

Crown and bridge Prosthodontics

Lecture. 8

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Shade matching (selection)

Matching two objects that reflect similar color (wave lengths of electromagnetic spectrum)

Shade Selection in fixed prosthodontics

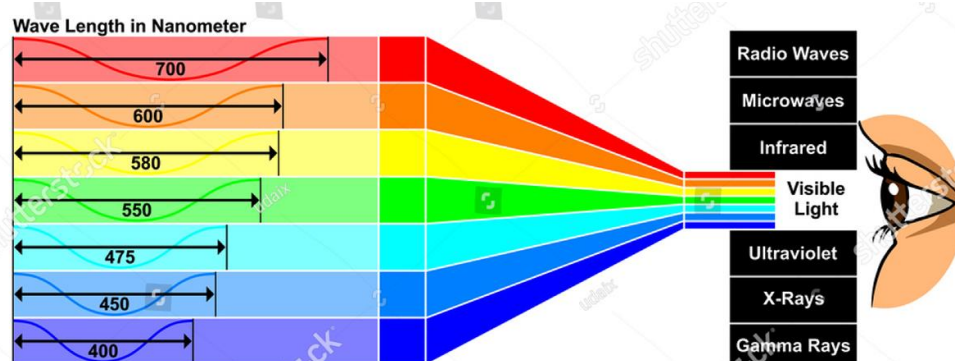
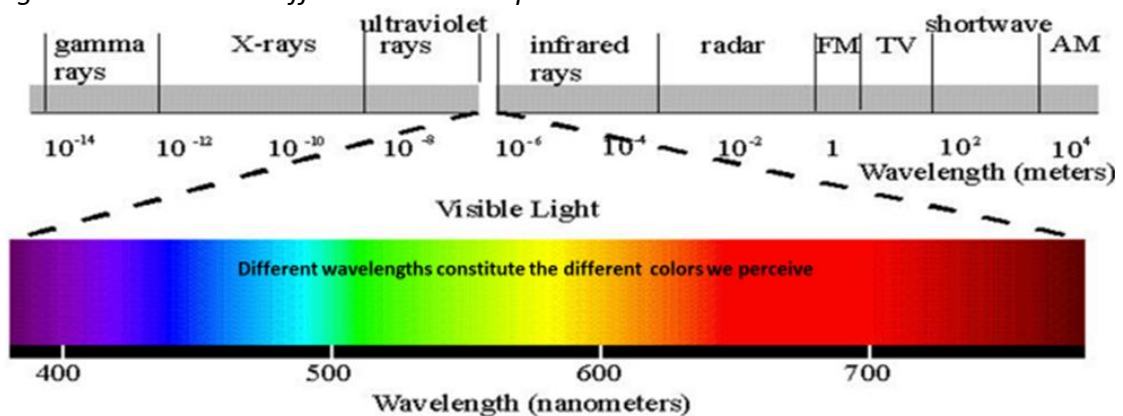
Process of replicating of the color of the adjacent teeth in an artificial prosthesis . The success of dental treatments as perceived by our patients is often evaluated on appearance, rather than long-term health, function and comfort. Everyone, it seems, is primarily interested in color, Color is light, modified by an object as perceived by an eye” .

Color that is perceived is the result of a light source, *the object that absorbs, transmits, reflects or scatters the light from the source*, and the interpretation of the result by the human visual system. Without Light Color Does Not Exist

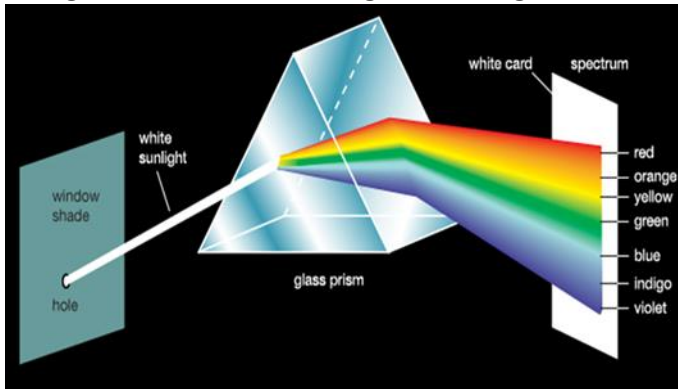
Color & Light

➤ *The color of an object is determined by the light that enters the human eye from that object*

➤ *What is commonly called "the color of a tooth" is actually the color of the reflected light so*
What is light????? *Light is a Form of visible energy that is part of the radiant energy spectrum. Radiant energy possesses specific wavelengths, which may be used to identify the type of energy. The eye is only sensitive to the visible portion of the spectrum (380 – 750nm) Different wavelengths constitute the different colors we perceive*



