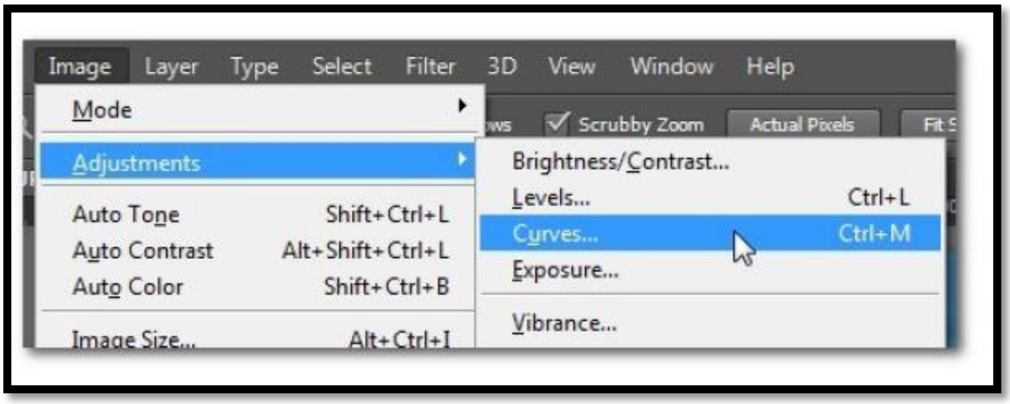


Fig 6

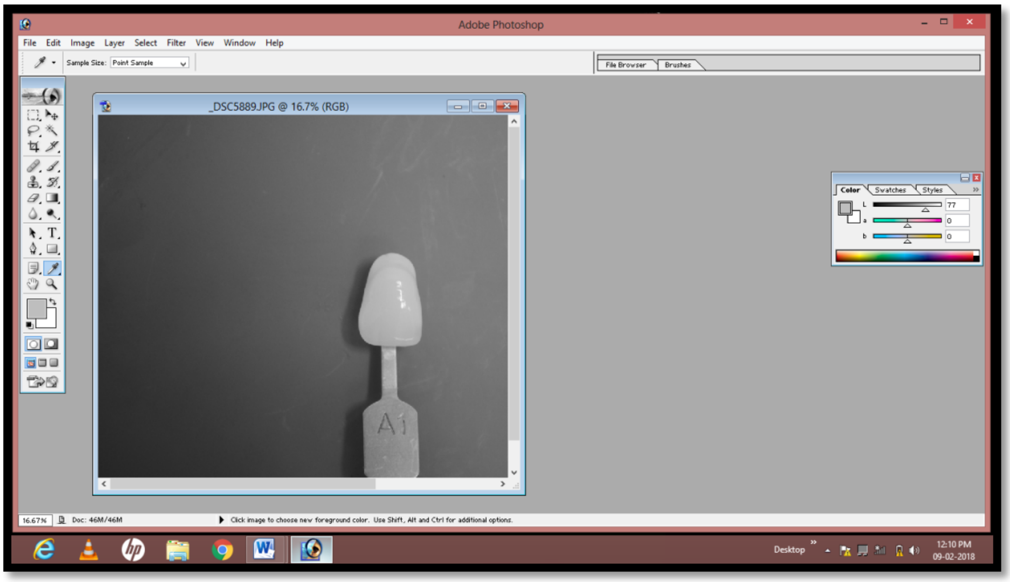


Fig 7

DATA HANDLING

The Lab value of each image is compared with the Original values of the shade tab. The difference is calculated using the formula,

$$\Delta E = [(L1 - L2)^2 + (a1 - a2)^2 + (b1 - b2)^2]1/2$$

This data is then statistically analysed using Statistical Package for the Social Sciences (SPSS version 21.0, IBM Corporation, New York, USA).

RESULTS

In this study the lab values of the shade tabs of the Vitapan 3d master and vita classic are obtained and taken as reference values for comparison. The lab values of the shade tabs calculated with adobe photoshop was obtained by analyzing the photographs taken by digital cameras are tabulated in (Table 1-42).

The delta E value for each shade tab is calculated for all 25 digital images are calculated and tabulated (Table 1-42).The ΔE (difference in the shade) between the reference L* a* b* values, and the values obtained by the digital photography technique was calculated using the following formula $\Delta E = [(L1 - L2)^2 + (a1 - a2)^2 + (b1 - b2)^2]^{1/2}$. The mean and standard deviation for each shade is calculated for comparism with the reference values (Table 43-44). A score of “agreement” or “not in agreement” was given for delta E <2 and more than 2, respectively (Table – 47). This was done because the color difference between two objects (delta E) of <2 is not discernible to the human eye as suggested by Della Bona *et al*.

Data were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS version 21.0, IBM Corporation, New York, USA). Coefficient of agreement was checked between reference values and values obtained from digital images of shade tabs. Percentage of samples with similar scores (accuracy) between reference values of shade tabs and values obtained from digital images was also checked.

(STANDARD DEVIATION) Values For 3d Master Shade Guide

TABLE : 1 (1M1)

L1	a1	b1	L2	a2	b2	Square	Square root
83.1	-0.1	12.5	83.16571	-0.00966	12.67528	0.043203	0.207853
83.1	-0.1	12.5	83.1629	-0.08892	12.53442	0.005264	0.072555
83.1	-0.1	12.5	83.26556	-0.08894	12.63515	0.045796	0.214
83.1	-0.1	12.5	83.19241	-0.07713	12.59611	0.0183	0.135277
83.1	-0.1	12.5	83.17328	-0.08673	12.62776	0.021869	0.147882
83.1	-0.1	12.5	83.29809	-0.00961	12.54854	0.049765	0.223081
83.1	-0.1	12.5	83.16814	-0.04143	12.58991	0.016157	0.127111
83.1	-0.1	12.5	83.25619	-0.08856	12.56997	0.029423	0.17153
83.1	-0.1	12.5	83.23877	-0.06529	12.62889	0.037074	0.192547
83.1	-0.1	12.5	83.25926	-0.06262	12.64947	0.049102	0.221589
83.1	-0.1	12.5	83.16559	-0.07713	12.53959	0.006392	0.079951
83.1	-0.1	12.5	83.2945	-0.01324	12.6309	0.062493	0.249986
83.1	-0.1	12.5	83.25771	-0.00586	12.55016	0.03625	0.190394
83.1	-0.1	12.5	83.26759	-0.06654	12.60705	0.040667	0.201661
83.1	-0.1	12.5	83.27394	-0.05886	12.51502	0.032172	0.179365
83.1	-0.1	12.5	83.24322	-0.01988	12.64837	0.048944	0.221233
83.1	-0.1	12.5	83.28809	-0.06721	12.69616	0.074931	0.273736
83.1	-0.1	12.5	83.26824	-0.02601	12.50454	0.0338	0.183847
83.1	-0.1	12.5	83.13282	-0.07086	12.69902	0.041536	0.203805
83.1	-0.1	12.5	83.18703	-0.01999	12.60757	0.025548	0.159836
83.1	-0.1	12.5	83.2152	-0.04108	12.69262	0.053847	0.232049
83.1	-0.1	12.5	83.16973	-0.01816	12.5344	0.012745	0.112894
83.1	-0.1	12.5	83.2349	-0.01232	12.68715	0.06091	0.2468
83.1	-0.1	12.5	83.14718	-0.0805	12.61405	0.015613	0.124952

TABLE : 2 (1M2)

L1	A1	B1	L2	A2	B2	Square	Square root
84	-0.2	18.8	84.04249	-0.16992	18.83257	0.003771	0.061407
84	-0.2	18.8	84.16907	-0.10477	18.96963	0.066431	0.257742
84	-0.2	18.8	84.14542	-0.16867	18.95529	0.046242	0.215039
84	-0.2	18.8	84.10992	-0.13267	18.89172	0.02503	0.158208
84	-0.2	18.8	84.01049	-0.18645	18.8096	0.000386	0.019639
84	-0.2	18.8	84.05733	-0.18309	18.87346	0.008968	0.094701
84	-0.2	18.8	84.02734	-0.15585	18.90771	0.014297	0.119571
84	-0.2	18.8	84.07986	-0.11695	18.91236	0.025899	0.160933
84	-0.2	18.8	84.02645	-0.15324	18.94822	0.024856	0.157659
84	-0.2	18.8	84.02376	-0.14658	18.83752	0.004826	0.069468
84	-0.2	18.8	84.03823	-0.17441	18.83387	0.003263	0.057125
84	-0.2	18.8	84.08587	-0.17012	18.82558	0.008922	0.094456
84	-0.2	18.8	84.03118	-0.13294	18.82546	0.006117	0.078211
84	-0.2	18.8	84.14101	-0.19831	18.95028	0.04247	0.206082
84	-0.2	18.8	84.15721	-0.13231	18.94973	0.051715	0.22741
84	-0.2	18.8	84.16106	-0.16543	18.82054	0.027557	0.166002
84	-0.2	18.8	84.05043	-0.11766	18.97839	0.041148	0.202849
84	-0.2	18.8	84.00858	-0.14935	18.98137	0.035535	0.188508
84	-0.2	18.8	84.06956	-0.11421	18.90358	0.022927	0.151416
84	-0.2	18.8	84.055	-0.16904	18.81034	0.004091	0.063958
84	-0.2	18.8	84.126	-0.15665	18.8611	0.021487	0.146585
84	-0.2	18.8	84.16591	-0.19427	18.87672	0.033444	0.182876
84	-0.2	18.8	84.09498	-0.18285	18.9258	0.025142	0.158561
84	-0.2	18.8	84.1222	-0.1779	18.98228	0.048648	0.220562
84	-0.2	18.8	84.13508	-0.13514	18.98923	0.058262	0.241375

TABLE : 3 (2L1.5)

L1	a1	b1	L2	a2	b2	Square	Squareroot
79	0	18.5	79.04282	0.065871	18.53221	0.00721	0.084912
79	0	18.5	79.18043	0.01356	18.51841	0.033078	0.181874
79	0	18.5	79.09719	0.043655	18.54842	0.013696	0.117029
79	0	18.5	79.11036	0.005777	18.53251	0.01327	0.115195
79	0	18.5	79.12851	0.002117	18.56177	0.020335	0.142602
79	0	18.5	79.105	0.043904	18.51539	0.01319	0.114849
79	0	18.5	79.12008	0.090189	18.5363	0.02387	0.154499
79	0	18.5	79.15522	0.084311	18.55419	0.034137	0.184762
79	0	18.5	79.17986	0.019714	18.52035	0.033154	0.182081
79	0	18.5	79.03196	0.086971	18.58581	0.015949	0.12629
79	0	18.5	79.18147	0.040336	18.51093	0.034678	0.18622
79	0	18.5	79.01554	0.082019	18.50581	0.007002	0.08368
79	0	18.5	79.18561	0.037807	18.59506	0.044917	0.211936
79	0	18.5	79.02393	0.035917	18.59604	0.011086	0.105291
79	0	18.5	79.14077	0.045198	18.5359	0.023146	0.15214
79	0	18.5	79.14223	0.014202	18.57869	0.026624	0.163169
79	0	18.5	79.15127	0.002666	18.54771	0.025166	0.158638
79	0	18.5	79.15156	0.046833	18.59687	0.034546	0.185867
79	0	18.5	79.14461	0.03942	18.51095	0.022586	0.150285
79	0	18.5	79.02989	0.002421	18.56666	0.005343	0.073093
79	0	18.5	79.18259	0.083995	18.53271	0.041466	0.203632
79	0	18.5	79.18457	0.092629	18.52549	0.043295	0.208075
79	0	18.5	79.1763	0.076451	18.52582	0.037593	0.19389
79	0	18.5	79.16919	0.060079	18.55743	0.035534	0.188506
79	0	18.5	79.10671	0.071309	18.59568	0.025626	0.16008

TABLE : 4 (2L2.5)

L1	a1	b1	L2	a2	b2	Square	Square root
79.5	0.2	24.5	79.57202	0.24117	24.528	0.007665	0.087552
79.5	0.2	24.5	79.56086	0.230267	24.57459	0.010184	0.100918
79.5	0.2	24.5	79.53278	0.26978	24.66958	0.0347	0.18628
79.5	0.2	24.5	79.57972	0.212646	24.50037	0.006515	0.080717
79.5	0.2	24.5	79.69408	0.255691	24.5746	0.046333	0.215251
79.5	0.2	24.5	79.61751	0.240505	24.56689	0.019923	0.141147
79.5	0.2	24.5	79.66179	0.266174	24.56993	0.035444	0.188266
79.5	0.2	24.5	79.52771	0.295915	24.61088	0.022261	0.149201
79.5	0.2	24.5	79.57591	0.21116	24.54883	0.008271	0.090947
79.5	0.2	24.5	79.6457	0.233772	24.69701	0.061182	0.24735
79.5	0.2	24.5	79.61569	0.271882	24.61185	0.031063	0.176247
79.5	0.2	24.5	79.66186	0.280918	24.58673	0.040268	0.20067
79.5	0.2	24.5	79.66287	0.227616	24.60544	0.038406	0.195974
79.5	0.2	24.5	79.60555	0.203279	24.6227	0.026207	0.161885
79.5	0.2	24.5	79.68909	0.23074	24.52957	0.037575	0.193844
79.5	0.2	24.5	79.62939	0.298159	24.65205	0.049497	0.22248
79.5	0.2	24.5	79.52765	0.249129	24.51177	0.003317	0.05759
79.5	0.2	24.5	79.59349	0.266956	24.51075	0.013339	0.115497
79.5	0.2	24.5	79.63956	0.241019	24.59854	0.030869	0.175697
79.5	0.2	24.5	79.65145	0.295867	24.61833	0.04613	0.21478
79.5	0.2	24.5	79.69165	0.299347	24.60205	0.057012	0.238771
79.5	0.2	24.5	79.53269	0.261337	24.63104	0.022001	0.148327
79.5	0.2	24.5	79.65065	0.271291	24.61495	0.040991	0.202461
79.5	0.2	24.5	79.58917	0.260212	24.5608	0.015273	0.123582
79.5	0.2	24.5	79.59075	0.256691	24.62756	0.027722	0.1665

TABLE : 5 (2M1)

L1	a1	b1	L2	a2	b2	Square	Square root
78.7	0.9	19.9	78.62772	0.937629	19.9255	0.007291	0.085387
78.7	0.9	19.9	78.16263	1.070181	19.97445	0.323273	0.568571
78.7	0.9	19.9	78.71162	0.992824	20.0169	0.022418	0.149726
78.7	0.9	19.9	78.44356	0.949843	19.93011	0.069155	0.262973
78.7	0.9	19.9	78.40953	0.926273	20.03604	0.103574	0.321829
78.7	0.9	19.9	78.5568	0.955908	19.93719	0.025015	0.158161
78.7	0.9	19.9	78.18527	1.003515	19.99545	0.284774	0.533642
78.7	0.9	19.9	78.64746	0.910575	20.02935	0.019603	0.140012
78.7	0.9	19.9	78.85215	1.014371	19.91848	0.036571	0.191237
78.7	0.9	19.9	78.6955	0.94629	19.94846	0.004511	0.067166
78.7	0.9	19.9	78.50037	0.929988	19.98871	0.04862	0.220499
78.7	0.9	19.9	78.89603	0.971262	19.97839	0.049652	0.222828
78.7	0.9	19.9	78.67592	1.06866	20.09101	0.065512	0.255953
78.7	0.9	19.9	78.00787	1.047346	19.96708	0.505249	0.710809
78.7	0.9	19.9	78.70377	1.075564	20.05277	0.054174	0.232754
78.7	0.9	19.9	78.21892	0.96403	19.95599	0.238669	0.488538
78.7	0.9	19.9	78.35714	1.04344	19.93205	0.139158	0.373039
78.7	0.9	19.9	78.59604	0.959655	19.96155	0.018155	0.134741
78.7	0.9	19.9	78.20408	1.012407	20.00633	0.26988	0.519499
78.7	0.9	19.9	78.48799	0.964461	19.97614	0.0549	0.234307
78.7	0.9	19.9	78.80949	1.026802	19.94076	0.029729	0.17242
78.7	0.9	19.9	78.72136	1.038731	20.04345	0.040282	0.200703
78.7	0.9	19.9	78.71684	1.074793	19.91456	0.031048	0.176204
78.7	0.9	19.9	78.41761	1.028926	19.92736	0.097116	0.311634

TABLE : 6 (2M2)

