

Applying color theory in clinical practice to improve patient treatment

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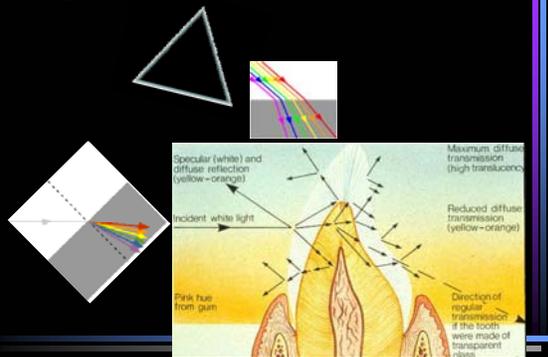


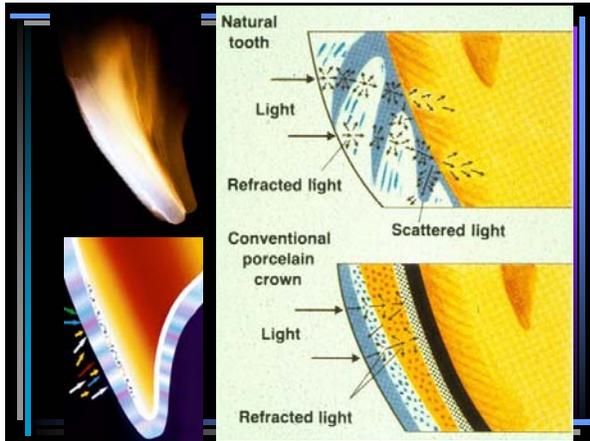
Learning objectives

- Be familiar with the physical mechanisms of tooth coloring and its measurement
- Recognize possible etiology for discoloration
- Realize the potentials and limitations of esthetic restorative materials
- Be acquainted with different shade guides and their characteristics
- Know of commercially available digital systems for shade matching
- Know procedures for optimizing correct shade matching & communication

2

Light- tooth interaction





Colors for teeth and dental materials are reported in the literature as:

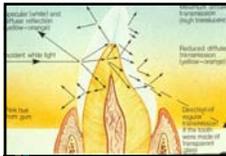
- *Munsell values* (Hue, Chroma, Value)
- *Tristimulus values* X, Y, Z
- *CIE chromaticity values* Y(%), x, y
- **CIE L*a*b**

5

*CIE L*a*b color system*

$\Delta E^* = \text{Change of } L^*a^*b \text{ values}$

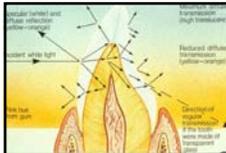
6



Proportional contributors to tooth color

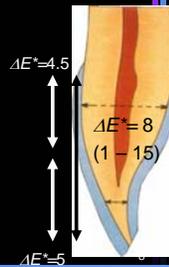
- The proportional contribution of enamel, dentin, pulp, gingiva and mucosa to the spectral reflection from the tooth in isolation remain uncertain

7

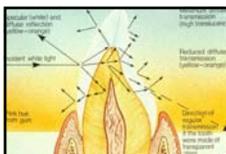


Proportional contributors to tooth color

- The proportional contribution of enamel, dentin, pulp, gingiva and mucosa to the spectral reflection from the tooth in isolation remain uncertain
- In general, dentin contributes the most as it is more chromatic than enamel

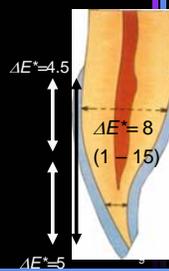


8



Proportional contributors to tooth color

- The proportional contribution of enamel, dentin, pulp, gingiva and mucosa to the spectral reflection from the tooth in isolation remain uncertain
- In general, dentin contributes the most as it is more chromatic than enamel
- Enamel is very translucent and more grey-blue than dentin



9

Realistic white shades for special cosmetic needs

DEFINITELY not realistic!

Learning objectives

1. Be familiar with the physical mechanisms of tooth coloring and its measurement
2. Recognize possible etiology for discoloration and best treatment
 - Extrinsic
 - Intrinsic

11

Extrinsic discolored teeth – etiology

N1-type colored material (chromogen) binds to the tooth surface. The color of the chromogen is similar to that of dental stains caused by tea, coffee, wine, chromogenic bacteria, and metals.