When Pure White Light passed through a prism we see component colors of white light, Shorter wavelengths bend more than longer wavelengths



Color mixture

Primary colors

Red, green, blue

Additive mixture system-

Mixing of two of the light mixture primary colors produce a new color

Red + blue = magenta Red + green = yellow Green + blue = cyan

Pigment mixture system

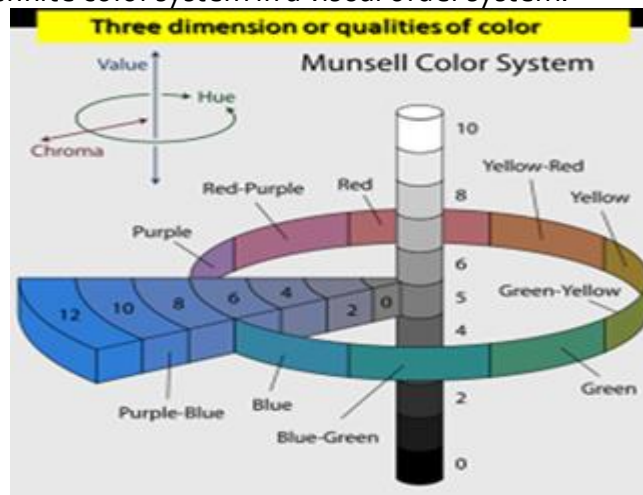
Yellow, cyan, magenta

How To Describe Color In Words

Albert Munsell, felt a need to describe the colors of his sketches in definite terms to his students. This led to the development of the Munsell Color System, which is presently a widely used visual color order system. He described *three dimensions* of color **as hue, chroma, and value**. It is possible to vary each of these qualities without disturbing the other. The ability to understand each of these dimensions and separate them from one another is fundamental to an understanding of color as it relates to dentistry

Munsell Color System (visual color order system)

Used to describe a definite color system in a visual order system.



Munsell define three dimension or qualities for color

1. hue

Quality by which we *distinguish one color family from another* (variety of color). We have ten hue color families; 1.R-red 2.YR-yellowgreen 3.Y-yellow 4.GY-greenyellow 5.G-green 6.BG-bluegreen 7.B-blue 8.PB-purpleblue 9.P-purple 10.RP-redpurple

2. Value

Quality by which we **distinguish a light color from a dark one or the relative brightness of object** (lightness or darkness), range from zero to ten, black is zero(0) and white is ten (10)

3. Chroma

Quality of color by which we **distinguish a strong color from a weak one (the intensity or saturation of hue)**. The degree of departure of a color sensation from that of white or gray ; the intensity of a distinctive hue, **color intensity** *_Range= 0 -- 12*

Color of Human Teeth

Dr. E. B. Clark was the first to accurately describe the color of teeth. In 1931, he reported his color data from a visual analysis of 6000 teeth from 1000 patients over an 8-year period

(Hue range from YR to 9 Y) (Value range of 4 to 8) (Chroma range from 0 to 7)

Factors influence the apparent color of an object (teeth):

1) Nature of light

We have three light source **Incandescent Light, Fluorescent Light and Natural Daylight**. Most dental offices are outfitted with incandescent and fluorescent lights. **Incandescent Light** Emits high concentration of yellow waves matching. while, **Fluorescent Light** Emits high concentration of blue waves Both of two Not suitable for shade matching. **Chair light** not recommended for colour matching as it is over powering and interferes with fine discrimination of three dimensions of colour

Natural Daylight considered the **best Closest to emitting the full spectrum of white light Used as the standard by which to judge other light sources**. At Morning and evening light spectrum rich in yellow/orange, lacks blue/green because Shorter wavelengths scatter before penetrating atmosphere, While. **At Mid-day time (Hours around noon) where Full spectrum of colors visible consider ideal time for color matching**