L1	a1	b1	L2	a2	b2	Square	Square root
79.2	0.7	25.3	79.36518	0.724705	25.41192	0.040419	0.201045
79.2	0.7	25.3	79.32159	0.770366	25.42862	0.036277	0.190464
79.2	0.7	25.3	79.36039	0.763503	25.30268	0.029766	0.172529
79.2	0.7	25.3	79.22732	0.710064	25.32042	0.001265	0.035563
79.2	0.7	25.3	79.27344	0.763325	25.4489	0.031573	0.177689
79.2	0.7	25.3	79.2582	0.708374	25.36319	0.007451	0.086318
79.2	0.7	25.3	79.20502	0.71019	25.41883	0.014249	0.119368
79.2	0.7	25.3	79.2452	0.707668	25.45586	0.026395	0.162466
79.2	0.7	25.3	79.2574	0.736133	25.36504	0.00883	0.093968
79.2	0.7	25.3	79.20422	0.775078	25.48294	0.039122	0.197794
79.2	0.7	25.3	79.35039	0.706593	25.35584	0.02578	0.160561
79.2	0.7	25.3	79.31574	0.776143	25.35614	0.022346	0.149487
79.2	0.7	25.3	79.3733	0.709977	25.32548	0.030781	0.175444
79.2	0.7	25.3	79.20188	0.712486	25.3294	0.001024	0.031997
79.2	0.7	25.3	79.2393	0.784904	25.46214	0.035041	0.187192
79.2	0.7	25.3	79.24717	0.797636	25.48335	0.045375	0.213015
79.2	0.7	25.3	79.30919	0.739656	25.31666	0.013772	0.117355
79.2	0.7	25.3	79.35291	0.716287	25.33884	0.025156	0.158607
79.2	0.7	25.3	79.37405	0.727604	25.46393	0.057927	0.24068
79.2	0.7	25.3	79.2851	0.769298	25.48088	0.044761	0.211568
79.2	0.7	25.3	79.35558	0.76972	25.37589	0.034827	0.186619
79.2	0.7	25.3	79.39013	0.764437	25.40753	0.051866	0.227741
79.2	0.7	25.3	79.2546	0.769667	25.43297	0.025516	0.159738
79.2	0.7	25.3	79.29623	0.754514	25.43981	0.03178	0.178269

TABLE : 7 (2M3)

L1	a1	b1	L2	a2	b2	Square	Square root
77.8	0.7	25.3	77.91686	0.755117	25.32298	0.017223	0.131235
77.8	0.7	25.3	77.90276	0.7636	25.41299	0.027371	0.165441
77.8	0.7	25.3	77.86477	0.729431	25.38974	0.013115	0.11452
77.8	0.7	25.3	77.87439	0.739069	25.31294	0.007227	0.085011
77.8	0.7	25.3	77.84582	0.797588	25.4013	0.021885	0.147935
77.8	0.7	25.3	77.82004	0.710174	25.44146	0.020516	0.143233
77.8	0.7	25.3	77.93032	0.769857	25.4094	0.033831	0.183932
77.8	0.7	25.3	77.85032	0.722011	25.32013	0.003422	0.058494
77.8	0.7	25.3	77.94245	0.770673	25.36736	0.029823	0.172695
77.8	0.7	25.3	77.96937	0.785399	25.36433	0.040119	0.200298
77.8	0.7	25.3	77.9004	0.715866	25.47588	0.041266	0.203141
77.8	0.7	25.3	77.84591	0.705739	25.32101	0.002582	0.050815
77.8	0.7	25.3	77.98851	0.710303	25.44487	0.056632	0.237975
77.8	0.7	25.3	77.99838	0.755704	25.39856	0.052171	0.22841
77.8	0.7	25.3	77.84147	0.789422	25.33911	0.011246	0.106049
77.8	0.7	25.3	77.895	0.782651	25.31928	0.016228	0.127388
77.8	0.7	25.3	77.86667	0.761881	25.36677	0.012733	0.112839
77.8	0.7	25.3	77.81025	0.708341	25.40856	0.01196	0.109361
77.8	0.7	25.3	77.90703	0.725715	25.42922	0.028816	0.169753
77.8	0.7	25.3	77.93928	0.70377	25.30418	0.019432	0.139398
77.8	0.7	25.3	77.94039	0.701217	25.35945	0.023244	0.15246
77.8	0.7	25.3	77.8665	0.725763	25.40999	0.017184	0.131086
77.8	0.7	25.3	77.90251	0.702453	25.43163	0.027842	0.166859
77.8	0.7	25.3	77.8574	0.738552	25.39077	0.01302	0.114103

TABLE : 8 (2R1.5)

L1	a1	b1	L2	a2	b2	Square	Square root
79.5	1.7	23.3	79.67039	1.70053	23.30755	0.029089	0.170556
79.5	1.7	23.3	79.55002	1.737	23.30341	0.003883	0.062313
79.5	1.7	23.3	79.58926	1.705107	23.36937	0.012805	0.113159
79.5	1.7	23.3	79.6574	1.740408	23.35573	0.029514	0.171798
79.5	1.7	23.3	79.54417	1.718832	23.33863	0.003798	0.061631
79.5	1.7	23.3	79.54769	1.728839	23.48966	0.039079	0.197683
79.5	1.7	23.3	79.51375	1.721537	23.43719	0.019473	0.139546
79.5	1.7	23.3	79.58782	1.744756	23.47018	0.038677	0.196665
79.5	1.7	23.3	79.61371	1.722096	23.48144	0.046339	0.215265
79.5	1.7	23.3	79.56263	1.780607	23.39232	0.018943	0.137632
79.5	1.7	23.3	79.57258	1.796611	23.3705	0.019572	0.1399
79.5	1.7	23.3	79.64693	1.715428	23.39601	0.031045	0.176195
79.5	1.7	23.3	79.58387	1.79302	23.34785	0.017976	0.134076
79.5	1.7	23.3	79.6349	1.775055	23.39452	0.032763	0.181007
79.5	1.7	23.3	79.58399	1.763722	23.33465	0.012315	0.110974
79.5	1.7	23.3	79.64752	1.765921	23.30036	0.026109	0.161582
79.5	1.7	23.3	79.69688	1.721953	23.44088	0.059091	0.243086
79.5	1.7	23.3	79.64293	1.715448	23.44331	0.041203	0.202985
79.5	1.7	23.3	79.62671	1.750551	23.33753	0.020019	0.141489
79.5	1.7	23.3	79.56809	1.795549	23.39725	0.023224	0.152395
79.5	1.7	23.3	79.58314	1.712226	23.42161	0.02185	0.147819
79.5	1.7	23.3	79.55848	1.715566	23.37219	0.008874	0.094201
79.5	1.7	23.3	79.50382	1.702781	23.46376	0.02684	0.163829
79.5	1.7	23.3	79.5923	1.762575	23.46524	550.6297	23.4655

TABLE : 9 (2R2.5)

L1	a1	b1	L2	a2	b2	Square	Square root
79.5	1.7	23.3	79.52219	1.749082	23.30707	0.002952	0.054328
79.5	1.7	23.3	79.67039	1.70053	23.30755	0.029089	0.170556
79.5	1.7	23.3	79.55002	1.737	23.30341	0.003883	0.062313
79.5	1.7	23.3	79.58926	1.705107	23.36937	0.012805	0.113159
79.5	1.7	23.3	79.6574	1.740408	23.35573	0.029514	0.171798
79.5	1.7	23.3	79.54417	1.718832	23.33863	0.003798	0.061631
79.5	1.7	23.3	79.54769	1.728839	23.48966	0.039079	0.197683
79.5	1.7	23.3	79.51375	1.721537	23.43719	0.019473	0.139546
79.5	1.7	23.3	79.58782	1.744756	23.47018	0.038677	0.196665
79.5	1.7	23.3	79.61371	1.722096	23.48144	0.046339	0.215265
79.5	1.7	23.3	79.56263	1.780607	23.39232	0.018943	0.137632
79.5	1.7	23.3	79.57258	1.796611	23.3705	0.019572	0.1399
79.5	1.7	23.3	79.64693	1.715428	23.39601	0.031045	0.176195
79.5	1.7	23.3	79.58387	1.79302	23.34785	0.017976	0.134076
79.5	1.7	23.3	79.6349	1.775055	23.39452	0.032763	0.181007
79.5	1.7	23.3	79.58399	1.763722	23.33465	0.012315	0.110974
79.5	1.7	23.3	79.64752	1.765921	23.30036	0.026109	0.161582
79.5	1.7	23.3	79.69688	1.721953	23.44088	0.059091	0.243086
79.5	1.7	23.3	79.64293	1.715448	23.44331	0.041203	0.202985
79.5	1.7	23.3	79.62671	1.750551	23.33753	0.020019	0.141489
79.5	1.7	23.3	79.56809	1.795549	23.39725	0.023224	0.152395
79.5	1.7	23.3	79.58314	1.712226	23.42161	0.02185	0.147819
79.5	1.7	23.3	79.55848	1.715566	23.37219	0.008874	0.094201
79.5	1.7	23.3	79.50382	1.702781	23.46376	0.02684	0.163829
79.5	1.7	23.3	79.5923	1.762575	23.46524	550.6297	23.4655

TABLE : 10 (3L1.5)

L1	a1	b1	L2	a2	b2	Square	Square root
73.1	1.5	16.3	73.17515	1.590074	16.31751	0.014067	0.118606
73.1	1.5	16.3	73.21027	1.554149	16.46076	0.040937	0.202328
73.1	1.5	16.3	73.21876	1.582629	16.36582	0.025264	0.158948
73.1	1.5	16.3	73.19512	1.5952	16.47817	0.049856	0.223284
73.1	1.5	16.3	73.23239	1.537073	16.33415	0.020067	0.14166
73.1	1.5	16.3	73.25389	1.572199	16.31567	0.02914	0.170704
73.1	1.5	16.3	73.14558	1.598188	16.38685	0.019261	0.138783
73.1	1.5	16.3	73.17697	1.598198	16.40019	0.025605	0.160017
73.1	1.5	16.3	73.16191	1.523158	16.39083	0.012618	0.11233
73.1	1.5	16.3	73.20624	1.52862	16.31955	0.012489	0.111754
73.1	1.5	16.3	73.15593	1.507415	16.46875	0.03166	0.177932
73.1	1.5	16.3	73.16425	1.583613	16.36027	0.014752	0.121457
73.1	1.5	16.3	73.22805	1.570899	16.42393	0.036781	0.191785
73.1	1.5	16.3	73.25934	1.585784	16.34535	0.034804	0.186558
73.1	1.5	16.3	73.19208	1.560521	16.39796	0.021738	0.147438
73.1	1.5	16.3	73.27629	1.546619	16.42268	0.0483	0.219773
73.1	1.5	16.3	73.28479	1.597465	16.39113	0.051951	0.227928
73.1	1.5	16.3	73.17029	1.566792	16.36043	0.013054	0.114252
73.1	1.5	16.3	73.13781	1.542991	16.46994	0.032158	0.179326
73.1	1.5	16.3	73.156	1.570213	16.34017	0.00968	0.098386
73.1	1.5	16.3	73.17513	1.536175	16.36453	0.011117	0.105438
73.1	1.5	16.3	73.25215	1.54276	16.4838	0.058762	0.242408
73.1	1.5	16.3	73.1618	1.511718	16.37636	0.009788	0.098934
73.1	1.5	16.3	73.13169	1.515146	16.4938	0.038793	0.196959

TABLE :11 (3M1)

L1	a1	b1	L2	a2	b2	Square	Square root
73.9	1.9	26.2	73.9494	1.926488	26.2108	0.003258	0.05708
73.9	1.9	26.2	73.92817	1.940016	26.34538	0.02353	0.153394
73.9	1.9	26.2	74.0922	1.937073	26.27793	0.044389	0.210688
73.9	1.9	26.2	74.06737	1.945501	26.28346	0.037049	0.192481
73.9	1.9	26.2	73.93447	1.948863	26.27159	0.008702	0.093284
73.9	1.9	26.2	74.01101	1.915443	26.22911	0.013409	0.115798
73.9	1.9	26.2	74.09714	2.090259	26.39487	0.113039	0.336212
73.9	1.9	26.2	74.05805	1.920729	26.39716	0.064281	0.253537
73.9	1.9	26.2	74.06102	1.993581	26.27669	0.040566	0.201409
73.9	1.9	26.2	73.93272	1.983583	26.37818	0.039806	0.199513
73.9	1.9	26.2	74.05738	2.083058	26.20932	0.058367	0.241592
73.9	1.9	26.2	74.09368	2.033932	26.27679	0.061346	0.247681
73.9	1.9	26.2	73.92458	1.930402	26.3551	0.025584	0.159951
73.9	1.9	26.2	74.04681	1.977958	26.20927	0.027716	0.166481
73.9	1.9	26.2	73.92736	2.025229	26.28739	0.024068	0.15514
73.9	1.9	26.2	74.07316	2.051356	26.31056	0.065118	0.255182
73.9	1.9	26.2	74.0074	1.984165	26.32423	0.034054	0.184537
73.9	1.9	26.2	74.04014	2.076851	26.35982	0.07646	0.276515
73.9	1.9	26.2	74.06029	2.059559	26.21172	0.051291	0.226474
73.9	1.9	26.2	73.90427	2.032988	26.22078	0.018136	0.13467
73.9	1.9	26.2	74.05345	1.99893	26.35781	0.058239	0.241328
73.9	1.9	26.2	73.92762	1.970716	26.22122	0.006214	0.078828
73.9	1.9	26.2	73.94585	1.912359	26.21103	0.002377	0.048751
73.9	1.9	26.2	73.91322	2.087274	26.32227	0.050197	0.224046

TABLE : 12 (3M1)

L1	a1	b1	L2	a2	b2	Square	Square root
73.4	1.8	15.4	73.56629	1.882246	15.54204	0.054593	0.233651
73.4	1.8	15.4	73.45866	1.873672	15.58051	0.041451	0.203596
73.4	1.8	15.4	73.50641	1.8612	15.45109	0.017678	0.132959
73.4	1.8	15.4	73.44649	1.805601	15.49508	0.011232	0.105981
73.4	1.8	15.4	73.49693	1.868769	15.49293	0.022761	0.150869
73.4	1.8	15.4	73.43226	1.816292	15.5294	0.01805	0.134351
73.4	1.8	15.4	73.46964	1.820394	15.56202	0.031517	0.177529
73.4	1.8	15.4	73.44894	1.841288	15.45676	0.007321	0.085564
73.4	1.8	15.4	73.5729	1.801476	15.53116	0.047102	0.21703
73.4	1.8	15.4	73.40953	1.864013	15.51225	0.016789	0.129572
73.4	1.8	15.4	73.41606	1.838737	15.5932	0.039085	0.1977
73.4	1.8	15.4	73.48195	1.853571	15.55411	0.033336	0.182582
73.4	1.8	15.4	73.5603	1.820928	15.55852	0.051265	0.226417
73.4	1.8	15.4	73.52926	1.854993	15.5659	0.047257	0.217386
73.4	1.8	15.4	73.48967	1.832781	15.55076	0.031843	0.178447
73.4	1.8	15.4	73.50874	1.820289	15.50649	0.023575	0.153541
73.4	1.8	15.4	73.56763	1.897918	15.5268	0.053766	0.231874
73.4	1.8	15.4	73.52274	1.885113	15.54486	0.043293	0.20807
73.4	1.8	15.4	73.49241	1.828481	15.57077	0.038514	0.19625
73.4	1.8	15.4	73.57731	1.859607	15.42789	0.035769	0.189128
73.4	1.8	15.4	73.59631	1.847482	15.43156	0.04179	0.204425
73.4	1.8	15.4	73.58399	1.802581	15.43976	0.035441	0.188259
73.4	1.8	15.4	73.50748	1.882078	15.48429	0.025395	0.159358
73.4	1.8	15.4	73.43859	1.814139	15.56267	0.02815	0.167779

TABLE : 13 (3M2)

L1	a1	b1	L2	a2	b2	Square	Square root
74.6	2	21.5	74.69488	2.017933	21.54203	0.01109	0.105311
74.6	2	21.5	74.62224	2.002612	21.60385	0.011286	0.106235
74.6	2	21.5	74.658	2.044049	21.63508	0.023551	0.153464
74.6	2	21.5	74.7427	2.062832	21.51505	0.024536	0.156641
74.6	2	21.5	74.64045	2.019173	21.68681	0.036904	0.192103
74.6	2	21.5	74.60269	2.045987	21.58874	0.009996	0.099982
74.6	2	21.5	74.61314	2.049784	21.62119	0.017337	0.131671
74.6	2	21.5	74.78193	2.001887	21.55096	0.035699	0.188942
74.6	2	21.5	74.60306	2.019253	21.65763	0.025229	0.158835
74.6	2	21.5	74.75757	2.062592	21.62463	0.044281	0.21043
74.6	2	21.5	74.78456	2.03882	21.60844	0.047326	0.217546
74.6	2	21.5	74.61146	2.006728	21.57167	0.005313	0.072894
74.6	2	21.5	74.74692	2.037955	21.64725	0.044709	0.211444
74.6	2	21.5	74.61552	2.080018	21.50532	0.006672	0.081683
74.6	2	21.5	74.73414	2.094127	21.51569	0.0271	0.164621
74.6	2	21.5	74.7571	2.047557	21.50705	0.026992	0.164292
74.6	2	21.5	74.7043	2.049236	21.68447	0.047332	0.21756
74.6	2	21.5	74.62865	2.032699	21.66653	0.029621	0.172107
74.6	2	21.5	74.71498	2.004307	21.65479	0.037199	0.192871
74.6	2	21.5	74.69515	2.020984	21.50604	0.00953	0.097623
74.6	2	21.5	74.75359	2.076376	21.54721	0.031651	0.177906
74.6	2	21.5	74.61478	2.032847	21.69325	0.038643	0.196579
74.6	2	21.5	74.73652	2.064482	21.51452	0.023006	0.151676