12



Extrinsic discolored teeth – etiology

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N2-type colored material changes color after binding to the tooth. The stains actually are N1-type food stains that darken with time.

13



Extrinsic discolored teeth – etiology

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N2-type colored material changes color after binding to the tooth. The stains actually are N1-type food stains that darken with time.

N3-type colorless material or prechromogen binds to the tooth and undergoes a chemical reaction to cause a stain. N3-type stains are caused by carbohydrate-rich foods (eg, apples, potatoes), stannous fluoride, and chlorhexidine.

(Nathoo 1997)

14

Discolored teeth – best treatments

Etiology	Appropriate method	Active agent
Surface staining	AirScaling / Brushing with (whitening) toothpaste + Patient counseling	Abrasives

15



Intrinsic discolored teeth – etiology

1. Hereditary defects

Dentinogenesis imperfecta.

- Teeth relatively normal at eruption
- Discolor increases with time
- More and more translucent, pink yellow, brownish or grey-brown
- Enamel may chip off with subsequent heavy dentin discoloration

16



Intrinsic discolored teeth - etiology

1. Hereditary defects

Dentinogenesis imperfecta. Normal at eruption. Translucent, yellow, pink, brownish or grey-brown. The enamel may chip off with subsequent heavy discoloration of dentin

Amelogenesis imperfecta. 2 categories:

1. Hypoplastic:
Teeth smooth and glossy
Color is orange, reddish or brown

2. Hypomineralised:
Color can vary between bone white, yellow, red and black
The enamel may chip off later

17

Intrinsic discolored teeth - etiology

2. Toxic effects during tooth development

Fluorosis: Surface may range between small opaque white spots to extensive yellow-brown bands and/or areas



18

Intrinsic discolored teeth - etiology

2. Toxic effects during tooth development

Fluorosis: The surface may range between small opaque white spots to extensive yellow-brown areas

Tetracycline:
 Chemical complex to ameloenamel proteins
 Color can vary between light to dark yellow
 Characteristic fluorescence in UV light
 Cervically usually darker due to thin enamel



Intrinsic discolored teeth - etiology



1. Hereditary defects: Dentinogenesis imperfecta. -
 Amelogenesis imperfecta

2. Toxic effects during tooth development: Fluorosis -
 Tetracycline

3. Trauma: Sometimes in the early phase following a trauma, due to internal bleeding in the pulp, with retention of porphyrines and iron in the dentin. The discoloration may be reversible or remain, even if the pulp remains vital

4. Pulp necrosis: Results usually in a tooth discoloration, but not always

Intrinsic discolored teeth - etiology



1. Hereditary: Dentinogenesis & Amelogenesis imperfecta

2. During tooth development: Fluorosis - Tetracycline

3. Trauma: Internal bleeding in the pulp, with retention of porphyrines and iron in the dentine

4. Pulp necrosis: Usually tooth discoloration, but not always

5. Other reasons:
 Degradation products from metallic restoratives
 Seldom bleeders' diseases
 Surface erosions
 Unknown reasons, possibly related to some childhood illness. E.g. hepatitis over a period

Discolored teeth – best treatments		
Etiology	Appropriate method	Active agent
Surface staining	AirScaling / Brushing with (whitening) toothpaste + Patient counseling	Abrasives
Hereditary defects	Restorative treatment	
Tetracycline staining	Custom bleaching trays worn by patient daily for six to 12 weeks	10 % carbamide peroxide
Single or multiple discolored teeth	External bleaching—in-office one to three visits	30 - 38 % H ₂ O ₂ , alone or with heat or light
Multiple teeth and entire arches, most effective for yellow or brown discoloration	Custom bleaching trays worn by patient daily for two to six weeks	10 % carbamide peroxide
Isolated brown or white discolorations of shallow depth in enamel	Microabrasion followed by neutral NaF applications	Abrasives + HCl up to 36 %
White discoloration on yellowish teeth	Microabrasion followed by custom tray bleaching	Abrasives and acid; 10 % carbamide peroxide
Endodontically treated teeth	Internal bleaching—in-office or walking	Na borborate or 35 % H ₂ O ₂

Learning objectives

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23

Dental Materials

Presently, there are no spectrophotometric quality control of materials with minimum criteria of performance

Among the direct materials, composite resins possess the best optical-physical properties regarding esthetics