2) Physical properties of object

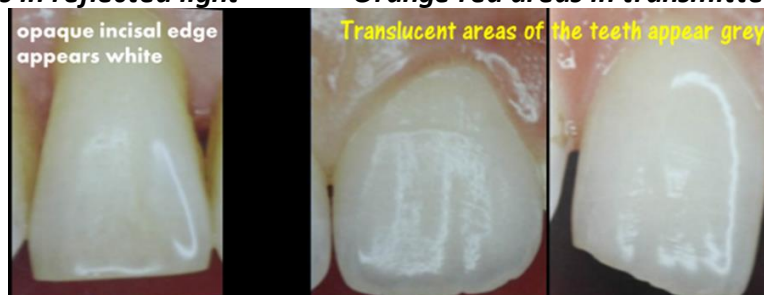
When light strikes an object, and according to the physical properties some wavelengths are **absorbed** by the object, while **other transfer** throw it, the remaining are **reflected**, color of an object – light that is actually reflected by the object. True color characteristic and appearance of depth translucency in a natural tooth cannot be correctly perceived unless the tooth is free of plaque and surface stains. With increasing opacity of teeth the grey scale value decreases and the brightness (value) increases , **The Higher the brightness (values) the lower the transparency becomes. The more transparent a tooth the more grey it appears.**

Opal Effect:

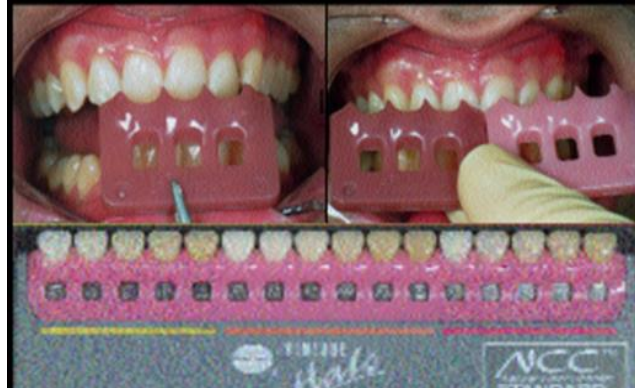
Fine particles in enamel (hydroxyapatite crystals) responsible for opal effect Fine particles reflect short wave lengths and allow longer wave lengths to pass through. Hence areas within a tooth or a restoration with higher translucency will have a lower value because light transilluminates through and away from the viewer. When evaluating enamel translucency, the observer will often focus on the opalescent blue areas that is why **Translucent areas of the teeth appear grey while opaque incisal edge appears white.** -hence tooth shows

•Bluish areas in reflected light

•Orange red areas in transmitted areas



Tooth must be kept moist during shade selection. The color environment surrounding an object influences our color perception of the tooth significantly (gum, lip color and color behind the object). The Gummy gingival mask (color contractor) was developed to neutralize the influence of the color environment on our color perception during visual shade selection.



Metamerism

phenomenon occurring when the color of the two objects appear to match under one lighting source but not under a different source, **that is why , shade selection must be evaluate under multiple light sources (different light sources)**

3) Subjective assessment of observer

The light first penetrates a layer of nerve fibers, then passes through several layers of cells, and finally reaches the rods and cones, which are embedded underneath • The rods and cones of the retina form the chief component of the retinal receptor complex. The rods detect only lightness and darkness (value). The cones perceive the chromatic aspects of an object (hue and chroma) .In Color - Deficient person which is Defect in color vision attack 8% males 0.5% females ,Several variations exist.

Achromatism – complete lack of hue sensitivity

Dichromatism – sensitivity to two primary hues

Anomalous Trichromatism – sensitivity to all three hues, with abnormality in retinal cones affecting one of primary pigments. **Dentists should have their color vision evaluated. If any deficiency is detected, a dentist should seek assistance when selecting tooth shades**

Shade Selection:

Traditional shade taking involves matching one or more selected colors from a range of shade tabs to the teeth adjacent or contralateral to the teeth to be restored. This serves as a guide to the lab technician fabricating the crown or the bridge. i.e it is Process of replicating of the color of the adjacent teeth in an artificial prosthesis, we have different methods for shade selection;

1) Visual shade matching.

Shade guide are Examples of various color combinations available from manufacturers of denture teeth, restorative resins and porcelains. These samples are compared with the natural teeth and the closest color match is determined, most commonly use shade guide in fixed prosthodontics;