TABLE : 14 (3M3)

L1	a1	b1	L2	a2	b2	Square	Square root
75	2.6	27.9	75.19616	2.624021	27.97246	0.044305	0.210487
75	2.6	27.9	75.10812	2.649462	28.0354	0.032471	0.180198
75	2.6	27.9	75.12024	2.66483	27.98258	0.025479	0.159622
75	2.6	27.9	75.04526	2.609942	27.99791	0.011735	0.108326
75	2.6	27.9	75.13149	2.622459	27.96857	0.022497	0.149991
75	2.6	27.9	75.10633	2.699844	28.04405	0.042027	0.205004
75	2.6	27.9	75.1977	2.611021	28.04226	0.059444	0.243811
75	2.6	27.9	75.14946	2.640378	27.99455	0.032908	0.181406
75	2.6	27.9	75.06698	2.663805	27.9405	0.010198	0.100985
75	2.6	27.9	75.02586	2.613919	28.08073	0.033527	0.183105
75	2.6	27.9	75.00606	2.623763	27.92758	0.001362	0.036903
75	2.6	27.9	75.16417	2.698917	28.04602	0.058059	0.240954
75	2.6	27.9	75.0242	2.675949	27.95223	0.009081	0.095296
75	2.6	27.9	75.07525	2.661558	28.08254	0.042774	0.206819
75	2.6	27.9	75.09726	2.61566	28.00978	0.021756	0.147498
75	2.6	27.9	75.14842	2.682037	27.90033	0.028757	0.16958
75	2.6	27.9	75.06192	2.674973	27.90408	0.009471	0.097321
75	2.6	27.9	75.17346	2.688049	27.95045	0.040388	0.200968
75	2.6	27.9	75.16994	2.629735	27.9773	0.03574	0.189049
75	2.6	27.9	75.06143	2.612927	28.00237	0.01442	0.120085
75	2.6	27.9	75.16933	2.600059	28.02575	0.044488	0.210921
75	2.6	27.9	75.14007	2.671309	28.00926	0.036642	0.191422
75	2.6	27.9	75.16424	2.667412	28.05381	0.055175	0.234894
75	2.6	27.9	75.0877	2.677831	27.97776	0.019795	0.140695

TABLE : 15 (3R1.5)

L1	a1	b1	L2	a2	b2	Square	Square root
73.4	2.7	17.9	73.52697	2.787031	18.08191	0.056787	0.238301
73.4	2.7	17.9	73.45863	2.754521	17.97578	0.012152	0.110238
73.4	2.7	17.9	73.45146	2.732969	17.99145	0.012097	0.109986
73.4	2.7	17.9	73.41541	2.728301	17.98071	0.007552	0.086904
73.4	2.7	17.9	73.59083	2.722228	17.91814	0.037238	0.192972
73.4	2.7	17.9	73.51678	2.723265	17.91746	0.014484	0.120351
73.4	2.7	17.9	73.4685	2.745429	18.00696	0.018197	0.134897
73.4	2.7	17.9	73.46407	2.718587	17.92402	0.005027	0.070903
73.4	2.7	17.9	73.45078	2.734678	17.91988	0.004176	0.064625
73.4	2.7	17.9	73.40199	2.722276	18.00835	0.012239	0.110631
73.4	2.7	17.9	73.44852	2.705154	17.98143	0.009012	0.094929
73.4	2.7	17.9	73.52162	2.79374	18.03276	0.041204	0.202987
73.4	2.7	17.9	73.58665	2.788247	17.9255	0.043274	0.208025
73.4	2.7	17.9	73.59879	2.792806	18.07495	0.07874	0.280607
73.4	2.7	17.9	73.47037	2.743932	17.99814	0.016512	0.128501
73.4	2.7	17.9	73.43188	2.718087	18.00216	0.01178	0.108534
73.4	2.7	17.9	73.46325	2.735999	18.02584	0.021133	0.145371
73.4	2.7	17.9	73.47458	2.74548	18.01883	0.02175	0.147479
73.4	2.7	17.9	73.41444	2.758071	17.96721	0.008098	0.089991
73.4	2.7	17.9	73.48359	2.775684	17.92056	0.013139	0.114625
73.4	2.7	17.9	73.55132	2.743884	17.96842	0.029503	0.171765
73.4	2.7	17.9	73.57453	2.745717	18.07568	0.063414	0.251821
73.4	2.7	17.9	73.42907	2.778094	17.99991	0.016925	0.130097
73.4	2.7	17.9	73.51863	2.761713	17.92087	0.018317	0.135342
73.4	2.7	17.9	73.46671	2.737511	17.90025	0.005858	0.076535

TABLE : 16 (3R2.5)

L1	a1	b1	L2	a2	b2	Square	Square root
73.6	3.5	25.9	73.78721	3.589607	26.05778	0.06797	0.26071
73.6	3.5	25.9	73.62836	3.636139	26.0075	0.030894	0.175767
73.6	3.5	25.9	73.62432	3.666459	26.04985	0.050754	0.225287
73.6	3.5	25.9	73.61474	3.695635	26.09629	0.077019	0.277524
73.6	3.5	25.9	73.74604	3.517025	26.01457	0.034745	0.186401
73.6	3.5	25.9	73.70122	3.626576	25.92567	0.026926	0.16409
73.6	3.5	25.9	73.79292	3.513278	26.0714	0.066773	0.258406
73.6	3.5	25.9	73.79368	3.619604	25.93701	0.053186	0.230622
73.6	3.5	25.9	73.60475	3.536682	25.99724	0.010824	0.104039
73.6	3.5	25.9	73.70904	3.651485	26.07171	0.064323	0.253619
73.6	3.5	25.9	73.62242	3.629803	26.0213	0.032065	0.179068
73.6	3.5	25.9	73.77118	3.632102	25.95003	0.049258	0.221942
73.6	3.5	25.9	73.65717	3.540812	25.98073	0.011452	0.107016
73.6	3.5	25.9	73.73057	3.645466	25.96679	0.042671	0.206569
73.6	3.5	25.9	73.68548	3.647862	25.98439	0.036292	0.190505
73.6	3.5	25.9	73.62027	3.69132	26.02368	0.052312	0.228718
73.6	3.5	25.9	73.70475	3.690002	25.98029	0.05352	0.231344
73.6	3.5	25.9	73.78321	3.602087	25.99546	0.053102	0.230438
73.6	3.5	25.9	73.78536	3.569218	25.96783	0.04375	0.209165
73.6	3.5	25.9	73.71865	3.686533	25.95176	0.051553	0.227052
73.6	3.5	25.9	73.65902	3.646242	26.02488	0.040466	0.201162
73.6	3.5	25.9	73.67941	3.61982	26.02424	0.036098	0.189995
73.6	3.5	25.9	73.76602	3.598114	26.05987	0.062747	0.250493
73.6	3.5	25.9	73.78435	3.630959	26.08086	0.083846	0.289561

TABLE : 17 (4L1.5)

L1	a1	b1	L2	a2	b2	Square	Square root
69.2	2.8	21.7	69.20215	2.92113	21.78828	0.02247	0.149901
69.2	2.8	21.7	69.38484	2.938544	21.75075	0.055936	0.236507
69.2	2.8	21.7	69.32792	2.86436	21.77651	0.02636	0.162359
69.2	2.8	21.7	69.20016	2.831486	21.86788	0.029174	0.170803
69.2	2.8	21.7	69.3935	2.977256	21.89585	0.10722	0.327444
69.2	2.8	21.7	69.27599	2.946422	21.84662	0.04871	0.220703
69.2	2.8	21.7	69.28384	2.814476	21.77695	0.013159	0.114712
69.2	2.8	21.7	69.2807	2.818284	21.71429	0.007051	0.083969
69.2	2.8	21.7	69.24179	2.949072	21.74259	0.025784	0.160573
69.2	2.8	21.7	69.38296	2.911799	21.71195	0.046118	0.21475
69.2	2.8	21.7	69.35053	2.973751	21.75547	0.055927	0.236489
69.2	2.8	21.7	69.23576	2.868094	21.75751	0.009223	0.096039
69.2	2.8	21.7	69.31651	2.823385	21.83411	0.032106	0.179182
69.2	2.8	21.7	69.31652	2.968334	21.82188	0.056769	0.238262
69.2	2.8	21.7	69.38043	2.858802	21.88733	0.071104	0.266653
69.2	2.8	21.7	69.2721	2.95027	21.70109	0.027781	0.166677
69.2	2.8	21.7	69.21743	2.859171	21.74646	0.005964	0.077227
69.2	2.8	21.7	69.34901	2.936676	21.88659	0.075701	0.275139
69.2	2.8	21.7	69.38989	2.823587	21.76811	0.041255	0.203113
69.2	2.8	21.7	69.39968	2.810015	21.705	0.039996	0.199991
69.2	2.8	21.7	69.20026	2.80264	21.88455	0.034068	0.184574
69.2	2.8	21.7	69.21379	2.986812	21.82497	0.050706	0.225179
69.2	2.8	21.7	69.3663	2.820042	21.86908	0.056644	0.238
69.2	2.8	21.7	69.35072	2.948819	21.89362	0.082353	0.286972

TABLE : 18 (4L2.5)

L1	a1	b1	L2	a2	b2	Square	Square root
69.1	3.7	28.5	69.11074	3.89237	28.65303	0.060539	0.246047
69.1	3.7	28.5	69.23575	3.742201	28.69632	0.058752	0.242388
69.1	3.7	28.5	69.12688	3.800113	28.65614	0.035126	0.18742
69.1	3.7	28.5	69.15456	3.871878	28.63649	0.051149	0.226161
69.1	3.7	28.5	69.26356	3.714284	28.57135	0.032047	0.179018
69.1	3.7	28.5	69.114	3.820718	28.542	0.016533	0.128581
69.1	3.7	28.5	69.1552	3.700119	28.57184	0.008208	0.090596
69.1	3.7	28.5	69.12786	3.86973	28.64951	0.051937	0.227898
69.1	3.7	28.5	69.16943	3.762806	28.50395	0.008781	0.09371
69.1	3.7	28.5	69.24599	3.769957	28.57951	0.03253	0.180361
69.1	3.7	28.5	69.23166	3.839228	28.53886	0.038228	0.195521
69.1	3.7	28.5	69.29869	3.826924	28.53928	0.057129	0.239017
69.1	3.7	28.5	69.14047	3.819124	28.51047	0.015938	0.126245
69.1	3.7	28.5	69.12188	3.836928	28.55571	0.022331	0.149437
69.1	3.7	28.5	69.2267	3.863028	28.66513	0.069898	0.264383
69.1	3.7	28.5	69.16695	3.710605	28.61792	0.0185	0.136015
69.1	3.7	28.5	69.14676	3.774203	28.59	0.015792	0.125666
69.1	3.7	28.5	69.12011	3.7545	28.64827	0.02536	0.159247
69.1	3.7	28.5	69.13391	3.89544	28.65549	0.063525	0.252041
69.1	3.7	28.5	69.2268	3.838834	28.66768	0.06347	0.251933
69.1	3.7	28.5	69.22459	3.87336	28.50833	0.045646	0.213648
69.1	3.7	28.5	69.21979	3.88354	28.53144	0.049024	0.221414
69.1	3.7	28.5	69.13311	3.803733	28.53857	0.013345	0.115519
69.1	3.7	28.5	69.21211	3.864257	28.5419	0.041304	0.203234

TABLE : 19 (4M1)

L1	a1	b1	L2	a2	b2	Square	Square root
68.3	2.9	17	68.3761	2.981462	17.11237	0.025055	0.158289
68.3	2.9	17	68.38446	2.959429	17.0787	0.016859	0.129844
68.3	2.9	17	68.47016	2.907403	17.12013	0.043439	0.20842
68.3	2.9	17	68.4885	2.985701	17.01998	0.043275	0.208027
68.3	2.9	17	68.30467	2.978336	17.13183	0.023536	0.153416
68.3	2.9	17	68.49882	2.930446	17.05	0.042956	0.207258
68.3	2.9	17	68.43833	2.901362	17.183	0.052629	0.22941
68.3	2.9	17	68.33639	2.901605	17.00298	0.001336	0.036547
68.3	2.9	17	68.30286	2.987391	17.15702	0.0323	0.179722
68.3	2.9	17	68.30676	2.906333	17.18915	0.035863	0.189374
68.3	2.9	17	68.35098	2.993536	17.14988	0.033812	0.183881
68.3	2.9	17	68.44723	2.976325	17.01301	0.02767	0.166344
68.3	2.9	17	68.41864	2.991983	17.12305	0.037677	0.194105
68.3	2.9	17	68.38594	2.96155	17.17089	0.040377	0.20094
68.3	2.9	17	68.41692	2.931377	17.05036	0.01719	0.13111
68.3	2.9	17	68.40276	2.956438	17.04858	0.016105	0.126906
68.3	2.9	17	68.33938	2.971607	17.11819	0.020648	0.143695
68.3	2.9	17	68.37406	2.955593	17.14527	0.029678	0.172273
68.3	2.9	17	68.33579	2.957398	17.06369	0.008632	0.092908
68.3	2.9	17	68.47518	2.975636	17.07266	0.041687	0.204173
68.3	2.9	17	68.40826	2.904027	17.12499	0.027359	0.165404
68.3	2.9	17	68.41714	2.925122	17.05847	0.017772	0.13331
68.3	2.9	17	68.44323	2.950935	17.04026	0.02473	0.157259
68.3	2.9	17	68.45149	2.904472	17.00973	0.023065	0.15187

TABLE : 20 (4M2)

L1	a1	b1	L2	a2	b2	Square	Square root
70.1	3.7	23.7	70.20246	3.87195	23.76857	0.044768	0.211584
70.1	3.7	23.7	70.23283	3.840727	23.76727	0.041974	0.204875
70.1	3.7	23.7	70.23705	3.723732	23.79827	0.029001	0.170298
70.1	3.7	23.7	70.20008	3.707572	23.849	0.032274	0.179648
70.1	3.7	23.7	70.1282	3.891483	23.80018	0.047497	0.217937
70.1	3.7	23.7	70.21809	3.806141	23.7824	0.032001	0.17889
70.1	3.7	23.7	70.25739	3.71371	23.86902	0.053528	0.231361
70.1	3.7	23.7	70.1306	3.770972	23.71698	0.006262	0.079131
70.1	3.7	23.7	70.16675	3.746209	23.88369	0.040333	0.200831
70.1	3.7	23.7	70.11197	3.807449	23.85187	0.034753	0.186421
70.1	3.7	23.7	70.14235	3.773764	23.76482	0.011437	0.106944
70.1	3.7	23.7	70.24011	3.736268	23.82323	0.03613	0.190078
70.1	3.7	23.7	70.16995	3.854519	23.83948	0.048223	0.219597
70.1	3.7	23.7	70.17925	3.775898	23.74433	0.014007	0.118351
70.1	3.7	23.7	70.18733	3.894999	23.87615	0.07668	0.276911
70.1	3.7	23.7	70.24834	3.779264	23.72476	0.028899	0.169998
70.1	3.7	23.7	70.20911	3.768539	23.77	0.021502	0.146637
70.1	3.7	23.7	70.26665	3.80515	23.71683	0.039111	0.197765
70.1	3.7	23.7	70.1385	3.818345	23.74909	0.017898	0.133783
70.1	3.7	23.7	70.11916	3.866695	23.80801	0.039821	0.199552
70.1	3.7	23.7	70.2921	3.741192	23.77192	0.043773	0.20922
70.1	3.7	23.7	70.17391	3.809574	23.89857	0.0569	0.238537
70.1	3.7	23.7	70.15355	3.855714	23.89794	0.066296	0.25748
70.1	3.7	23.7	70.18983	3.847488	23.89368	0.067332	0.259484

TABLE : 21 (4M3)