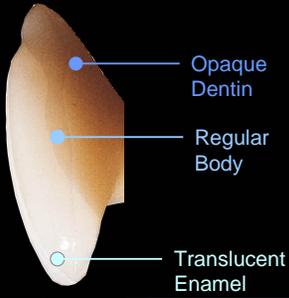
24

Technique in 1980



25

New products in 2004



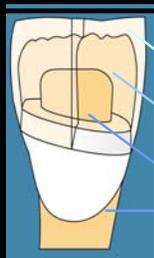
Opaque Dentin

Regular Body

Translucent Enamel



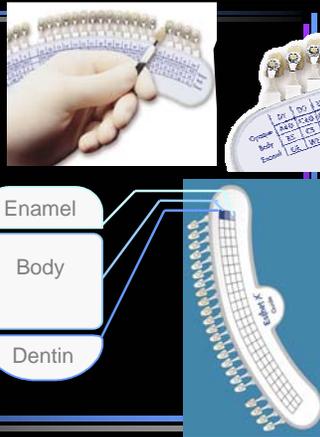
Shade Selection



Enamel

Body

Dentin



Dental Materials- composites, clinical observations

- Most materials become more opaque and lighter after a while intraorally, due to water uptake
 - This varies markedly among different materials

28

Dental Materials- composites, clinical observations

- Most materials become more opaque and lighter after a while intraorally, due to water uptake
- Chemically polymerised composites discolor more into yellow than the light polymerised due to the polymerisation chemicals in the resin

29

Dental Materials- composites, clinical observations

- Most materials become more opaque and lighter after a while intraorally, due to water uptake
- Chemically polymerised composites discolor more into yellow than the light polymerised due to the polymerisation chemicals in the resin
- Chemically polymerised composites with microfillers discolor more compared to those with macrofillers.



Composites are tested in laboratory for discoloration potential. E.g.



1. Color Stability, in 60/80°C Water
2. Color Stability, Xenon light
3. Stain Resistance, in 37/80°C Coffee
4. Stain Resistance, in 37/80°C Tea

31

An absolute requirement is adequate preparation depth!

- The thickness of a restoration / veneer is critical to obtain a correct reflection spectrum and thus acceptable shade
- Not removing enough tooth substance will either result in poor esthetics or to overcontouring with risk for subsequent gingival recession. This is especially critical cervically.



32

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33

Shade guides

Producer	Materials	Shade
3M ESPE	Composite / Hybrid	VITA/ Biodent / Own
Bisco	Composite / Hybrid	VITA
Coltène	Composite	VITA
Dentsply	Composite / GIC / Hybrid / Ceram / Prefabricated teeth	Biodent/ VITA/ Own
Discus	Composite	Own
DMG	Composite / Hybrid / GIC	VITA
Ducera	Ceram	Biodent / VITA
GC	Hybrid / GIC / Ceram	VITA
H Kulzer	Composite / Hybrid / Prefab teeth	Biodent/VITA
Jeneric	Composite / Ceram	Bioform/VITA
Kerr	Composite	VITA
Shofu	Ceram	VITA / Vintage Halo
Ultradent	Composite	VITA
VITA	Ceram / Prefabricated teeth	VITA VITA3D
Vivadent	Composite / Ceram	Chromascop/VITA/ Own



Shade guides

- Large deviations between supposedly similar tooth shades from the same producer is not uncommon

35

Shade guides

- Large deviations between supposedly similar tooth shades from the same producer is not uncommon
- Custom-made color shades using the actual restorative material is claimed to be better than using a standard color shade