a) **Vita Classic Shade Guide**

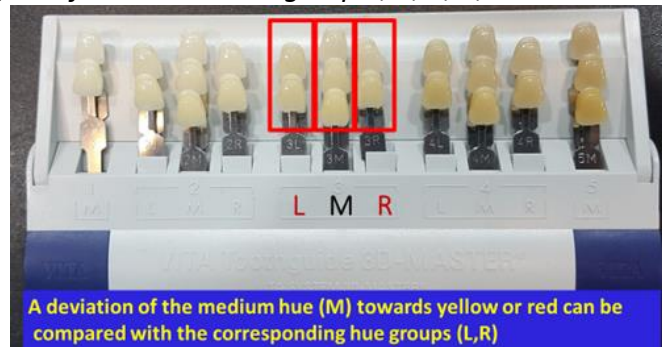
b) **Vita-3D –Master shade guide**

Principles of Shade Selection

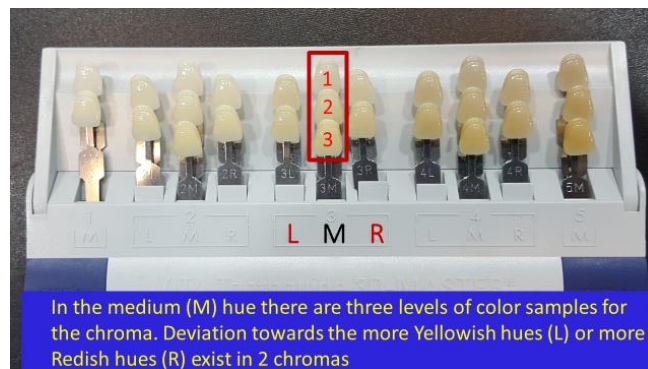
1. **Teeth to be matched must be clean & moist**
2. **Remove bright colors from field of view**
 - - makeup / tinted eye glasses
 - - bright gloves
 - - neutral operatory walls

How to use Vita-3D –Master shade guide

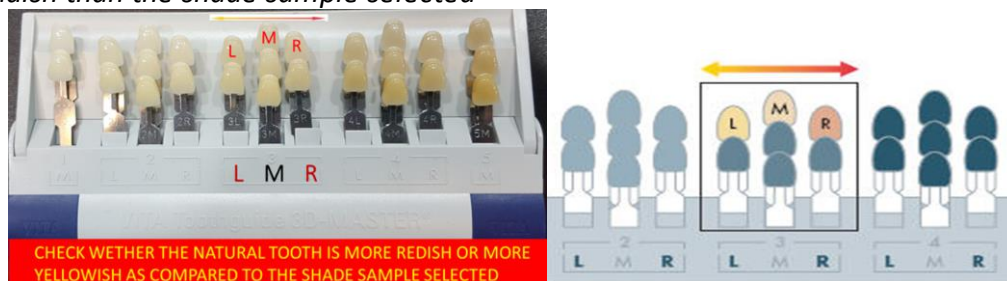
Step 1 Determine the lightness level (value). Hold shade guide to patient's mouth and start with darkest group moving to left . Select Value group 1, 2, 3, 4, or 5



Step 2 Select the chroma from From your selected Value group, remove the middle tab (M) and spread the samples out like a fan Select one of the three shade samples to determine chroma.



Step 3 Determine the hue and Check whether the natural tooth is more yellowish or more reddish than the shade sample selected



Photography & shade matching

- Consider as effective technique for shade matching
- Photography greatly simplifies the shade taking process, particularly for treatment in the aesthetic zone; providing the ceramist with a “palate” of shades rather than trying to match a single shade. (technicians need more information than just a single shade tab
- A shade tab with the shade that is closest to the shade of the tooth is placed next to the tooth in question and is photographed with the tooth.
- If needed, several photographs can be taken with different shade tabs.

2) Instrumental color analysis (Digital shade-scanning devices)

Digital devices are available that can be used to select the shade

- **Tooth should be clean & free of debris**
- **Need to hold probe perpendicular to tooth**
- **There is variation in the color depending on where the probe is located**
- **Tip centered (1– 2 mm from gingiva and incisal edge) or do 3 zones (gingival, middle, and incisal)**

The advantages of a digital shade-matching system include **objective readings and accuracy**. There are **two types** of digital shade-matching devices commonly used in dentistry: the **spectrophotometer and the colorimeter**.

The spectrophotometer **consistently and accurately** measures **natural tooth coloration in reference to any known specific color or can be based on any shading system**. It measures the color characteristics of the natural tooth precisely and scientifically, indicating the deviations and gradations of value, chroma, and hue from a standard and provides all the information that is necessary to create an accurate restoration, or to modify an existing one such that it will accurately match the tooth. The **spectrophotometer develops an accurate interpretation of the tooth shade on a given color system**, which can then be related to an existing shade tab within dentistry or to a color that is interpolated between the shade tabs. In either case a lab technician is given all the color clues to recreate a shade that is very natural in appearance and very close to the target coloration.

The **colorimeter analyzes the tooth coloration based on preloaded data that is related to a shade system**. It determines the **shade tab that is closest to the actual color of the tooth**. The **colorimeter** is typically **less accurate than the spectrophotometer** but may suffice in most dental situations.