L1	a1	b1	L2	a2	b2	Square	Square root
69.5	4.8	30.7	69.65099	4.810775	30.79594	0.032119	0.179217
69.5	4.8	30.7	69.5506	4.841328	30.78591	0.011649	0.107929
69.5	4.8	30.7	69.69146	4.874761	30.86175	0.068408	0.26155
69.5	4.8	30.7	69.66255	4.804025	30.82997	0.043332	0.208164
69.5	4.8	30.7	69.69381	4.899161	30.85094	0.07018	0.264915
69.5	4.8	30.7	69.54285	4.824388	30.88976	0.03844	0.19606
69.5	4.8	30.7	69.66164	4.809766	30.78391	0.033264	0.182383
69.5	4.8	30.7	69.58999	4.826548	30.88146	0.04173	0.204278
69.5	4.8	30.7	69.66191	4.895801	30.74704	0.037606	0.193923
69.5	4.8	30.7	69.55384	4.893128	30.71977	0.011962	0.109373
69.5	4.8	30.7	69.62961	4.822125	30.83335	0.03507	0.187271
69.5	4.8	30.7	69.55426	4.82542	30.74822	0.005915	0.076912
69.5	4.8	30.7	69.6172	4.845114	30.70536	0.015801	0.125702
69.5	4.8	30.7	69.53177	4.832094	30.89885	0.041581	0.203914
69.5	4.8	30.7	69.52824	4.829687	30.72906	0.002524	0.050235
69.5	4.8	30.7	69.60715	4.821561	30.78382	0.018972	0.137738
69.5	4.8	30.7	69.64027	4.819751	30.78719	0.027667	0.166334
69.5	4.8	30.7	69.53652	4.872395	30.73914	0.008107	0.090039
69.5	4.8	30.7	69.50024	4.839864	30.80059	0.011707	0.108197
69.5	4.8	30.7	69.59697	4.882765	30.7176	0.016563	0.128697
69.5	4.8	30.7	69.66225	4.839393	30.80168	0.038216	0.195488
69.5	4.8	30.7	69.69462	4.892172	30.72791	0.047151	0.217143
69.5	4.8	30.7	69.65361	4.830678	30.70231	0.024542	0.156659
69.5	4.8	30.7	69.53038	4.892935	30.71536	0.009796	0.098973

TABLE : 22 (4R1.5)

L1	a1	b1	L2	a2	b2	Square	Square root
69.6	4.3	20.8	69.79052	4.300544	20.9782	0.068052	0.260869
69.6	4.3	20.8	69.61881	4.354754	20.94002	0.022958	0.151519
69.6	4.3	20.8	69.74664	4.358275	20.8921	0.033381	0.182706
69.6	4.3	20.8	69.72352	4.32237	20.81929	0.01613	0.127004
69.6	4.3	20.8	69.70076	4.347622	20.80983	0.012518	0.111884
69.6	4.3	20.8	69.64802	4.301394	20.91307	0.015092	0.122851
69.6	4.3	20.8	69.61467	4.362447	20.91205	0.016671	0.129116
69.6	4.3	20.8	69.76737	4.339608	20.85516	0.032625	0.180623
69.6	4.3	20.8	69.6334	4.395182	20.98866	0.045769	0.213937
69.6	4.3	20.8	69.62304	4.30262	20.89552	0.009661	0.098292
69.6	4.3	20.8	69.71588	4.319705	20.9375	0.032722	0.180892
69.6	4.3	20.8	69.66491	4.333125	20.97453	0.035771	0.189133
69.6	4.3	20.8	69.70212	4.314749	20.95873	0.035841	0.189318
69.6	4.3	20.8	69.64114	4.359851	20.94307	0.025743	0.160445
69.6	4.3	20.8	69.69223	4.326319	20.87943	0.015508	0.124532
69.6	4.3	20.8	69.774	4.354808	20.86846	0.037966	0.194849
69.6	4.3	20.8	69.69241	4.399356	20.9457	0.039639	0.199096
69.6	4.3	20.8	69.69143	4.345806	20.92186	0.025307	0.159081
69.6	4.3	20.8	69.75896	4.336192	20.94622	0.047957	0.21899
69.6	4.3	20.8	69.72533	4.330515	20.86224	0.020513	0.143223
69.6	4.3	20.8	69.70383	4.390392	20.90168	0.029291	0.171146
69.6	4.3	20.8	69.66415	4.381123	20.94404	0.031444	0.177324
69.6	4.3	20.8	69.60174	4.331985	20.9807	0.033679	0.183518
69.6	4.3	20.8	69.62759	4.38418	20.90245	0.018343	0.135435
69.6	4.3	20.8	69.62977	4.350412	20.99899	0.043024	0.207421

TABLE : 23 (4R2.5)

L1	a1	b1	L2	a2	b2	Square	Square root
64.4	4.2	19.4	64.58532	4.266949	19.4137	0.039014	0.197519
64.4	4.2	19.4	64.43745	4.213397	19.40685	0.001629	0.040355
64.4	4.2	19.4	64.5922	4.223476	19.44649	0.039651	0.199126
64.4	4.2	19.4	64.53081	4.228382	19.56883	0.04642	0.215453
64.4	4.2	19.4	64.47701	4.303399	19.5958	0.054959	0.234433
64.4	4.2	19.4	64.41483	4.386623	19.41213	0.035195	0.187604
64.4	4.2	19.4	64.45154	4.375257	19.58292	0.066832	0.258518
64.4	4.2	19.4	64.48911	4.393251	19.46888	0.050031	0.223676
64.4	4.2	19.4	64.40203	4.384158	19.55706	0.058587	0.242048
64.4	4.2	19.4	64.47311	4.25873	19.49391	0.017613	0.132714
64.4	4.2	19.4	64.54066	4.357197	19.56639	0.072183	0.268669
64.4	4.2	19.4	64.58234	4.204921	19.49083	0.041523	0.203772
64.4	4.2	19.4	64.56681	4.204747	19.43303	0.028937	0.17011
64.4	4.2	19.4	64.58236	4.391838	19.48189	0.076763	0.277062
64.4	4.2	19.4	64.40855	4.213742	19.48861	0.008114	0.09008
64.4	4.2	19.4	64.51303	4.206867	19.42891	0.013659	0.116872
64.4	4.2	19.4	64.5995	4.366287	19.45463	0.070437	0.265399
64.4	4.2	19.4	64.56835	4.293121	19.42478	0.037629	0.193981
64.4	4.2	19.4	64.46535	4.358881	19.54527	0.050616	0.22498
64.4	4.2	19.4	64.58549	4.206207	19.47427	0.039961	0.199902
64.4	4.2	19.4	64.49542	4.358736	19.40235	0.034309	0.185226
64.4	4.2	19.4	64.47248	4.336126	19.44176	0.025528	0.159774
64.4	4.2	19.4	64.51806	4.23214	19.44134	0.016681	0.129154
64.4	4.2	19.4	64.41103	4.203458	19.48128	0.006739	0.082094
64.4	4.2	19.4	64.56052	4.282402	19.54419	0.053347	0.230969

TABLE : 24 (5M1)

L1	a1	b1	L2	a2	b2	Square	Square root
65.1	5.7	26.3	65.23575	5.7781	26.37324	0.029891	0.172891
65.1	5.7	26.3	65.13451	5.752649	26.40734	0.015485	0.124437
65.1	5.7	26.3	65.1576	5.719863	26.43394	0.021651	0.147144
65.1	5.7	26.3	65.20132	5.715043	26.48026	0.042985	0.207329
65.1	5.7	26.3	65.23747	5.779281	26.43658	0.043838	0.209376
65.1	5.7	26.3	65.249	5.738421	26.41216	0.036256	0.19041
65.1	5.7	26.3	65.1616	5.726045	26.40617	0.015745	0.125478
65.1	5.7	26.3	65.21922	5.75045	26.33025	0.017673	0.132941
65.1	5.7	26.3	65.10684	5.797158	26.4027	0.020033	0.141537
65.1	5.7	26.3	65.21072	5.747955	26.38172	0.021236	0.145727
65.1	5.7	26.3	65.15964	5.738254	26.49995	0.045	0.212131
65.1	5.7	26.3	65.25026	5.707891	26.31026	0.022746	0.150817
65.1	5.7	26.3	65.20957	5.765127	26.31124	0.016374	0.127963
65.1	5.7	26.3	65.10234	5.754135	26.40794	0.014588	0.12078
65.1	5.7	26.3	65.27965	5.740741	26.36335	0.037947	0.194799
65.1	5.7	26.3	65.17961	5.731513	26.3574	0.010625	0.103079
65.1	5.7	26.3	65.2787	5.790765	26.42686	0.056266	0.237205
65.1	5.7	26.3	65.17819	5.739524	26.43855	0.026872	0.163928
65.1	5.7	26.3	65.2169	5.750663	26.33436	0.017413	0.13196
65.1	5.7	26.3	65.2413	5.729784	26.44051	0.040595	0.201482
65.1	5.7	26.3	65.27925	5.719744	26.40058	0.042638	0.20649
65.1	5.7	26.3	65.29537	5.712063	26.49707	0.077152	0.277762
65.1	5.7	26.3	65.2773	5.78997	26.4169	0.053196	0.230642
65.1	5.7	26.3	65.18279	5.703972	26.34212	0.008644	0.092972

TABLE : 25 (5M2)

L1	a1	b1	L2	a2	b2	Square	Square root
65.9	7	33.4	65.98288	7.103494	33.54141	0.037576	0.193844
65.9	7	33.4	65.99927	7.112417	33.44351	0.024385	0.156157
65.9	7	33.4	66.06161	7.175146	33.44838	0.059136	0.243178
65.9	7	33.4	65.94644	7.115015	33.4676	0.019955	0.141262
65.9	7	33.4	65.92011	7.152696	33.52308	0.038869	0.197151
65.9	7	33.4	66.0422	7.014477	33.50179	0.03079	0.175472
65.9	7	33.4	65.96373	7.155942	33.51637	0.041922	0.204747
65.9	7	33.4	66.05625	7.049627	33.50261	0.037405	0.193403
65.9	7	33.4	66.00551	7.192716	33.53331	0.066044	0.25699
65.9	7	33.4	66.03368	7.156795	33.57929	0.0746	0.273131
65.9	7	33.4	66.03242	7.072011	33.59067	0.059076	0.243055
65.9	7	33.4	66.04291	7.047933	33.45897	0.026199	0.161862
65.9	7	33.4	65.94505	7.100646	33.55787	0.037083	0.192569
65.9	7	33.4	65.96763	7.069001	33.57453	0.039793	0.199483
65.9	7	33.4	65.93152	7.189002	33.53814	0.055799	0.236218
65.9	7	33.4	65.91597	7.1858	33.47176	0.039926	0.199816
65.9	7	33.4	65.98263	7.055044	33.54379	0.030532	0.174734
65.9	7	33.4	66.05487	7.084086	33.53599	0.049547	0.222592
65.9	7	33.4	65.90158	7.021797	33.44249	0.002283	0.04778
65.9	7	33.4	66.09224	7.035481	33.45833	0.041618	0.204004
65.9	7	33.4	66.03683	7.077469	33.56422	0.051692	0.227359
65.9	7	33.4	66.00849	7.197861	33.46869	0.055637	0.235874
65.9	7	33.4	65.96506	7.069867	33.52708	0.025263	0.158943
65.9	7	33.4	66.00896	7.014967	33.53573	0.03052	0.174699

TABLE : 26 (5M3)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
65.9	7	33.4	66.02493	7.114209	33.40353	0.028662	0.1693
65.9	7	33.4	65.98288	7.103494	33.54141	0.037576	0.193844
65.9	7	33.4	65.99927	7.112417	33.44351	0.024385	0.156157
65.9	7	33.4	66.06161	7.175146	33.44838	0.059136	0.243178
65.9	7	33.4	65.94644	7.115015	33.4676	0.019955	0.141262
65.9	7	33.4	65.92011	7.152696	33.52308	0.038869	0.197151
65.9	7	33.4	66.0422	7.014477	33.50179	0.03079	0.175472
65.9	7	33.4	65.96373	7.155942	33.51637	0.041922	0.204747
65.9	7	33.4	66.05625	7.049627	33.50261	0.037405	0.193403
65.9	7	33.4	66.00551	7.192716	33.53331	0.066044	0.25699
65.9	7	33.4	66.03368	7.156795	33.57929	0.0746	0.273131
65.9	7	33.4	66.03242	7.072011	33.59067	0.059076	0.243055
65.9	7	33.4	66.04291	7.047933	33.45897	0.026199	0.161862
65.9	7	33.4	65.94505	7.100646	33.55787	0.037083	0.192569
65.9	7	33.4	65.96763	7.069001	33.57453	0.039793	0.199483
65.9	7	33.4	65.93152	7.189002	33.53814	0.055799	0.236218
65.9	7	33.4	65.91597	7.1858	33.47176	0.039926	0.199816
65.9	7	33.4	65.98263	7.055044	33.54379	0.030532	0.174734
65.9	7	33.4	66.05487	7.084086	33.53599	0.049547	0.222592
65.9	7	33.4	65.90158	7.021797	33.44249	0.002283	0.04778
65.9	7	33.4	66.09224	7.035481	33.45833	0.041618	0.204004
65.9	7	33.4	66.03683	7.077469	33.56422	0.051692	0.227359
65.9	7	33.4	66.00849	7.197861	33.46869	0.055637	0.235874
65.9	7	33.4	65.96506	7.069867	33.52708	0.025263	0.158943
65.9	7	33.4	66.00896	7.014967	33.53573	0.03052	0.174699

(STANDARD DEVIATION) For Vita Classic Shade Guide

TABLE: 27 (A1)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
82.4	-1.4	14.3	82.56666	-1.3747	14.38879	0.0363	0.190525
82.4	-1.4	14.3	82.46708	-1.33637	14.36124	0.012299	0.110902
82.4	-1.4	14.3	82.58841	-1.36641	14.43188	0.054021	0.232425
82.4	-1.4	14.3	82.48122	-1.31144	14.31949	0.014821	0.121741
82.4	-1.4	14.3	82.55913	-1.39363	14.47435	0.05576	0.236135
82.4	-1.4	14.3	82.49787	-1.36994	14.48252	0.043795	0.209272
82.4	-1.4	14.3	82.55642	-1.33553	14.44396	0.049349	0.222146
82.4	-1.4	14.3	82.47566	-1.33244	14.40257	0.020808	0.144249
82.4	-1.4	14.3	82.46358	-1.30484	14.36179	0.016915	0.130057
82.4	-1.4	14.3	82.44609	-1.36685	14.46074	0.029062	0.170475
82.4	-1.4	14.3	82.53127	-1.38223	14.42702	0.033681	0.183523
82.4	-1.4	14.3	82.52629	-1.39659	14.40442	0.026864	0.163902
82.4	-1.4	14.3	82.49601	-1.31677	14.49102	0.052636	0.229425
82.4	-1.4	14.3	82.47775	-1.31336	14.36359	0.017595	0.132646
82.4	-1.4	14.3	82.55002	-1.3573	14.33611	0.025632	0.160101
82.4	-1.4	14.3	82.58563	-1.32977	14.45884	0.064621	0.254208
82.4	-1.4	14.3	82.44941	-1.38905	14.4728	0.03242	0.180055
82.4	-1.4	14.3	82.50316	-1.33087	14.36358	0.019463	0.139508
82.4	-1.4	14.3	82.43196	-1.32749	14.36542	0.01056	0.102762
82.4	-1.4	14.3	82.53748	-1.34376	14.48793	0.057383	0.239548
82.4	-1.4	14.3	82.42284	-1.39086	14.40084	0.010774	0.103797
82.4	-1.4	14.3	82.41661	-1.37534	14.32563	0.001541	0.039257
82.4	-1.4	14.3	82.47664	-1.33857	14.44452	0.030535	0.174742
82.4	-1.4	14.3	82.56147	-1.36137	14.49526	0.06569	0.2563

TABLE : 28 (A2)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
79.1	0.6	19.2	79.16026	0.665996	19.29367	0.016761	0.129463
79.1	0.6	19.2	79.2777	0.638499	19.20595	0.033096	0.181922
79.1	0.6	19.2	79.27865	0.649357	19.35205	0.057472	0.239732
79.1	0.6	19.2	79.20133	0.647387	19.28126	0.019118	0.138268
79.1	0.6	19.2	79.22731	0.683856	19.38193	0.056339	0.237358
79.1	0.6	19.2	79.2957	0.607775	19.31504	0.051595	0.227146
79.1	0.6	19.2	79.14211	0.630569	19.21011	0.00281	0.053007
79.1	0.6	19.2	79.28714	0.622668	19.31688	0.049198	0.221807
79.1	0.6	19.2	79.25037	0.610444	19.34082	0.042552	0.206282
79.1	0.6	19.2	79.10375	0.6013	19.2692	0.004804	0.069311
79.1	0.6	19.2	79.23867	0.668515	19.34699	0.045532	0.213382
79.1	0.6	19.2	79.21453	0.634994	19.32466	0.029881	0.172861
79.1	0.6	19.2	79.11374	0.642083	19.32273	0.017023	0.130472
79.1	0.6	19.2	79.15827	0.625145	19.31851	0.018072	0.134434
79.1	0.6	19.2	79.20621	0.676419	19.34544	0.038273	0.195636
79.1	0.6	19.2	79.26461	0.640847	19.31301	0.041535	0.203803
79.1	0.6	19.2	79.22618	0.679156	19.37478	0.052734	0.22964
79.1	0.6	19.2	79.13191	0.656324	19.28165	0.010857	0.104197
79.1	0.6	19.2	79.26184	0.667425	19.34797	0.052634	0.22942
79.1	0.6	19.2	79.22623	0.636677	19.27228	0.022504	0.150012
79.1	0.6	19.2	79.13194	0.616316	19.2667	0.005735	0.075733
79.1	0.6	19.2	79.25682	0.673946	19.28734	0.03769	0.194138
79.1	0.6	19.2	79.23557	0.656948	19.37333	0.051667	0.227304
79.1	0.6	19.2	79.15655	0.632353	19.26299	0.008212	0.090619