36

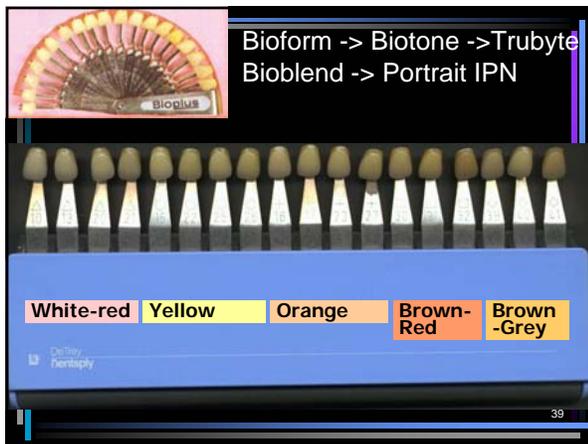
Shade guides

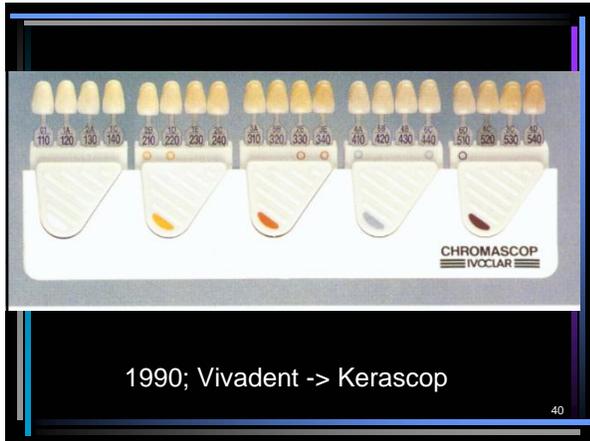
- Large deviations between supposedly similar tooth shades from the same producer is not uncommon
- Custom-made color shades using the actual restorative material is claimed to be better than using a standard color shade
- Some tooth shades changes following immersion in disinfectants. Keep away from chlorine-containing solutions!

37

The 5 most common shade guides in use internationally





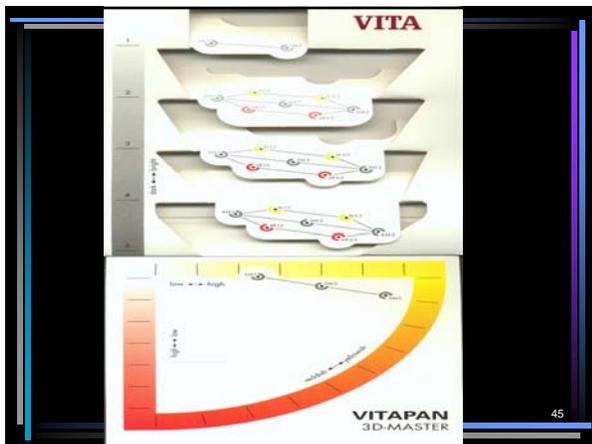


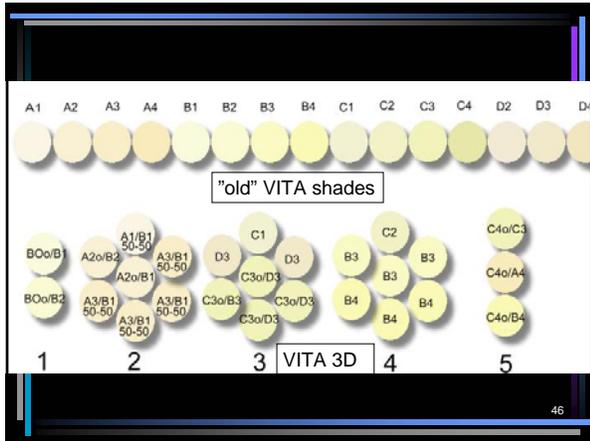




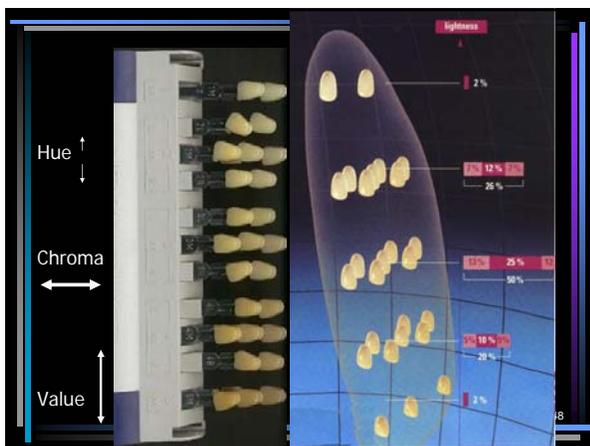


A more modern principle for a shade guide









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49

Digital Shade Matching Systems

A hand held optic device with dual light source connected through fiber optics to a spectrophotometer



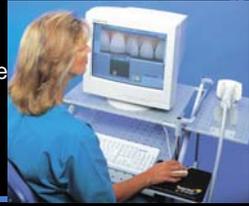
Digital Shade Systems

- Dental Color Analyser (clearlight.com/~aei)
- Metalor-ikam system (metalor-ikam.com)
- Pocketspec (Pocketspec.com)
- ShadeVision /ShadeRite (X-Rite.com)
- Shadescan (Cynovad.com)
- Spectroshade (mhtint.com)
- ShadeEye NCC (Shofu.com)



Digital Shade Systems -Benefits

- Improved communication between dentist and lab
- Can integrate with
 - Intra-oral camera
 - Digital Camera
 - Image enhancing software
 - Mouth Simulator
 - Printer



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53

Fixed Prosthetic Dentistry- shade selection Before you start...