Because both spectrophotometers and colorimeters tend to eliminate ambient light by standardizing the immediate environs of the target tooth, the shade can be taken in any operatory with any kind of lighting streaming in through the window. Digital shade taking therefore is far easier, far more practical, and far more accurate than shade taking using color tabs and the naked eye in a variable environment.

The current **best approach** to shade taking is the **spectrophotometer**. It provides the **most accurate method** for matching the coloration of the tooth. Some systems provide readings of translucence and reflectivity as well. Spectrophotometers **provide consistent shade measurement regardless of the environment, lighting conditions, or other operatory variables** including the dental team member who is conducting the shade-taking process. With some systems, a further comparative analysis can be undertaken on shade scans taken before and after treatment to provide the color difference between the two measurements. This is particularly useful for tooth-whitening procedures

An example of digital shade scanning devices

- a) VITA EASYSHADE
- b) VITA EASYSHADE COMPACT
- c) MHT SPECTROSHADE SYSTEM

CYNOVAD SHADESCAN

The system is user friendly and is integrated with computed-aided design and manufacturing (CAD/CAM) technologies. The shade is measured by a handheld optical device from a single image of the whole tooth at the click of a button. The dentist can instantly obtain a shade map of the whole tooth with various established and popular shade systems.



Provisional (temporary) restoration

Between the time that the tooth is prepared and the final crown restoration is delivered, it is important that the patient should be comfortable and the tooth should be protected and stabilized with an adequate temporary restoration so temporary crown can be **defined as** ;Crown or bridge restorations that are used in fixed prosthodontics during the interim between tooth preparation and final placement of **definitive** (permanent) crown or bridge restorations.

Why provisional restoration needed???

Provisional restoration is given for a period of time until a permanent arrangement can be made.

- *To protect the prepared tooth and kept patient comfortable.*
- *By successful treatment with provisional restoration dentist can get the patient confidence which is an influencing factor for success in the final restoration.*

Requirement of provisional restoration

A. Biological requirement

1. **Pulp Protection:** *A provisional restoration must seal and insulate the prepared tooth surface from the oral environment to prevent sensitivity and further irritation to the pulp.*
2. **Occlusal Compatibility and Tooth Position:** *provisional restoration should establish or maintain proper contacts with adjacent and opposing teeth Inadequate contacts allow over eruption and horizontal movement.*
3. **Periodontal Health:** *To facilitate plaque removal, a provisional restoration must have good marginal fit, proper contour and smooth surface.*
4. **Prevention of Enamel Fracture:** *provisional restoration should protect crown preparation margin. This is particularly true with partial-coverage designs in which the preparation margin is close to the occlusal surface of the tooth and could be damaged during chewing.*

B. Mechanical Requirements

1. **Function:** *The greatest stresses in a provisional restoration are likely to occur during chewing. Internal stresses will be similar to these in the definitive restoration. Fracture is not problem with complete crown due to adequately tooth reduction.*
2. **Removal for reuse:** *Provisional restorations often need to be reused and therefore should not be damaged when removed from teeth.*
3. **Esthetic Requirements**

The appearance of a provisional restoration is particularly important for incisors, canines, and sometimes premolars.

☐ IDEAL REQUIREMENTS OF PROVISIONAL RETORATIVE MATERIAL:

- 1- *Adequate strength and wear resistance.*
- 2- *Biocompatible.*
- 3- *Good dimensional stability.*
- 4- *Easy to contour and polish.*
- 5- *Odourless and non-irritating.*
- 6- *Chemically compatible with luting cement.*
- 7- *Aesthetically acceptable.*
- 8- *Adequate working and setting time.*
- 9- *Easy to repair.*

CLASSIFICATION

- ❖ According to method of fabrication:
 - Preformed
 - Custom made
- ❖ According to material used:
 - Resin :
 - ✓ Preformed (Polycarbonate, Cellulose acetate)
 - ✓ Custom made (Acrylics, Bis-acryl composites)
 - Metals:
 - ✓ Preformed (Aluminium, Tin silver, Nickel chromium)
 - ✓ Custom made (Cast metal alloy)
- ❖ According to duration of use:
 - Short term.
 - Long term.
- ❖ According to technique of fabrication:
 - Direct technique.
 - Indirect technique.