TABLE : 29 (A3)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
73.4	2.3	24.5	73.40361	2.358046	24.51054	0.003494	0.059106
73.4	2.3	24.5	73.47785	2.377212	24.66225	0.038349	0.195828
73.4	2.3	24.5	73.42875	2.321477	24.67685	0.032562	0.180451
73.4	2.3	24.5	73.41071	2.332875	24.6648	0.028355	0.168389
73.4	2.3	24.5	73.54534	2.375376	24.56862	0.031515	0.177524
73.4	2.3	24.5	73.4212	2.344182	24.52143	0.002861	0.053487
73.4	2.3	24.5	73.58294	2.315057	24.67052	0.062771	0.250542
73.4	2.3	24.5	73.46204	2.346246	24.66153	0.032079	0.179105
73.4	2.3	24.5	73.54536	2.316048	24.56984	0.026265	0.162066
73.4	2.3	24.5	73.5071	2.342086	24.50118	0.013243	0.115079
73.4	2.3	24.5	73.58706	2.330531	24.53277	0.036997	0.192346
73.4	2.3	24.5	73.49158	2.301619	24.61254	0.021055	0.145104
73.4	2.3	24.5	73.43853	2.398114	24.65637	0.035562	0.188579
73.4	2.3	24.5	73.53219	2.350395	24.61125	0.032392	0.179978
73.4	2.3	24.5	73.40733	2.386457	24.68075	0.040197	0.200493
73.4	2.3	24.5	73.53342	2.366043	24.68085	0.05487	0.234243
73.4	2.3	24.5	73.45899	2.363085	24.55591	0.010585	0.102885
73.4	2.3	24.5	73.4601	2.383652	24.5177	0.010923	0.104513
73.4	2.3	24.5	73.4421	2.34809	24.50184	0.004088	0.06394
73.4	2.3	24.5	73.56417	2.327749	24.61067	0.039968	0.199921
73.4	2.3	24.5	73.49782	2.367516	24.63983	0.033679	0.183518
73.4	2.3	24.5	73.55126	2.356371	24.64038	0.045766	0.213929
73.4	2.3	24.5	73.55379	2.330398	24.58374	0.031588	0.177731
73.4	2.3	24.5	73.48589	2.361323	24.63876	0.030391	0.17433
73.4	2.3	24.5	73.5637	2.305813	24.60164	0.03716	0.19277

TABLE : 30 (A3.5)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
77.6	1	21	77.68251	1.048161	21.01726	0.009425	0.097084
77.6	1	21	77.66942	1.08081	21.16427	0.038334	0.19579
77.6	1	21	77.76765	1.092466	21.06285	0.040607	0.201511
77.6	1	21	77.64546	1.084312	21.10665	0.020549	0.143351
77.6	1	21	77.6727	1.019093	21.09854	0.015361	0.12394
77.6	1	21	77.64623	1.083017	21.19948	0.048823	0.220959
77.6	1	21	77.76426	1.020428	21.16277	0.053894	0.23215
77.6	1	21	77.72601	1.015564	21.11651	0.029697	0.172329
77.6	1	21	77.67693	1.040574	21.04615	0.009694	0.098458
77.6	1	21	77.77927	1.099146	21.06347	0.045997	0.214468
77.6	1	21	77.63164	1.032004	21.00404	0.002042	0.045188
77.6	1	21	77.7164	1.086709	21.09003	0.029173	0.1708
77.6	1	21	77.70061	1.009838	21.12158	0.024999	0.158112
77.6	1	21	77.61605	1.090041	21.18691	0.0433	0.208088
77.6	1	21	77.72045	1.062032	21.16194	0.044579	0.211138
77.6	1	21	77.6695	1.074282	21.00515	0.010374	0.101853
77.6	1	21	77.74665	1.008286	21.07458	0.027136	0.164731
77.6	1	21	77.72584	1.069977	21.0337	0.021869	0.147883
77.6	1	21	77.71089	1.038203	21.06601	0.018112	0.134581
77.6	1	21	77.67089	1.068046	21.01971	0.010045	0.100224
77.6	1	21	77.77115	1.095788	21.19304	0.075731	0.275193
77.6	1	21	77.73938	1.089351	21.12046	0.04192	0.204744
77.6	1	21	77.61264	1.024492	21.03694	0.002124	0.046087
77.6	1	21	77.78493	1.050837	21.13062	0.053847	0.23205

TABLE : 31 (A4)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
69	2.4	25.4	69.05907	2.566732	25.57848	0.063143	0.251283
69	2.4	25.4	69.01626	2.599543	25.46967	0.044936	0.211981
69	2.4	25.4	69.09832	2.423394	25.49791	0.0198	0.140714
69	2.4	25.4	69.09714	2.421395	25.46717	0.014406	0.120024
69	2.4	25.4	69.00823	2.599822	25.51784	0.053883	0.232128
69	2.4	25.4	69.18541	2.435568	25.40152	0.035646	0.188801
69	2.4	25.4	69.01001	2.401112	25.59278	0.037264	0.19304
69	2.4	25.4	69.13945	2.567671	25.55714	0.072254	0.268801
69	2.4	25.4	69.08104	2.53197	25.59072	0.060359	0.245681
69	2.4	25.4	69.10675	2.503906	25.54856	0.044263	0.210388
69	2.4	25.4	69.12064	2.444506	25.40411	0.016552	0.128656
69	2.4	25.4	69.17056	2.546226	25.59161	0.087187	0.295274
69	2.4	25.4	69.0424	2.426948	25.45382	0.005421	0.073628
69	2.4	25.4	69.18213	2.502761	25.59167	0.080468	0.283669
69	2.4	25.4	69.0747	2.435071	25.57504	0.037449	0.193516
69	2.4	25.4	69.0576	2.52011	25.43048	0.018673	0.136649
69	2.4	25.4	69.05568	2.497624	25.58157	0.045598	0.213537
69	2.4	25.4	69.05852	2.556915	25.449	0.030448	0.174492
69	2.4	25.4	69.04015	2.464061	25.40992	0.005814	0.076249
69	2.4	25.4	69.01775	2.586472	25.43018	0.035998	0.189731
69	2.4	25.4	69.1822	2.475575	25.43943	0.040463	0.201154
69	2.4	25.4	69.13871	2.473086	25.58844	0.060092	0.245138
69	2.4	25.4	69.15787	2.525317	25.463	0.044596	0.211178
69	2.4	25.4	69.02749	2.503681	25.40082	0.011506	0.107266

TABLE : 32 (B1)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
80.1	-1	18.2	80.2921	-0.83978	18.22377	0.063136	0.251269
80.1	-1	18.2	80.26129	-0.93275	18.26202	0.034383	0.185425
80.1	-1	18.2	80.24154	-0.82765	18.24516	0.051777	0.227547
80.1	-1	18.2	80.10759	-0.89821	18.29571	0.019579	0.139926
80.1	-1	18.2	80.23177	-0.9978	18.25842	0.020781	0.144155
80.1	-1	18.2	80.13765	-0.95545	18.20635	0.003443	0.058676
80.1	-1	18.2	80.16129	-0.81017	18.21058	0.039904	0.199759
80.1	-1	18.2	80.17252	-0.8882	18.23372	0.018896	0.137463
80.1	-1	18.2	80.28957	-0.80303	18.21821	0.075064	0.273979
80.1	-1	18.2	80.19628	-0.88425	18.27516	0.028318	0.168279
80.1	-1	18.2	80.15835	-0.87362	18.25607	0.022521	0.150069
80.1	-1	18.2	80.20362	-0.89609	18.2813	0.028145	0.167765
80.1	-1	18.2	80.14218	-0.92048	18.20712	0.008152	0.09029
80.1	-1	18.2	80.11207	-0.8311	18.2084	0.028742	0.169536
80.1	-1	18.2	80.15007	-0.86511	18.24669	0.022881	0.151264
80.1	-1	18.2	80.23795	-0.8448	18.29876	0.05287	0.229935
80.1	-1	18.2	80.13742	-0.84252	18.21979	0.026591	0.163067
80.1	-1	18.2	80.15917	-0.98506	18.26597	0.008076	0.089869
80.1	-1	18.2	80.29025	-0.97843	18.29294	0.045299	0.212835
80.1	-1	18.2	80.27588	-0.82305	18.29393	0.071069	0.266587
80.1	-1	18.2	80.22247	-0.93223	18.26807	0.024227	0.15565
80.1	-1	18.2	80.21051	-0.91398	18.27791	0.025681	0.160253
80.1	-1	18.2	80.23984	-0.81535	18.23971	0.055229	0.235008
80.1	-1	18.2	80.13747	-0.98872	18.27891	0.007758	0.088082

TABLE : 33 (B2)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
74.8	0.9	25	74.80338	0.923918	25.25757	0.066926	0.258701
74.8	0.9	25	74.80951	0.965382	25.14458	0.025268	0.158959
74.8	0.9	25	74.93391	0.960667	25.19321	0.058942	0.24278
74.8	0.9	25	74.88866	0.954301	25.09737	0.020288	0.142438
74.8	0.9	25	74.93059	0.962393	25.26593	0.091668	0.302766
74.8	0.9	25	74.81396	0.932276	25.17752	0.03275	0.18097
74.8	0.9	25	74.98367	0.968554	25.26862	0.110594	0.332557
74.8	0.9	25	74.99005	0.937784	25.17361	0.067687	0.260167
74.8	0.9	25	74.99254	0.919521	25.05891	0.040923	0.202295
74.8	0.9	25	74.86532	0.994808	25.13346	0.031067	0.176259
74.8	0.9	25	74.96702	0.991264	25.0011	0.036227	0.190335
74.8	0.9	25	74.98884	0.954737	25.28789	0.121534	0.348618
74.8	0.9	25	74.80995	0.932517	25.14844	0.023192	0.152289
74.8	0.9	25	74.9526	0.935841	25.04842	0.026917	0.164065
74.8	0.9	25	74.98444	0.989796	25.2736	0.116937	0.341961
74.8	0.9	25	74.88167	0.989844	25.03511	0.015974	0.126387
74.8	0.9	25	74.89563	0.90125	25.14054	0.028897	0.169992
74.8	0.9	25	74.89992	0.902965	25.02086	0.010428	0.102116
74.8	0.9	25	74.84466	0.945079	25.19139	0.040657	0.201636
74.8	0.9	25	74.87562	0.917271	25.2161	0.052715	0.229597
74.8	0.9	25	74.84598	0.932606	25.27266	0.077519	0.278423
74.8	0.9	25	74.93083	0.981335	25.19124	0.060303	0.245567
74.8	0.9	25	74.85165	0.937669	25.04921	0.006509	0.080678
74.8	0.9	25	74.93297	0.90814	25.2481	0.0793	0.281603

TABLE : 34 (B3)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
75.5	1	26.1	75.52569	1.075222	26.17817	0.012429	0.111487
75.5	1	26.1	75.64053	1.005257	26.12379	0.020343	0.142628
75.5	1	26.1	75.60359	1.0032	26.22379	0.026065	0.161446
75.5	1	26.1	75.69736	1.092391	26.2102	0.059632	0.244196
75.5	1	26.1	75.50859	1.029645	26.15491	0.003968	0.062991
75.5	1	26.1	75.57951	1.168623	26.16057	0.038425	0.196022
75.5	1	26.1	75.5184	1.062642	26.15207	0.006974	0.083512
75.5	1	26.1	75.56742	1.062576	26.19963	0.018389	0.135604
75.5	1	26.1	75.52632	1.075994	26.14096	0.008146	0.090255
75.5	1	26.1	75.61357	1.003731	26.19088	0.021172	0.145506
75.5	1	26.1	75.54597	1.026863	26.26478	0.029988	0.173169
75.5	1	26.1	75.51509	1.178762	26.10677	0.03223	0.179526
75.5	1	26.1	75.50266	1.016948	26.1948	0.009281	0.096335
75.5	1	26.1	75.55393	1.024678	26.13933	0.005064	0.071161
75.5	1	26.1	75.62329	1.188801	26.19585	0.060035	0.245021
75.5	1	26.1	75.51759	1.152521	26.28972	0.059566	0.244062
75.5	1	26.1	75.57187	1.016099	26.24457	0.026324	0.162245
75.5	1	26.1	75.53979	1.128177	26.17118	0.023079	0.151919
75.5	1	26.1	75.586	1.047218	26.26221	0.035938	0.189574
75.5	1	26.1	75.62309	1.034294	26.11794	0.01665	0.129035
75.5	1	26.1	75.52323	1.097249	26.13472	0.011202	0.10584
75.5	1	26.1	75.53525	1.042799	26.18489	0.01028	0.10139
75.5	1	26.1	75.67117	1.146946	26.24953	0.073252	0.270651
75.5	1	26.1	75.68944	1.158041	26.22865	0.077414	0.278234

TABLE : 35 (B4)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
76.6	-0.7	14.2	76.75961	-0.68342	14.2852	0.033008	0.181682
76.6	-0.7	14.2	76.78475	-0.6242	14.3702	0.068844	0.262382
76.6	-0.7	14.2	76.64453	-0.61617	14.28018	0.01544	0.124256
76.6	-0.7	14.2	76.635	-0.64022	14.31619	0.018297	0.135268
76.6	-0.7	14.2	76.65246	-0.64392	14.20746	0.005953	0.077156
76.6	-0.7	14.2	76.67125	-0.62118	14.33021	0.028244	0.168059
76.6	-0.7	14.2	76.71766	-0.68939	14.2073	0.014009	0.118361
76.6	-0.7	14.2	76.60132	-0.6577	14.3646	0.028886	0.169958
76.6	-0.7	14.2	76.71906	-0.65492	14.29975	0.026158	0.161734
76.6	-0.7	14.2	76.76862	-0.69715	14.26439	0.032587	0.180518
76.6	-0.7	14.2	76.61822	-0.60418	14.22006	0.009916	0.099578
76.6	-0.7	14.2	76.71739	-0.66106	14.35589	0.0396	0.198998
76.6	-0.7	14.2	76.63849	-0.60579	14.21991	0.010752	0.103694
76.6	-0.7	14.2	76.62712	-0.67932	14.28206	0.007897	0.088865
76.6	-0.7	14.2	76.69312	-0.60436	14.27249	0.023073	0.151897
76.6	-0.7	14.2	76.74559	-0.64043	14.38214	0.057921	0.240667
76.6	-0.7	14.2	76.64809	-0.68708	14.20499	0.002505	0.050048
76.6	-0.7	14.2	76.64756	-0.60702	14.33284	0.028554	0.168981
76.6	-0.7	14.2	76.67958	-0.65952	14.23951	0.009534	0.097641
76.6	-0.7	14.2	76.70912	-0.66983	14.24913	0.015231	0.123414
76.6	-0.7	14.2	76.61446	-0.68082	14.34589	0.02186	0.147853
76.6	-0.7	14.2	76.72377	-0.61224	14.30609	0.034275	0.185136
76.6	-0.7	14.2	76.67013	-0.61022	14.27012	0.017896	0.133777
76.6	-0.7	14.2	76.66069	-0.69204	14.2324	0.004797	0.069258

TABLE : 36 (C1)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
72.7	0.2	20	72.78176	0.261037	20.09013	0.018534	0.018534
72.7	0.2	20	72.79739	0.218998	20.18482	0.044003	0.044003
72.7	0.2	20	72.76043	0.249352	20.00165	0.00609	0.00609
72.7	0.2	20	72.86952	0.214225	20.03081	0.029888	0.029888
72.7	0.2	20	72.78342	0.200205	20.14991	0.029431	0.029431
72.7	0.2	20	72.88644	0.254882	20.03426	0.038946	0.038946
72.7	0.2	20	72.82368	0.245807	20.03472	0.018601	0.018601
72.7	0.2	20	72.77999	0.275201	20.13605	0.030563	0.030563
72.7	0.2	20	72.84754	0.226439	20.15173	0.045488	0.045488
72.7	0.2	20	72.89523	0.20062	20.16273	0.064598	0.064598
72.7	0.2	20	72.74776	0.261067	20.05871	0.009457	0.009457
72.7	0.2	20	72.86929	0.218803	20.17796	0.060683	0.060683
72.7	0.2	20	72.7988	0.287224	20.0316	0.018368	0.018368
72.7	0.2	20	72.8027	0.227178	20.11084	0.023572	0.023572
72.7	0.2	20	72.70157	0.268862	20.0278	0.005517	0.005517
72.7	0.2	20	72.80934	0.217072	20.07406	0.017732	0.017732
72.7	0.2	20	72.81601	0.204448	20.0127	0.013639	0.013639
72.7	0.2	20	72.74407	0.247429	20.14489	0.025185	0.025185
72.7	0.2	20	72.72072	0.244805	20.17815	0.034175	0.034175
72.7	0.2	20	72.73155	0.22166	20.04488	0.003479	0.003479
72.7	0.2	20	72.76614	0.264273	20.05583	0.011623	0.011623
72.7	0.2	20	72.81684	0.212053	20.11032	0.025969	0.025969
72.7	0.2	20	72.80139	0.228879	20.16821	0.039408	0.039408
72.7	0.2	20	72.71691	0.202107	20.17288	0.030179	0.030179