1. Have the patient remove lipstick or bright makeup
2. If patient is wearing bright clothing, drape him or her with a neutral colored cover, i.e. light blue or light gray
3. Keep a surface with a neutral color nearby
4. Clean the teeth if doubt of extrinsic discoloration
5. Don't recline your patient – keep at eye level
6. Do not wear glasses that changes with light

54

Fixed Prosthetic Dentistry- shade selection

... right environment

1. Do not use direct lights. Lighting should be in the most natural light possible. Incoming light may be altered if the window in your operatory has a lot of greenery around it

55

Fixed Prosthetic Dentistry- shade selection

... right environment

1. Do not use direct lights. Lighting should be in the most natural light possible. Incoming light may be altered if the window in your operatory has a lot of greenery around it
2. Compare your shade selection under varying conditions such as with lip retraction versus lip down and when the patient moves their head in different directions or lighting angles

56

Fixed Prosthetic Dentistry- shade selection

... right environment

1. Do not use direct lights. Lighting should be in the most natural light possible. Incoming light may be altered by greenery around the window
2. Compare your shade selection under varying conditions such as with lip retraction versus lip down and when the patient moves their head in different directions or lighting angles
3. Have also your patient press their tongue against the lingual surface, when doing an anterior tooth restoration

57

Light sources

Fluorescent Natural daylight Incandescent



The same teeth look different under different light sources

58

Fixed Prosthetic Dentistry - shade selection



... right time

1. Select the shade at the beginning of the session before the tooth becomes dehydrated and your eyes fatigued
2. An impression and the use of rubber dam will cause lighter teeth. Retraction cord may influence the tooth color both ways. Anaesthetics too?
3. The canines are good for selecting shade as they have the highest chroma of the dominant color of the teeth
4. Once the tooth is fully prepared, use your guide to select the shade of the dentin in the tooth's body⁹³

Important:



1. The first impression is usually the most accurate in shade selection
2. It is important avoid fatiguing the eyes. Do not stare for >3-10 secs. Gazing at a neutral color, e.g. blue or grey for approx. 30 seconds will help to cleanse and refocus the eyes

60

Fixed Prosthetic Dentistry - shade selection



... the process ...

1. Place the shade tab parallel to the facial surface of the teeth, not in front or behind
2. Arrange each tab on the guide so that the incisal edge is facing out or away from the tab holder. Since incisal shading has the greatest influence on value, it is helpful to position the incisal area of the tabs closest to the teeth you are shading. This will also help avoiding color choice being influenced by the hue area of the tab
3. Always select the value reading first. It may help to squint
4. Now that the value reading has been taken, use your hue guide to select the color reading

61

Fixed Prosthetic Dentistry - shade selection



... finalising

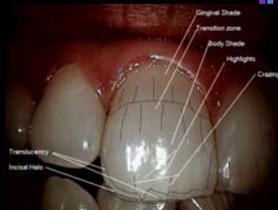
1. Make your final shade selection after comparing your selections with those of a staff member and/or ask the patient's opinion on your choice
2. Make a mental note of morphological details
3. If unable to match, choose a lower chroma and higher value
4. Take photo with shade tab if possible

62

Communicate this to laboratory

Get as detailed as possible with characterization
Every piece of information helps:

- Surface texture
- Glaze
- Translucency
- Wear
- Proximal view with incisal/thickness of enamel
- Any unique color characterizations of the dentine





Thank you
for your
kind
attention

64

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“Unravelling the Cracked Tooth Syndrome”