1. Preformed Temporary Crowns.

Generally they consist of a shell of plastic or metal and may be cemented directly on the prepared tooth following adjustments or after lining them with of a resin material. They are indicated for single or multiple preparations. These include:

A- Metal temporary crowns:

Metal crowns are mainly used for posterior teeth. They are made of stainless steel, nickel chromium or aluminum .The most commonly used metal temporary crown is **aluminum temporary crown**, which is of two types;

- 1-Non Anatomical or Flat topped cylindrical AL. temporary crown.
- 2- Morphological or Anatomical AL. temporary crown.

B- Plastic Temporary Crowns:

They are mostly used for anterior teeth, the clinical procedure for their use is nearly the same as that for the metal T.C.

Types of Plastic temporary crowns:

1-Polycarbonate Temporary Crowns: made from polycarbonate plastic combined with micro-glass fibers, they are available for anterior and posterior teeth.

2-Acrylic Temporary Crowns: made from acrylic resin (tooth colored) & they are available in different sizes and colors, they used for anterior teeth.

In case we need to improve the fitness of the temporary crown or if there is no size which approximately fit the prepared tooth, we can reline the temporary crown with resin material to improve its fitness after selection of the most suitable size and shade of the crown and cutting its margin according to the finishing line. The procedure of relining could be done either directly on the prepared tooth in a similar manner to that of celluloid temporary crown or could be done indirectly on study cast of prepared tooth.

3-Celluloid Crown forms:

They are mainly used for anterior teeth, but can be used for posterior teeth also. They are made from very thin translucent layer of cellulose acetate, they act as a mold for construction of temporary crown, they come in different size.

2. Customized temporary crown and bridge:

The fabrication of customized temporary crowns involves the construction of a mold or a matrix of the patient's teeth before they have been prepared, it may be obtained certain materials (elastic impression material), into which we place polymer resin material (**acrylic or composite**) which is held directly on the prepared tooth or teeth or indirectly against a model of prepared teeth.

□ **MATERIALS USED:**

1-Acrylics

■ **Polymethyl Methacrylate's:**

Advantages:

low cost, good wear resistance, good esthetics, high polishability, good color stability.

Disadvantages:

significant amount of heat given off by exothermic reaction, high degree of shrinkage (about 8%), strong, objectionable odor, short working time, hard to repair, must be mixed, radiolucent.

2. Poly-R' Methacrylate's (R' = ethyl, vinyl, isobutyl):

Advantages:

Low cost, less heat given off during reaction than polymethyl methacrylates, less shrinkage than polymethylmethacrylates, extended working time.

Disadvantages:

Less esthetic than others, poor wear resistance, poor color stability, strong, objectionable odor, hard to repair, must be mixed, radiolucent.

3. **Bis-Acryl Composites:**

Advantages:

Less shrinkage than acrylics, minimal heat generated during setting reaction, relatively high strength, minimal odor, excellent esthetics, most products use automix delivery, can be repaired or characterized using resin composite, easy to trim, good color stability, radiopaque.

Disadvantages:

Greater cost than acrylics, some do not have a rubbery stage, viscosity cannot be altered, sticky surface layer present after polymerization, may be more brittle than acrylics.

4. **Epimines (resin material)**

Advantages

low exothermic heat reaction during polymerization, low residual monomer content and low volumetric shrinkage.

Disadvantages

-could not be altered or repaired.

-weak (low degree of hardness).

Provisional restoration might need some time to be reinforced, ethylene fiber or glass fiber or metal casting can be used to increase their strength. The indications for such reinforcement are the following:

- 1) Long posterior span fixed partial denture long duration provisional restoration
- 2) Excessive occlusal force on the restoration
- 3) History of frequent breakage
- 4) masticatory muscles strength above average

Methods of construction of customized temporary crowns and bridge:

According to the type of material used for mold or matrix construction we have the following method:

- 1) Impression method.
- 2) Template method.
- 3) Polycarbonate matrix method.
- 4) Acrylic shell method.

TECHNIQUES FOR FABRICATION OF CUSTOMIZED PROVISIONAL RESTORATION

- 1) DIRECT TECHNIQUE
- 2) INDIRECT TECHNIQUE
- 3) DIRECT-INDIRECT TECHNIQUE

The most commonly used method is the **impression method**.

- ▶ **Alginate:** absorbs resin exotherm
- ▶ **Elastomers:** reusable

Advantages: simple, quick, inexpensive.