TABLE : 37 (C2)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
70.5	0.8	19.1	70.55047	0.878365	19.27041	0.037728	0.194237
70.5	0.8	19.1	70.52156	0.806328	19.15666	0.003715	0.060953
70.5	0.8	19.1	70.52269	0.887975	19.23114	0.025453	0.159539
70.5	0.8	19.1	70.6142	0.825382	19.21147	0.026111	0.161588
70.5	0.8	19.1	70.6661	0.818448	19.17731	0.033906	0.184136
70.5	0.8	19.1	70.50649	0.854582	19.20973	0.015063	0.12273
70.5	0.8	19.1	70.56829	0.823072	19.27032	0.034205	0.184945
70.5	0.8	19.1	70.55942	0.849774	19.17984	0.012383	0.111277
70.5	0.8	19.1	70.65806	0.828355	19.18699	0.033353	0.182629
70.5	0.8	19.1	70.50915	0.884151	19.29934	0.046901	0.216567
70.5	0.8	19.1	70.67727	0.837865	19.2173	0.046617	0.215909
70.5	0.8	19.1	70.61927	0.825097	19.24922	0.037122	0.192671
70.5	0.8	19.1	70.58087	0.863164	19.12661	0.011238	0.106009
70.5	0.8	19.1	70.5515	0.889339	19.29387	0.048219	0.219589
70.5	0.8	19.1	70.56749	0.8187	19.27428	0.035277	0.187821
70.5	0.8	19.1	70.667	0.830382	19.21156	0.041259	0.203124
70.5	0.8	19.1	70.61042	0.82247	19.13194	0.013719	0.117126
70.5	0.8	19.1	70.55514	0.87005	19.15738	0.011239	0.106016
70.5	0.8	19.1	70.56502	0.818679	19.26234	0.030929	0.175866
70.5	0.8	19.1	70.62538	0.865349	19.15183	0.022678	0.150591
70.5	0.8	19.1	70.58258	0.83987	19.20462	0.019355	0.139122
70.5	0.8	19.1	70.57832	0.867171	19.2403	0.030328	0.17415
70.5	0.8	19.1	70.58187	0.881077	19.28169	0.046285	0.21514
70.5	0.8	19.1	70.53308	0.811979	19.11811	0.001566	0.039572

TABLE : 38 (C3)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
64.2	2.6	22.1	64.39163	2.706223	22.1319	0.049024	0.221413
64.2	2.6	22.1	64.23182	2.717125	22.11948	0.01511	0.122924
64.2	2.6	22.1	64.22643	2.731275	22.15481	0.020936	0.144693
64.2	2.6	22.1	64.21084	2.764016	22.12123	0.02747	0.16574
64.2	2.6	22.1	64.30842	2.6791	22.26717	0.045957	0.214376
64.2	2.6	22.1	64.25471	2.602111	22.20055	0.013109	0.114493
64.2	2.6	22.1	64.35591	2.78055	22.14475	0.05891	0.242713
64.2	2.6	22.1	64.34809	2.639936	22.12862	0.024346	0.156033
64.2	2.6	22.1	64.38231	2.620425	22.24988	0.056118	0.236892
64.2	2.6	22.1	64.2563	2.775775	22.25681	0.058657	0.242192
64.2	2.6	22.1	64.27808	2.740931	22.27111	0.055238	0.235028
64.2	2.6	22.1	64.20257	2.724578	22.11208	0.015672	0.125189
64.2	2.6	22.1	64.31099	2.744313	22.24081	0.052974	0.23016
64.2	2.6	22.1	64.39159	2.726031	22.28777	0.087847	0.29639
64.2	2.6	22.1	64.29587	2.650393	22.1506	0.01429	0.119542
64.2	2.6	22.1	64.33247	2.658507	22.18983	0.029041	0.170413
64.2	2.6	22.1	64.28739	2.739907	22.24955	0.049577	0.222659
64.2	2.6	22.1	64.31852	2.715616	22.23421	0.045429	0.21314
64.2	2.6	22.1	64.20049	2.760817	22.24495	0.046873	0.216502
64.2	2.6	22.1	64.32789	2.721175	22.19144	0.0394	0.198494
64.2	2.6	22.1	64.31241	2.786026	22.16398	0.051334	0.22657
64.2	2.6	22.1	64.28945	2.642879	22.26089	0.035727	0.189016
64.2	2.6	22.1	64.27139	2.754476	22.25655	0.053467	0.231229
64.2	2.6	22.1	64.33969	2.68521	22.21781	0.040651	0.201622

TABLE : 39 (C4)

L1	a1	b1	L2	a2	b2	Square	Square root
73.4	1.8	15.4	73.56629	1.882246	15.54204	0.054593	0.233651
73.4	1.8	15.4	73.45866	1.873672	15.58051	0.041451	0.203596
73.4	1.8	15.4	73.50641	1.8612	15.45109	0.017678	0.132959
73.4	1.8	15.4	73.44649	1.805601	15.49508	0.011232	0.105981
73.4	1.8	15.4	73.49693	1.868769	15.49293	0.022761	0.150869
73.4	1.8	15.4	73.43226	1.816292	15.5294	0.01805	0.134351
73.4	1.8	15.4	73.46964	1.820394	15.56202	0.031517	0.177529
73.4	1.8	15.4	73.44894	1.841288	15.45676	0.007321	0.085564
73.4	1.8	15.4	73.5729	1.801476	15.53116	0.047102	0.21703
73.4	1.8	15.4	73.40953	1.864013	15.51225	0.016789	0.129572
73.4	1.8	15.4	73.41606	1.838737	15.5932	0.039085	0.1977
73.4	1.8	15.4	73.48195	1.853571	15.55411	0.033336	0.182582
73.4	1.8	15.4	73.5603	1.820928	15.55852	0.051265	0.226417
73.4	1.8	15.4	73.52926	1.854993	15.5659	0.047257	0.217386
73.4	1.8	15.4	73.48967	1.832781	15.55076	0.031843	0.178447
73.4	1.8	15.4	73.50874	1.820289	15.50649	0.023575	0.153541
73.4	1.8	15.4	73.56763	1.897918	15.5268	0.053766	0.231874
73.4	1.8	15.4	73.52274	1.885113	15.54486	0.043293	0.20807
73.4	1.8	15.4	73.49241	1.828481	15.57077	0.038514	0.19625
73.4	1.8	15.4	73.57731	1.859607	15.42789	0.035769	0.189128
73.4	1.8	15.4	73.59631	1.847482	15.43156	0.04179	0.204425
73.4	1.8	15.4	73.58399	1.802581	15.43976	0.035441	0.188259
73.4	1.8	15.4	73.50748	1.882078	15.48429	0.025395	0.159358
73.4	1.8	15.4	73.43859	1.814139	15.56267	0.02815	0.167779

TABLE : 40 (D2)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
74.9	-0.4	13.2	74.91045	-0.39901	13.29933	0.009976	0.099881
74.9	-0.4	13.2	75.07946	-0.35058	13.28747	0.042298	0.205664
74.9	-0.4	13.2	75.07824	-0.31176	13.21562	0.0398	0.1995
74.9	-0.4	13.2	74.95124	-0.33373	13.35651	0.031513	0.177519
74.9	-0.4	13.2	75.02285	-0.32102	13.20066	0.02133	0.146048
74.9	-0.4	13.2	74.9181	-0.36073	13.34325	0.02239	0.149632
74.9	-0.4	13.2	74.97321	-0.32835	13.24605	0.012613	0.11231
74.9	-0.4	13.2	74.95851	-0.38372	13.35553	0.027878	0.166966
74.9	-0.4	13.2	75.05375	-0.34427	13.27914	0.03301	0.181686
74.9	-0.4	13.2	74.95272	-0.32993	13.20718	0.007741	0.08798
74.9	-0.4	13.2	74.93121	-0.31399	13.34632	0.029782	0.172576
74.9	-0.4	13.2	74.99788	-0.32605	13.22991	0.015945	0.126272
74.9	-0.4	13.2	75.07292	-0.35903	13.27825	0.037705	0.194178
74.9	-0.4	13.2	74.93529	-0.3152	13.21186	0.008577	0.092611
74.9	-0.4	13.2	75.06305	-0.32019	13.24334	0.034833	0.186636
74.9	-0.4	13.2	74.92064	-0.30279	13.29701	0.019287	0.138878
74.9	-0.4	13.2	74.96499	-0.3293	13.26526	0.013481	0.116107
74.9	-0.4	13.2	75.03104	-0.32167	13.2988	0.033069	0.181848
74.9	-0.4	13.2	75.08024	-0.39066	13.27519	0.038226	0.195516
74.9	-0.4	13.2	75.01078	-0.30244	13.26969	0.026647	0.163239
74.9	-0.4	13.2	75.0591	-0.31962	13.37974	0.064082	0.253145
74.9	-0.4	13.2	75.06481	-0.33773	13.2827	0.037879	0.194625
74.9	-0.4	13.2	74.94955	-0.3526	13.34845	0.026739	0.163521
74.9	-0.4	13.2	74.93523	-0.36007	13.26522	0.007089	0.084197
74.9	-0.4	13.2	74.91475	-0.34345	13.3843	0.03738	0.19334

TABLE : 41 (D3)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaure root
74.7	1.1	18.3	74.89095	1.272838	18.36577	0.07066	0.265819
74.7	1.1	18.3	74.71147	1.250262	18.40875	0.034537	0.185842
74.7	1.1	18.3	74.81395	1.233383	18.41973	0.04511	0.21239
74.7	1.1	18.3	74.85157	1.288611	18.30073	0.058547	0.241964
74.7	1.1	18.3	74.84156	1.214674	18.42197	0.048066	0.219239
74.7	1.1	18.3	74.84811	1.146867	18.37457	0.029695	0.172322
74.7	1.1	18.3	74.83802	1.134721	18.38536	0.027542	0.165958
74.7	1.1	18.3	74.8806	1.176995	18.40519	0.049611	0.222734
74.7	1.1	18.3	74.70167	1.187886	18.48596	0.042309	0.205692
74.7	1.1	18.3	74.79878	1.200893	18.31335	0.020116	0.141829
74.7	1.1	18.3	74.79295	1.224578	18.31065	0.024272	0.155796
74.7	1.1	18.3	74.82359	1.271869	18.48656	0.079618	0.282167
74.7	1.1	18.3	74.86489	1.265997	18.48123	0.087589	0.295954
74.7	1.1	18.3	74.83153	1.280285	18.47002	0.078712	0.280556
74.7	1.1	18.3	74.86104	1.187397	18.42768	0.049874	0.223324
74.7	1.1	18.3	74.84391	1.295809	18.34826	0.06138	0.24775
74.7	1.1	18.3	74.71378	1.212804	18.38555	0.020234	0.142246
74.7	1.1	18.3	74.86124	1.209282	18.45591	0.062248	0.249496
74.7	1.1	18.3	74.77307	1.232858	18.49368	0.060502	0.245972
74.7	1.1	18.3	74.70391	1.260606	18.47725	0.057229	0.239225
74.7	1.1	18.3	74.72497	1.117352	18.47881	0.032897	0.181374
74.7	1.1	18.3	74.82309	1.255113	18.36131	0.04297	0.207292
74.7	1.1	18.3	74.89251	1.135083	18.35712	0.041552	0.203844
74.7	1.1	18.3	74.7315	1.265214	18.30313	0.028298	0.168219
74.7	1.1	18.3	74.74723	1.206277	18.43754	0.032441	0.180114

TABLE : 42 (D4)

L1	a1	b1	L2	a2	b2	Sqaure	Sqaureroot
73.5	-0.6	21.1	73.53203	-0.45456	21.1136	0.022365	0.14955
73.5	-0.6	21.1	73.64573	-0.45336	21.19269	0.051331	0.226565
73.5	-0.6	21.1	73.623	-0.4576	21.1222	0.0359	0.189474
73.5	-0.6	21.1	73.53935	-0.49266	21.2515	0.036023	0.189797
73.5	-0.6	21.1	73.54859	-0.41955	21.14934	0.037358	0.193282
73.5	-0.6	21.1	73.64681	-0.55299	21.22907	0.040422	0.201053
73.5	-0.6	21.1	73.59936	-0.47108	21.19471	0.035464	0.188319
73.5	-0.6	21.1	73.68299	-0.57874	21.10895	0.034016	0.184434
73.5	-0.6	21.1	73.55516	-0.43291	21.26101	0.056888	0.238512
73.5	-0.6	21.1	73.50721	-0.47988	21.163	0.018448	0.135824
73.5	-0.6	21.1	73.55233	-0.59763	21.17707	0.008685	0.093191
73.5	-0.6	21.1	73.6711	-0.50808	21.18238	0.044511	0.210977
73.5	-0.6	21.1	73.5815	-0.47	21.18519	0.030801	0.175502
73.5	-0.6	21.1	73.56684	-0.51774	21.27655	0.042405	0.205924
73.5	-0.6	21.1	73.68514	-0.55247	21.18387	0.043571	0.208736
73.5	-0.6	21.1	73.57615	-0.46155	21.18826	0.032755	0.180984
73.5	-0.6	21.1	73.52247	-0.5175	21.12523	0.007948	0.08915
73.5	-0.6	21.1	73.59201	-0.44027	21.15499	0.037002	0.192359
73.5	-0.6	21.1	73.53836	-0.55201	21.24961	0.026158	0.161736
73.5	-0.6	21.1	73.56502	-0.58411	21.21648	0.018047	0.13434
73.5	-0.6	21.1	73.62646	-0.57326	21.2306	0.033763	0.183748
73.5	-0.6	21.1	73.52131	-0.5464	21.24427	0.024141	0.155372
73.5	-0.6	21.1	73.57576	-0.51816	21.19835	0.022109	0.148693
73.5	-0.6	21.1	73.61348	-0.49927	21.24218	0.043239	0.20794
73.5	-0.6	21.1	73.64596	-0.49753	21.24688	0.053378	0.231038

TABLE NO. 43 - DESCRIPTIVE STATISTICS (3D MASTER)

	N	Mean	Std. Deviation	Minimum	Maximum
1M1	25	0.18307	0.05207	0.0726	0.2737
1M2	25	0.148014	0.065743	0.0196	0.2577
2L1.5	25	0.153144	0.040913	0.0731	0.2119
2L2.5	25	0.163277	0.052306	0.0576	0.2474
2M1	25	0.155915	0.059663	0.0523	0.2767
2M2	25	0.278709	0.164776	0.0672	0.7108
2M3	25	0.157426	0.054681	0.032	0.2407
2R1.5	25	0.144575	0.046799	0.0508	0.238
2R2.5	25	0.1489	0.047599	0.0543	0.2431
3L1.5	25	0.161911	0.044525	0.0984	0.2424
3L2.5	25	0.183822	0.071387	0.0488	0.3362
3M1	25	0.178253	0.038986	0.0856	0.2337
3M2	25	0.161312	0.045035	0.0729	0.2176
3M3	25	0.167233	0.051689	0.0369	0.2438
3R1.5	25	0.141057	0.058162	0.0646	0.2806
3R2.5	25	0.208065	0.050292	0.1021	0.2896
4L1.5	25	0.196927	0.06302	0.0772	0.3274
4L2.5	25	0.188597	0.055218	0.0906	0.2644
4M1	25	0.160988	0.043668	0.0365	0.2294
4M2	25	0.18838	0.049432	0.0791	0.2769
4M3	25	0.162072	0.056236	0.0502	0.2649
4R1.5	25	0.168528	0.038493	0.0983	0.2609
4R2.5	25	0.17899	0.047501	0.0859	0.2493
5M1	25	0.18918	0.06179	0.0404	0.2771
5M2	25	0.168642	0.046395	0.093	0.2778
5M3	25	0.195345	0.045789	0.0478	0.2731