Dr. SAW LIP HEAN, Malaysia

The first dentist in Malaysia who set up his private endodontic practice. He did his graduation and postgraduation from Melbourne. He is the President of Malaysian Endodontics Society and part time teaching faculty. He has lectured extensively in Malaysia. He will present how to diagnose, classify and help formulating a treatment plan for the Cracked Teeth/Roots. Case studies will be presented for discussion. **“Endodontic Surgery or Re-treatment- what are the rationales ?”** Failures in endodontic treatment are always very frustrating to the dentists and the patients. This is especially so if they involve complicated prosthodontic works. The debate between endodontic surgery and re-treatment has been going on for many years. The basis of decision is frequently based on clinical convenience. This lecture will look at failed cases in greater detail. The rationales in treatment planning with respect to success rates, advantages and disadvantages, cost effectiveness on endodontic surgery and re-treatment will be analysed. Case studies related to both these approaches will be presented for discussion.



DR. NAILESH GANDHI, India

“A 15 years clinical experience in dental implants”



He is basically a Prosthodontist from Gujarat, India and practising Implantology since last 15 years. He is past president of Indian Dental Association, Founder President of Society of Oral Implantology in Gujarat, Vice Chairman PFA, Ex-member of Dental Council of India and presently Chairman of Continuing Dental Education committee of IDA. He received advance training in Implants by Dr. O'Hilt Tatum, USA. He has lectured extensively in India and abroad on implantology. His articles on Implants are published in Dental Asia & National Journals regularly. Presently he is only Indian appointed on Advisory Committee of “Dental Asia” for Dental Implants. He will be sharing his experiences of past 15 years in Implantology, review the current state of implantology in India and make recommendations based on evidence based practice in a variety of situations ranging from single tooth restorations to complete edentulism. He will present importance of length & width of bone, Implant Angulations Placement, emergence profile, as well as esthetic, considerations for successful implant practice.

“Preservation of Ideal Implant site to Achieve the ultimate esthetics.”

DR. SHAHVIR S. NOORYEZDAN, India.

He did his BDS from Mumbai, India and Masters in Restorative Dentistry from University of Sheffield, UK in 1992. He did advance training in Implants at Germany and Holland. He has lectured and conducted many training courses on Implants in India and abroad.

He will be speaking on the ideal implant site-the extraction socket. The definite advantages of immediate implantation combined with innovative soft & hard tissue techniques, incision free procedures and temporization with non-functional loading to achieve esthetic excellence will be demonstrated with clinical cases.



DR. GITA AUPLISH, U.K.

“Clinical Management of Perio Disease using chemotherapeutics.”



Dr. Gita Auplish did her BDS from Guy's Hospital, London and Masters in Periodontics from Estimation. Institute with distinction in 1998. Currently she is working as a specialist practitioner in Periodontology at Eastman Dental Hospital, London. She will be speaking on Clinical management of Perio disease using chemotherapeutics.

Dr. STEPHEN MOSS, U.S.A.

“Clinical Management of early caries.”

Prof. Stephen J. Moss is a past president of the American Academy of Pediatric Dentistry. He did graduation and masters from NYU, USA. His major area of study is preventive dentistry. His present activities include developing international education programs designed to promote oral health. He will be speaking on Clinical management of early caries.



DR. ASBJORN JOKSTAD, Oslo

“Color Theory and application in dentistry”



Dr. Asbjorn Jokstad is a professor at the Institute of Clinical Dentistry, University of Oslo. He obtained a DDS degree in 1979, prepared a thesis for Dr. Odont. (PhD) in 1992, and became specialist in prosthodontics in 1994. He has authored more than 100 publications focused on evidence based dentistry, dental materials and clinical trials, toxicology, prosthodontics and TMD, and has lectured extensively on these topics internationally. He is currently also the science manager of the FDI World Dental Federation.

The aim of this two-hour course is to review basic principles in colour theory, to explain how these principles influence our daily situation in the general dental clinic environments, to address how to convey information about appearance and to demonstrate how this knowledge can to be applied purposefully to provide better patient treatment.

Dr. A. KUMARSWAMY, India.

“Periodontal Therapy : A preventive Approach.”

He did his Masters in Periodontics from Mumbai, India. He has pioneered the philosophy and techniques in Perio-Aesthetics in India. Lectured in India and internationally number of times. He is Vice President of AAACD, Editor of ISP journal, Secretary of International Academy of Periodontology.

He will be presenting on prevention of occurrence and recurrence of periodontal disease. The talk will include prophylaxis, plaque control measures, iligent homecare regimen and the role of practitioner.