1) Clinical procedure for DIRECT TECHNIQUE

- 1- A preoperative over impression with alginate or silicon rubber base is made from the patient mouth or study model & carefully stored until complete teeth preparation (in case if you want to construct temporary bridge fill the missing tooth area with acrylic denture teeth and remove it after you complete preoperative over impression).
- 2- Complete the preparation of the teeth & Coat the prepared tooth with separation medium (saliva or Vaseline)
- 3- Mix tooth colored acrylic resin, the mixed acrylic were then place in the over impression at the area of the prepared tooth only. Seat over impression in it position over the dental arch
- 4- Remove over impression from patient mouth and separate acrylic restoration from the prepared teeth before acrylic completely polymerized , otherwise ,it cannot remove due to shrinkage of acrylic also to reduce the effect of heat of polymerization of acrylic on the prepared tooth (polymerization reaction of acrylic is exothermic reaction).leave the restoration a side until complete setting
- 5- Trim any excess material from the formed crown, the crown were then seat on the prepared tooth , check and adjust occlusal, the crown were then smoothen
- 6- Cement T.C. on the prepared tooth using temporary cement.



2) Clinical procedure for INDIRECT TECHNIQUE

- 1- A preoperative **over impression** with alginate or silicon rubber base is made from the patient mouth or study model & carefully stored until complete teeth preparation
- 2- Complete the preparation of the teeth. An alginate impression were then taken and pour with a fast setting plaster or stone , wait till stone is set, the cast were then separate from the impression
- 3- Coat the prepared tooth (on the cast) with separation medium (petroleum gully).
- 4- Mix tooth colored acrylic resin , mixed acrylic were then place in the **over impression** at the area of the prepared tooth only.
- 5- Seat the cast onto the over impression in upright position and maintain pressure (rubber band can used for this respect) until acrylic is set completely, be sure that the cast correctly seat into the over impression.
- 6- After complete polymerization, separate the cast from the over impression , the formed crown were then removed from the prepared tooth (from the cast).
- 7- Trim any excess material from the formed crown, the crown were then seat on the prepared tooth , check and adjust occlusal, the crown were then smoothen
- 8- Cement T.C. on the prepared tooth using ZOE cement.

3) Clinical procedure for DIRECT-INDIRECT TECHNIQUE:

1. A preoperative over impression with alginate or silicon rubber base is made for the study model (fill the missing tooth area with acrylic denture teeth prior to impression taken)
2. Remove the acrylic tooth from the cast and start Preparation of abutment on diagnostic cast (more conservative than an actual preparation)
3. Mix tooth colored acrylic resin , mixed acrylic were then place in the over impression at the area of the prepared tooth and denture tooth only.
4. Seat the cast onto the over impression in upright position and maintain pressure (rubber band can used for this respect) until acrylic is set completely, be sure that the cast correctly seat into the over impression.
5. After complete polymerization, finish restoration
6. After complete the preparation of teeth in patient mouth, try and relined the preformed restoration, finally Cement T.C. on the prepared tooth

Advantages of indirect over direct technique:

- 1) There is no direct contact of free monomers with the prepared teeth or gingival tissue which might cause tissue damage or allergic reactions.
- 2) The procedure avoids subjecting a prepared tooth to the heat of polymerization of resin (acrylic exothermic polymerization reaction).
- 3) The marginal fitness of temporary restoration is significantly better (stone restricts resin polymerization shrinkage).
- 4) Save the clinician chair time.

Vacuum formed thermoplastic (Template method) (Vacuum-Formed Template):

- Stone models of both arches are used prior to mouth prep.
- used only in presence of number of adjacent locating teeth
- Constructed with the aid of a thermal vacuum machine that adapts a plastic sheet (**clear vinyl sheet**) over the entire stone cast
- Plastic sheet is trimmed around the teeth to be prepared
- Could be used with light cured resins.

Clinical procedure:

*Prior to tooth preparation make a study model from alginate impression. In this technique, in state of using over impression as a mold or matrix for construction temporary restoration, we construct plastic matrix (to be used later as a mold) from the study model using clear plastic vacuum made matrix (translucent coping material or transparent splint material that come as sheet 5 x 5 inch dimension & 0.025 inch thickness). By the aid of Thermal Vacuum forming machine , a sheet of clear plastic vacuum made template (matrix or mold) is adapt over the diagnostic cast covering the whole dental arch. In order that fits comfortably inside the patient mouth, After teeth preparation, cut any excess from plastic matrix that might interfere with accurate seating of template(matrix). If too much of matrix is removed it well makes the final placement of crown in the patient mouth more difficult. **Quadrant matrix is the most comfortable.** Then follow the same steps discus in impression method*