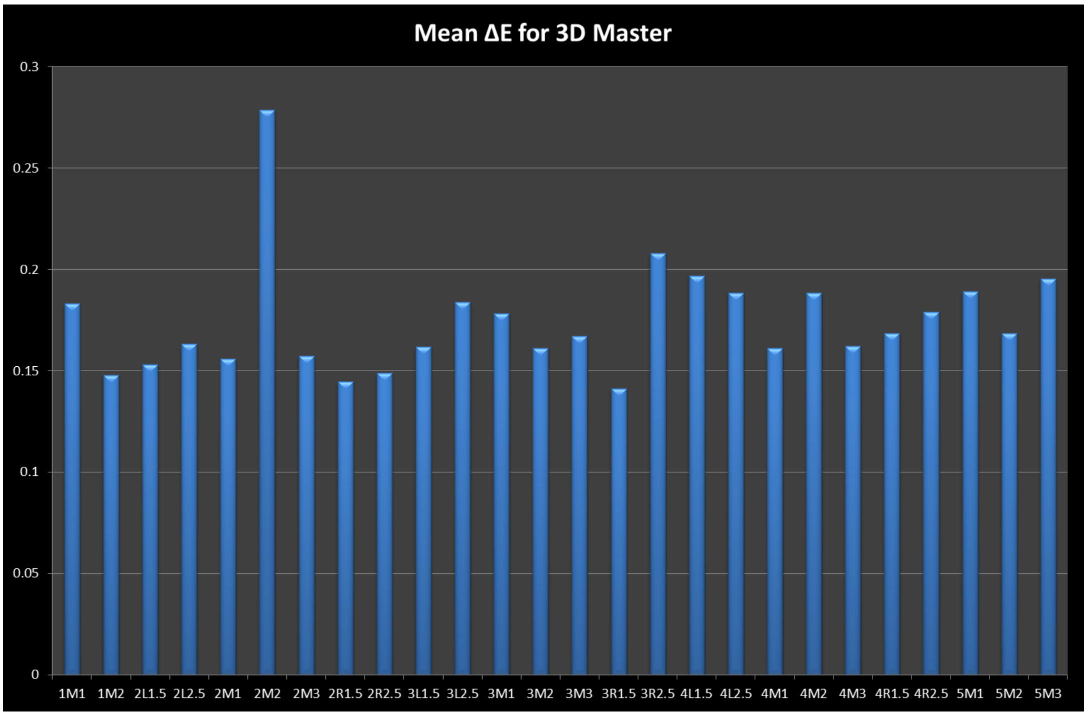
TABLE NO. 44 - DESCRIPTIVE STATISTICS (VITA CLASSIC)

	N	Mean	Std. Deviation	Minimum	Maximum
A1	25	0.17282	0.055161	0.0393	0.2563
A2	25	0.16972	0.058081	0.053	0.2397
A3	25	0.16122	0.0594	0.0452	0.2752
A3.5	25	0.163834	0.052311	0.0535	0.2505
A4	25	0.192646	0.060627	0.0736	0.2953
B1	25	0.175484	0.053477	0.0515	0.2367
B2	25	0.170593	0.056612	0.0587	0.274
B3	25	0.216996	0.073719	0.0807	0.3486
B4	25	0.156174	0.062468	0.063	0.2782
C1	25	0.146951	0.054163	0.05	0.2624
C2	25	0.026139	0.016313	0.0035	0.0646
C3	25	0.163285	0.05249	0.0396	0.2608
C4	25	0.197216	0.046567	0.1145	0.2964
D2	25	0.159355	0.043021	0.0842	0.2531
D3	25	0.213485	0.04407	0.1418	0.296
D4	25	0.17906	0.03828	0.0892	0.2385

TABLE NO.45- ANOVA 1

Square root

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.478	25	.019	5.221	.000
Within Groups	2.284	624	.004		
Total	2.761	649			

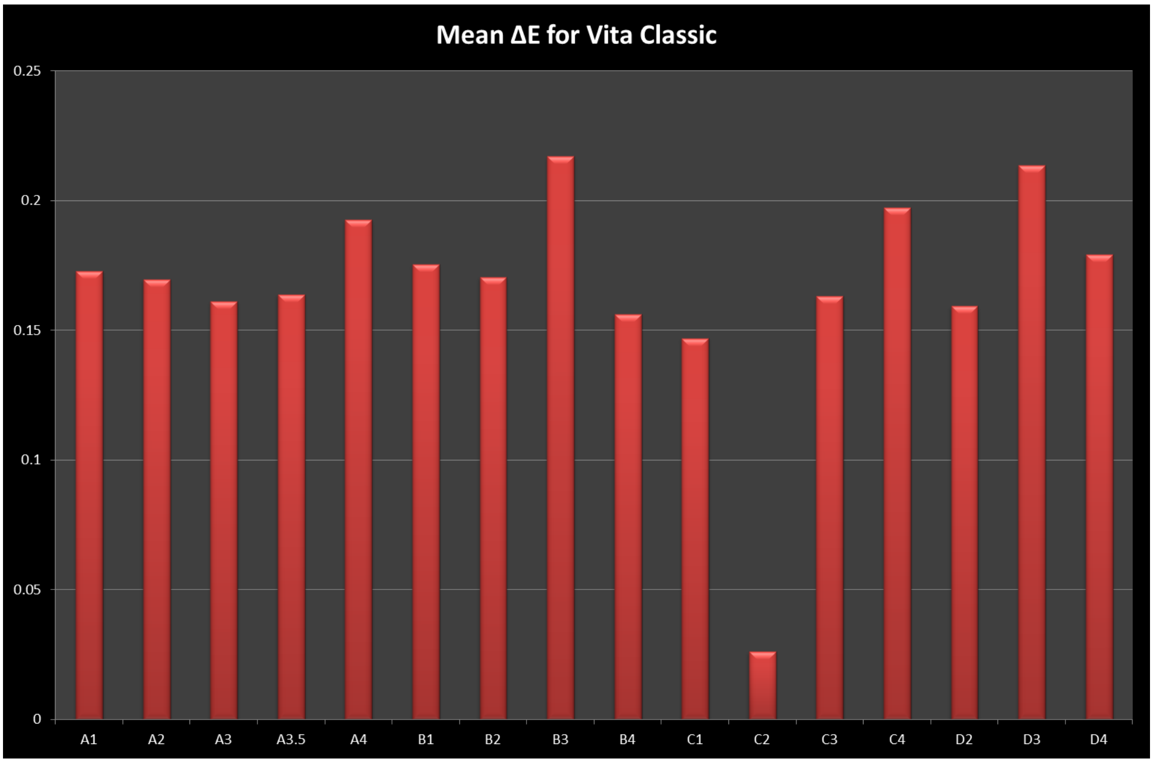


GRAPH 1 – MEAN DELTA E FOR 3D MASTER

TABLE NO.46 – ANOVA 2

Square root

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.674	15	.045	15.937	.000
Within Groups	1.083	384	.003		
Total	1.758	399			



GRAPH 2 – MEAN DELTA E FOR VITA CLASSIC

TABLE NO. 47 - CONSOLIDATED RESULT FOR ALL SHADE TABS

SL.NO	SHADE TAB	DELTA E VALUE (MEAN)	AGREEMENT **YES** OR **NO**
1.	1M1	.183070	YES
2.	1M2	.148014	YES
3.	2L1.5	.153144	YES
4.	2L2.5	.163277	YES
5.	2M1	.155915	YES
6.	2M2	.278709	NO
7.	2M3	.157426	YES
8.	2R1.5	.144575	YES
9.	2R2.5	.148900	YES
10.	3L1.5	.161911	YES
11.	3L2.5	.183822	YES
12.	3M1	.178253	YES
13.	3M2	.161312	YES
14.	3M3	.167233	YES
15.	3R1.5	.141057	YES
16.	3R2.5	.208065	NO
17.	4L1.5	.196927	YES
18.	4L2.5	.188597	YES
19.	4M1	.160988	YES
20.	4M2	.188380	YES

21.	4M3	.162072	YES
22.	4R1.5	.168528	YES
23.	4R2.5	.178990	YES
24.	5M1	.189180	YES
25.	5M2	.168642	YES
26.	5M3	.195345	YES
27.	A1	.17282	YES
28.	A2	.16972	YES
29.	A3	.16122	YES
30.	A3.5	.163834	YES
31.	A4	.192646	YES
32.	B1	.175484	YES
33.	B2	.170593	YES
34.	B3	.216996	NO
35.	B4	.156174	YES
36.	C1	.146951	YES
37.	C2	.026139	YES
38.	C3	.163285	YES
39.	C4	.197216	YES
40.	D2	.159355	YES
41.	D3	.213485	NO
42.	D4	.17906	YES

DISCUSSION

The aim of the study was to compare the effectiveness of digital photography assisted shade selection. The success of aesthetic dentistry is determined on the basis of functional and esthetic results. To achieve esthetics, four basic determinants are required in sequence - position, contour, texture and color(24). Because esthetic dentistry imposes several demands on the artistic abilities of thedentist and the technician, knowledge of the underlying scientific principles of color is essential. Color combination not only improves esthetics but also makes the restoration appear natural and attractive. The basic fundamentals of color and light, the radiation spectrum and the optical characteristics of the object is to be understood before evaluating and selecting the proper color shade for the restoration(25).The interest in color research in dentistry has increased significantly over the past several decades.

According to the Glossary of Prosthodontic terms, color can be defined as ‘the quality of an object or substance with respect to light reflected or transmitted by it. Color is usually determined visually by measurement of hue, saturation, and luminous reflectance of the reflected light.’ The three components of color are: light source (illuminates the object), object (reflects, absorbs or transmits the incident light to the observer) and the observer (perceives the reflected light).(23)(26)

EFFECT OF THE ENVIORMENT:

Color perception is affected by the reflection or interference from the surrounding colors. The effects of clothing andmake-up, especially lipstick, should be neutralized. One should stare at a tooth for less than 5 s because our eyes become accommodated to the red and yellow colors. The eyes should be given a break with a neutral grey background such as a Pensler Shield (Kulzer), which is designed to screen out the background color glare.[29]

Three dimensions of color

Color is usually described according to the Munsell colo rspace in terms of hue, value, and chroma. Hue is the attribute of a color that enables the clinician to distinguish between different families of color, whereas value indicates the lightness of a color. Chroma is the degree of color saturation[30][31]. When color is determined using the Munsell system, value is determined first followed by chroma. Hueis determined last by matching with shade tabs of the value and chroma already determined.

Hue

"Hue" is the quality that distinguishes one family of color from another. It is specified as the dominant range of wavelengths in the visible spectrum that yields the perceived color, even though the exact wavelength of the perceived color may not be present. Hue is a physiologic and psychologic interpretation of a sum of wavelengths.

Hue is represented by A, B, C or D on the commonly used Vita Classic shade guide.(28)(32)(33)

Value

"Value," or brightness, is the amount of light returned froman object. Munsell described value as a white to-black gray scale. Bright objects have lower amounts of gray and low-value objects have larger amounts of gray and will appear darker. The brightness of a crown is usually increased in two ways: by lowering chroma or by increasing the reflectivity of the (surface. Lowering value means lesslight returns from the illuminated object and the remaining light is being absorbed or scattered elsewhere.(33)

Chroma

"Chroma" is the saturation, intensity or strength of the Hue. If any dye (say red) is added into a glass of water and the same dye is added again and again, the intensity increases, but the color remains the same (hue).As more dye is added, the mixture appears darker; thus, the increase in chroma has a corresponding change in value. Aschroma is increased, the value is decreased; chroma and value are inversely related. Higher numbers on the Vita Classic shade guide represent increased chroma.(33)

Translucency

Human teeth are characterized by varying degrees of translucency, which can be defined as the gradient between transparent and opaque. Generally, increasing the translucency of a crown lowers its value because less light returns to the eye.[34]

Metamerism

Two colors that appear to match under a given lighting condition but have different spectral reflectance are called metamers, and the phenomenon is known as metamerism. The problem of metamerism can be avoided by selecting a shade and confirming it under different lighting conditions, such as natural daylight and fluorescent light.[33][34]

Light quality

The quality of light source is the most influential factor When determining tooth shade. The ideal light source is natural light, occurring around mid-day for accurate color comparison. The time of the day, month and weather conditions affect the color of sunlight.

The absence of ideal conditions has led to the use of artificial lighting for color matching. Color temperature, spectral reflectance curves and Color Rendering Index (CRI)are all used to measure the capacity to reproduce standard daylight (CRI over 90 is recommended for color matching). Color-corrected fluorescent lightsare also available, which render the color more accurately. Full-spectrum light-emitting diodes (LEDs) are now replacing incandescent bulbs."The Optilume True shade," uses full-spectrum LEDs and shows a color spectrum similar to mid-day light.[35]

SHADE GUIDES:

The shade-matching tools that most dental practitioners use to identify and communicate color and shade information with others are called colorreference standards or, simply, *shade guides*. Presently, dentists use shade guides for describing tooth shades, prepared teeth(dentin/stump guides), gingival tissues, and even human skin.

Tooth shade guides were first developed inthe late 1920s in response to the acceptance of Munsell's color theory and the development of dental ceramics intended for artificial porcelain teeth and customized dental restorations. The best-known and most popular guide worldwide is the VITA Classical Shade Guide. The 16 shades of the VITA Classic Shade Guide have been reported to cover only 6%of the color range of human teeth.

The Vitapan 3D Master Guide (VITA),which was introduced in 1998, has 26shades and has been systematically arranged and designed to address some short comingsof earlier guides. It has a superior range of coverage but still only approximates 25% of tooth color range. According to Paravina et al, the actual coverage for each guide is somewhat higher, and when the range of the 2 shade guides are combined, can be as high as 52%. Other popular guides fall somewhat in between the range of these 2 guides.[(18)(23)(29)]

In addition to having a limited shade range, the vast majority of tooth shade guides are *hue-based* and not *value-based*. Value represents the optical brightness or luminosity of the color. Humans are incredibly more sensitive to the value of an object than its hue. Even small differences between the value of a restoration and the tooth being matched can be readily detected and may appear to be a mismatch in shade. This why a chieving a good value match is much more important than a perfect hue match. Despite its popularity, the VITA Classic Shade Guide is hue-based. Its tabs are subdivided into the following 4 major hue groups: A = reddish brown, B = reddish yellow, C =gray, and D = reddish gray.[39]

The Chromascop Shade Guide (Ivoclar Vivadent)is also hue-based. It has 20 possible shades in the following 5 hue groups: Group 100 =white, Group 200 = yellow, Group 300 = light brown, Group 400 = gray, and Group500 = dark brown (Figure 3). Each hue group has 4 shade variations of increasing chroma.

Another popular guide, the TrubyteBioform Color Ordered Shade Guide (DENT SPLY Trubyte) has 24shades that are based more directly on Munsell’s work. Its shade tabs are broken down into the following 4 hues: reddish brown, yellow, gray, and reddish gray. The guide may be purchased in 2 different materials - plastic and porcelain - and 2 different versions. Style A, where all 24 tabs are ordered by value from lightest to darkest, and Style B, where the tabs are ordered firstby hue and then lightest to darkest within the hue group.[15][23][24][40]

It is worth noting that the only tooth shade guide which uses a value-based designis the Vitapan 3D Master and its variations(Vitapan 3D Master Bleach Guide, Linear Guide). Including the optional bleach shades, it has 26 tabs that cover the following 6 value-based groups: zero, 1, 2, 3, 4, and 5 (with zero being the lightest or highest value and5 being the darkest or lowest value).(40)Within each value group, there are the following 3 hue variations: M = standard hue, L = yellow, and R = red. Each of the hue groups is further differentiated by 2 or 3 chroma variations (ie,1M1, 1M2, and 1M3).

DIGITAL SHADE ANALYSIS:

Recent Advances [4,7,17,18]

Advances in electronic technology have provided solutions for many of the current problems in shade selection and color matching in dentistry:

a. Colorimeters

b. Spectrophotometer

c. Digital cameras as filter colorimeters

d. Spectrophotometers and spectroradiometers

All color-measuring devices consist of, a detector, signal conditioner and a software that process the signal in a manner that makes the data usable in the dental operatory or laboratory. Because of the complex relationship between these elements, accurate colorimetric analysis is difficult at best.

Colorimeters:

Filter colorimeters generally use three or four silicon photodiodes that have spectral correction filters that closely simulate the standard observer functions. These filters act as analog function generators that limit the spectral characteristic of the light that strikes the detector surface. The inability to match the standard observer functions with filters while retaining adequate sensitivity for low light levels is the reason that the absolute of filter colorimeters is considered inferior to scanning device like Spectrophotometers and spectroradiometers. However, because of the consistent and rapid sensing nature, these devices can be precise with differential measurements. This is why they often are used for quality control.[(23)(36)(41)]

Fiber optic colorimeter:

Burget., *et al*. (1990) 6 described the advantage of fiber optic colorimeter. Tooth color is caused by volume reflection, that is, passage of incident light through the tooth followed by backward emergence. This passage is concurrent with sideward displacement of photons that, in effect, influence the result of usual instrumental methods of determining tooth color. This problem is overcome by the use of large-field illumination and small-field observation. A fiber-optics colorimeter based on this principle is described. The color observed through two holes in a double box was visually matched by subtractive adjustment of the illuminating color in one box, whereas the other box showed the central part of the tooth diffusely illuminated by illuminant C light. This colorimeter was tested on wet, extracted human incisors in the tooth arch of a phantom-head. Results were compared with a visual standard-strip method and with a conventional spectrophotometer. It was concluded that the fiber-optics colorimeter is a promising instrument, although technical improvement is necessary.