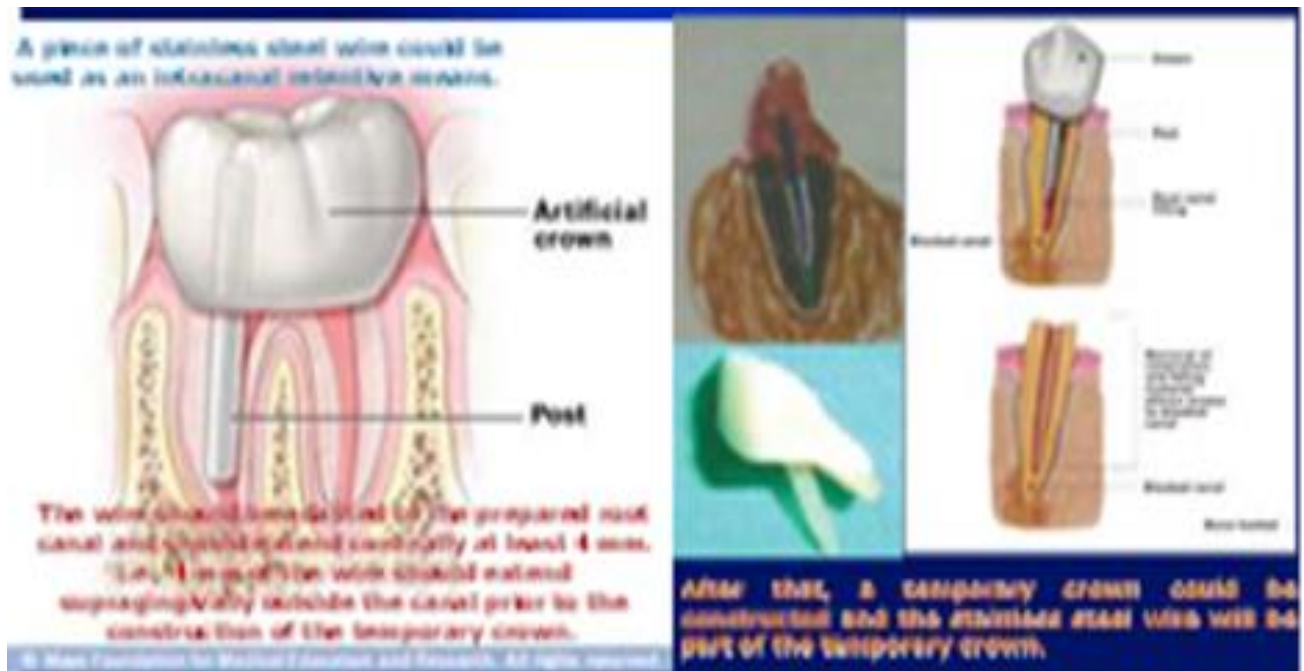


Direct versus Indirect

- *Direct is faster for routine provisional restorations*
- *Indirect can save time with multiple units or complex fixed partial dentures*
- *Indirect provisionals can be fabricated in advance of the tooth preparation appointment*

Temporary restoration for tooth prepared to receive post crown.

It is often difficult to fabricate T.C. for a tooth that has been prepared for postcrown because there is so little of tooth structure left standing supragingivally that cannot give support to the T.C , so, in such a case we need intra canal retentive mean to give retention for the T.C. A piece of stainless steel wire can be used intra canal retentive mean, it should be place and adapted to the prepared canal (the wire should extend coronally so that we will have at least 4mm. of the wire extend supra gingivally outside the canal) prior to construction of the temporary crown. After that you can construct the T.C. in the normal way ,as result at the end the wire will be a part within the formed temporary crown.



CEMENTATION OF PROVISIONAL RESTORATION

❑ IDEAL PROPERTIES OF CEMENT:

- Ability to seal against leakage of oral fluid.
- Strength consist with intentional removal.
- Low solubility.
- Chemical compatibility with provisional polymer.
- Ease of eliminating excess.
- Adequate working time and short setting time.

❑ CEMENTS USED:

- 1) Zinc oxide eugenol.
 - 2) Reinforced zinc oxide eugenol , The liquid can be ethoxybenzoic acid, known as ZOEB, making it stronger.
 - 3) Non- eugenol cements, do not soften resin (as in provisional restorations), They use carboxylic acids in place of eugenol.
 - 4) TempBond Clear is a translucent cement with Triclosan (an antibacterial & antifungal agent)
- ❖ Zinc oxide eugenol cement is the most commonly used cementing medium for T.C and bridge. This cement promote healing and allow easy removal of the temporary restoration
Zinc phosphate, Zinc polycarboxylate, and Glass ionomer cements are not used because their comparatively high strength makes intentional removal difficult.