Spectrophotometer:

A spectrophotometer is a device that measures the spectral reflectance of a body. It is a photometer (a device for measuring light intensity) that can measure intensity as a function of the color, or more specifically, the wavelength of light. A spectrophotometer is a more complicated instrument and there are several configurations. To get a precise measurement of color, it is advisable to use a spectrophotometer. A spectrophotometer measures the reflectance for each wavelength, and allows to calculate values. The general principle is that a light source is diffracted (that is the various wavelengths are spatially separated by a grating or prism). The various wavelengths pass through an entrance slit and the test sample (in some configurations the sample and entrance slit are reversed). The sample selectively absorbs the various wavelengths of light in varying amounts. The light then passes through another slit, called the exit slit, and impinges upon a detector. The detector converts the light intensity at the particular wavelength into an electrical signal that is amplified and displayed on a screen or traced on a chart (light absorbed versus wavelength). In short, a colorimeter provides an overall measure of the light absorbed, while a Spectrophotometer measures the light absorbed at varying wavelengths.[4][9][24]

Crystaleye (Olympus, Tokyo, Japan) combines the benefits ofa traditional spectrophotometer with digital photography. The digital image produced by the Crystaleye uses a 7-band LED light source, which results ina more precise depiction of color than the conventional systems used with digital cameras. Moreover, the imageproduced by the Crystal-eye is taken from inside the oral cavityand consequently is devoid of the external light that can causediscrepancies.[(43)]

Vita Easyshade Compact (Vita Zahnfabrik,Germany) is cordless, small, portable, cost efficient, batteryoperated, contact-type spectrophotometer that providesenough shade information to help aid in the color analysisprocess. Different measurement modes are possible withEasyshade Compact: tooth single mode, tooth area mode(cervical, middle and incisal shades), restoration colorverification (includes lightness, chroma and hue comparison)and shade tab mode (practice/training mode).

Shade-X (X-Rite, Grandville, MI) is also compact andcordless ‘‘spot’’ measurement’’ spectrophotometer with 3-mm probe diameter, and keyed to the majority of popularshade guides. Shade-X have two databases to match the colorof the dentin (more opaque) and the incisal tooth regions (more translucent).

SpectroShade Micro (MHT Optic Research, Niederhasli,Switzerland) is an imaging spectrophotometer. It uses adigital camera/LED spectrophotometer combination. It hasan internal computer with the analytical software. The toothpositioning guidance system, shown on the LCD touch screen,is used during color measurement. Images and spectral datacan be saved on the internal memory and transferred to acomputer.[44][23]

DIGITAL CAMERAS:

Most consumer video or digital still camerasacquire red, green and blue image information that is utilizedto create a color image. The RGB color model is an additivemodel in which red, green and blue light are added together invarious ways to reproduce a broad array of colors. Digitalcameras represent the most basic approach to electronicshade taking, still requiring a certain degree of subjectiveshade selection with the human eye.Clinicians and technicians are frequently located indifferent areas. A digital camera permits the transfer ofimages from the clinician to the technician. The best way toreference shade information is by using shade tabs tocommunicate shade. A systematic protocol to referencingshade information as well as changes in shade between tabs isrequired. Shades identified in the digital map are arranged bygingival (G), middle (M) and incisal third (I). The shade tabsshould be selected and photographs should be taken with eachtab in its proper orientation in reference to the tooth.Camera and light settings and image format must be keptconstant at all times for consistent shade color communication.

According to this study the digital camera assisted shade selection and the reference values of shade guide tabs were in agreement in 90% success which indicates that this technique can be used as a reliable alternative technique for shade selection in the field of aesthetic dentistry. Some of the darker shade tab were not matched correctly. In a similar study done by Miyajiwala, et al.: Evaluation of different methods for shade selection the overall agreement percentage between spectrometer and digital photography was 66% and the author conclude that the newly emerged digitalphotography method shows a statistically significantpercentage agreement with the spectrophotometricmethod of shade selection.

Advances in photography and computer technology haveled to the emergence of digital photography as a tool forshade selection. The images obtained can be analysed using appropriate software, and thus color values of entireobjects or even parts of objects are recorded. The adventof this technique has led to overcoming of problemsof the contact type shade selection instruments.(44) (45)

CONCLUSION

Within the limitation of the study,the digitalphotography method showed a high (statisticallysignificant) percentage of agreement with the reference values for the shade tabs selected. So Digital photography can emerge as a viable alternativeto the use of spectrophotometers for shade selectionin a clinical setup. Further studies are needed to asses the various factors which can cause the variation in results such as the different set of digital camera or different lenses used or different types of sensors used in camera, which has to be further investigated.

REFERENCES

1. If Alsiddi, Lc Richards ; A comparison of conventional visual and spectrophotometric shade taking by trained and untrained dental students , Australian dental journal 2015 ;60 176-181
2. Rodrigo Tiossi ; Comparison between visual and instrumental methods for natural tooth shade matching , General dentistry November 2014
3. Degerongul, Mehmet cudibalkaya ; Visual and instrumental evaluation of colour match ability of 2 Shade guide on a ceramic system
4. Michale hemming , So Ran Kwon ; Repeatability in colour measurements of spectrophotometer using different positioning devices
5. ShrutiLakhanpal, Menon S Neelima ; Accuracy of Three Shade-matching Devices in Replicatingthe Shade of Metal Ceramic Restorations: An in vitro Study 10.5005/jp-journals-10024-1971
6. Won sukoh , john pogoncheff , willam ,j, o brien ; Digital computer matching of tooth colour 2010 ,3 ,3699 ; doi 10. 3390 / ma 3063694
7. Mohammad M Rayyan ; Comparison of hand held full spectrum light and two different lighting conditions on , research gate 264424051 ari 2004 .
8. MohammadrezaNakhaei ; Shade matching performance of dental students with three various lighting conditions .

9. Karl martin lehmann, christoherigiel , Iren Schmidtmann, Herbert scheller ; Four colour measuring devices compared with a spectrophotometer reference system journal of dentistry 38s 2010 e65, e70

10. Stehen jchu , Richard d trushkowsky , Rade d Aravina ; Dental colour matching instrument and systems review of clinical and research aspects , journal of dentistry 38s 2010 e2/e16

11. If Alsiddi, Lc Richards ; A comparison of conventional visual and spectrophotometric shade taking by trained and untrained dental students , Australian dental journal 2015 ;60 176-181

12. Rodrigo Tiossi ; Comparison between visual and instrumental methods for natural tooth shade matching , General dentistry November 2014

13. Won sukoh , john pogoncheff , willam ,j, o brien ; Digital computer matching of tooth colour 2010 ,3 ,3699 ; doi 10. 3390 / ma 3063694

14. RaghunathanJ.RameshA.S.Prabhu .k ; A systemic review of efficacy of shade marching in prosthodontics , international journal of recent scientific research . vol ,7 4pp 99499954 April 2016

15. Won sukoh , john pogoncheff , willam ,j, o brien ; Digital computer matching of tooth colour 2010 ,3 ,3699 ; doi 10. 3390 / ma 3063694

16. Leticia rubio , Juan surez , Maria Jesus Gaitan Stella Martin De Heras ; Spectrophotometric analysis of color changes in teeth incinerated at increasing temperature . Forensic science international April 2015

17. Karl martin lehmann, christoherigiel , Iren Schmidtmann, Herbert scheller ; Four colour measuring devices compared with a spectrophotometer reference system journal of dentistry 38s 2010 e65, e70

18. Dhruvanand , Rahul sharma , shade selection ; spectrophotometer vs digital camera . A comparative in vivo study .researchgate 3093308311.

19. Alvin G. Wee, BDS, DDS, MS, MPH, PhD,a Alison Meyer, BS,b Wendy Wu, BA,c and Christopher S. Wichman, PhDd. Lighting conditions used during visual shade matching in private dental offices. THE JOURNAL OF PROSTHETIC DENTISTRY2015 International Association of Dental Research Annual Session in March 2015, Boston, Mass.

20. B. Culic1,a, V. Prejmerean2,b, C. Gasparik1,c, C. Culic1,d, C. Dragos3,e, D. Dudea1,f. In vitro evaluation of newdental software for shade matching. Key Engineering Materials Vol. 587 (2014) pp 360-365.

21. AlperCaglar&KivancYamanel& Kamran Gulsahi& Bora Bagis&MutluÖzcan. Could digital imaging be an alternative for digital colorimeters? Clin Oral Invest (2010) 14:713–718 DOI 10.1007/s00784-009-0329-6.

12)Christopher IGIEL, Michael WEYHRAUCH, Stefan WENTASCHEK, Herbert SCHELLER and Karl Martin

LEHMANN.Dental color matching: A comparison between visual and instrumental methods.Dental Materials Journal 2016; 35(1): 63–

13)B.T. Xu a, B. Zhang a, Y. Kang, Y.N. Wang*, Q. Li **.Applicability of CIELAB/CIEDE2000 formula in visual color assessments of metal ceramic restorations. 16 April 2012.

15) Oscar E. Pechoa,b, RazvanGhineab, Rodrigo Alessandrettia,María M. Pérezb, Alvaro Della Bonaa,∗. Visual and instrumental shade matching usingCIELAB and CIEDE2000 color difference formulas. 0109-5641/© 2015 Academy of Dental Materials.

22. DeğerÖngül, DMD, PhD,aBülentŞermet, DMD, PhD,b and Mehmet CudiBalkaya, DMD, PhDc.Visual and instrumental evaluation of color match ability of 2 shade guides on a ceramic system. The Journal of prosthetic dentistry · July 2012 DOI: 10.1016/S0022-3913(12)60102-4 · Source: PubMed.

23. FabianaTakatsui(a) Marcelo Ferrarezi de Andrade(a) MaximilianoPieroNeisser(b) LuizAntônio Borelli Barros(c) Leonor de Castro MonteiroLoffredo(c). CIE L*a*b*: comparison of digital images obtained photographically by manual and automatic modes.Braz Oral Res., (São Paulo) 2012 Nov-Dec;26(6):578-83.

24. Karl Glockner, Karl Glockner and Bernd Haiderer. Visual vs. Spectrophotometric Methods for Shade Selection.Coll. Antropol. 39 (2015) 3: 801–802.

25. Jon Gurrea, DDS1/Marta Gurrea, CDT1,AugustBruguera, MDT2/Camila S. Sampaio, DDS, MS3. MalvinJanal, DDS, MS, PhD4, EstevamBonfante, DDS, MS, PhD5, Paulo G. Coelho, DDS, MS, PhD6, Ronaldo Hirata, DDS, MS, PhD7. Evaluation of Dental Shade Guide Variability Using Cross-Polarized Photography. The International Journal of Periodontics & Restorative Dentistry©2016.

26. Karl Martin Lehmann a,*, Christopher Igiel a, Irene Schmidtmann b, Herbert Scheller a. Four color-measuring devices compared with a spectrophotometric reference system. journal of dentistry 38s(2010)e65–e70.

27. P. Gehrkea/ U. Riekebergb/ O. Facklerc / G. Dhomd.Comparison of In Vivo Visual, Spectrophotometric and Colorimetric Shade Determination of Teeth and Implant-supported Crowns. International Journal of Computerized Dentistry 2009; 12: 000–000.

28. Punit RS Khurana, P Vivek Thomas, Soudhamini V Rao, R Balamuragan, Mohan Preet Singh. A Clinical Study to Correlate Maxillary Anterior NaturalTeeth with that of the Commercially Available Acrylicand Porcelain Shade Guides. The Journal of Contemporary Dental Practice, May-June 2013;14(3):427-433.

29. Romina Roodgarian1, Toloo Jafari2, Soraya Khafri3, Faezeh Abolghasemzadeh2. Influence of different light sources on visual shade matching performance. Caspian J Dent Res-September 2016, 5(2): 30-36.

30. 1Shruti Lakhanpal, 2Menon S Neelima. Accuracy of Three Shade-matching Devices in Replicating the Shade of Metal Ceramic Restorations: An in vitro Study. The Journal of Contemporary Dental Practice, December 2016;17(12):1003-1008.

31. William D. Browning a,*, Rosalia Contreras-Bulnes b, Martha G. Brackett c, William W. Brackett c. Color differences: Polymerized composite and corresponding Vitapan Classical shade tab. journal of dentistry 37s(2009)e34–e39.

32. Welson Pimentel, DDS, MSc n Rodrigo Tiossi, DDS, PhD. Comparison between visual and instrumental methods for natural tooth shade matching. Published with permission of the Academy of General Dentistry. © Copyright 2014 by the Academy of General Dentistry.

33. KIVANC YAMANEL, PhD* ALPER CAGLAR, PhD† MUTLU ÖZCAN, Dr. MED. DENT., PhD‡ KAMRAN GULSAH, PhD§ BORA BAGIS, PhD||. Assessment of Color Parameters of Composite Resin Shade Guides Using Digital Imaging versus Colorimeter. JOURNAL COMPILATION © 2010, WILEY PERIODICALS, INC. DOI 10.1111/j.1708-8240.2010.00370.x VOLUME 2 2 , NUMBER 6 , 2010 379.

34. P.Gehrke , U. Riekeberg , O. Fackler , g. Dhom ; Comparison of in vivo visual spectrophotometric and colorimeter shade determination of teeth and implant supported crowns , international journal of computerized dentistry 2009;12;

35.M.AlomariR.G Chadwick ; Factors influencing the shade selection matching performance of dentist and dental technicians when using two different shade guide British dental journal 2011 ;211;e23

36. Yong ketin lee ;Influence of surface layer removal of shade guide tabs on the measure colour by spectrophotometer and spectroradiometer , journal of dentistry october2008

37. Kivancyamanel , Alpercaglar , , Kamran gulsah ; Assessment of parameters of composite resin shade guide using digital imaging versus colorimeter journal compilationvol 22 no. 6 2010

38. Qing li ;Applicability of CIELAB formula in visual colour assessments of metal ceramic restoration , journal of dentistry . April 2012

39. Rakeshvadher , girishparmar , shikhakanodia ; Basic of colour in dentistry ; A review volume 13 issue 9 ver I (Sep .2014) pp 78,85

40. Leticia rubio , Juan surez , Maria Jesus Gaitan Stella Martin De Heras ; Spectrophotometric analysis of color changes in teeth incinerated at increasing temperature . Forensic science international April 2015

41. Malvin N janal ,Estevam a Bonfante ; Paulo Coelho , Evaluation of dental shade guide variability using cross polarized photography . research gate 307515215 sep 2016

42. Leticia rubio , juansurezstela martin ; Spectrophotometric analysis of color changes in teeth incinerated at increasing temperatures research gate 276210056

43. Emily hawary ; The art of matching anterior porcelain restoration cad journal vol24

44.B. Culic ,v. Prejmerean ,C.Gasparik, C.Dragos . In vitro evaluation of dental software for shade matching

45. FabianaTakatsui, Marcelo Ferrarezi ; CIE L*a*b comparison of digital images obtained photographically by manual and automatic mondes , braz oral research 2012 novdec 26 };578 .83

46. Diego klee De Vasconcellons , MutiuOzcan; Clinical evaluation of the influence of illumination during visual shade matching , research gate 281409971

47. Oscar E pecho , RazvanlonutGhinea , Rodrigo alessandrettia; Visual and instrumental shade matching using CIELAB and CIEDE2000 color difference formulas research gate 28503761

48. Alpercaglar , KivancYamunel , Could digital imaging be an alternative for digital colorimeter doi 10.1007 / s00784 .009.0329 .6

49. DegerOngul , Mehmet cud Balkaaya ;Visual and instrumental evolution of color match ability of shade guides on a ceramic system the journal of prosthetic dentistry july 2012

50. RaghunathanJ.RameshA.S.Prabhu .k ; A systemic review of efficacy of shade marching in prosthodontics , international journal of recent scientific research . vol ,7 4pp 99499954 April 2016

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This ethical committee has undergone the research protocol submitted by **Dr.A.MANIARASAN,** Post Graduate Student, Department of Prosthodontics and crown & bridge under the title **"To chart the color accuracy of DSLR camera in conjunction with the imaging software for excellence in fixed prosthodontics"** Reference No: **2015-MD-BrI-PRB-02/APDCH,** under the guidance of Prof. **Dr.A.S.Ramesh MDS.,** for consideration of approval to proceed with the study.

This committee has discussed about the material being involved with the study, the qualification of the investigator, the present norms and recommendation from the Clinical Research scientific body and comes to a conclusion that this research protocol fulfils the specific requirements and the committee authorizes the proposal.

Date: **Member secretary**