Shade Selection(Matching):

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

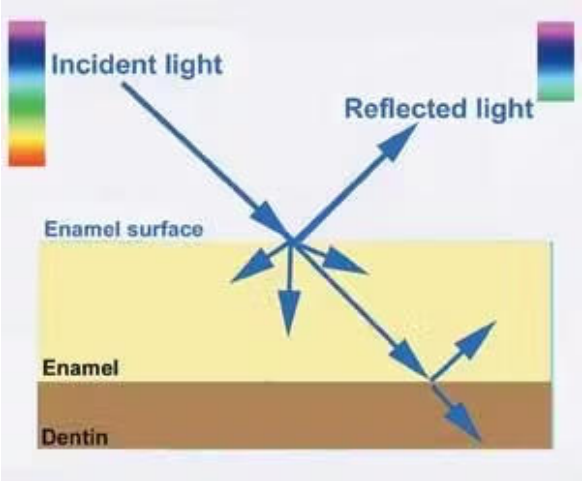
Shade Selection in fixed prosthodontics:

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".

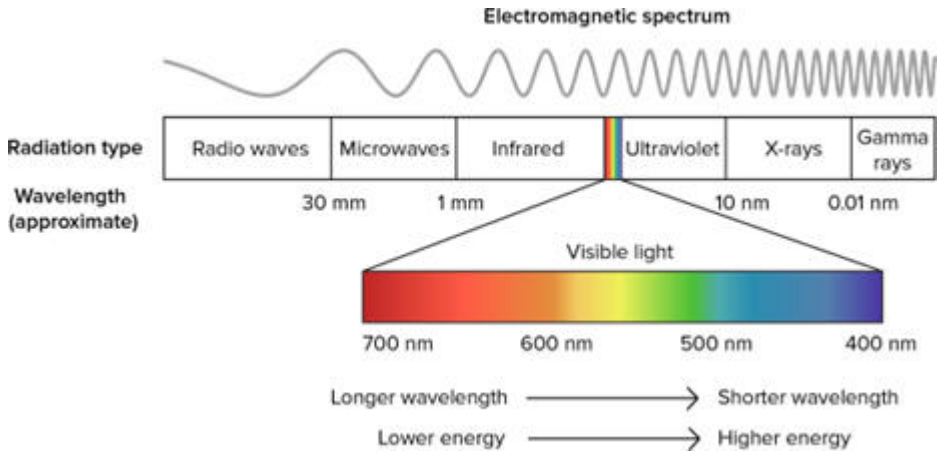
Color that is perceived is the result of a light source, *the object that absorbs, transmits, reflects or scatters the light from the source*, and the interpretation of the result by the human visual system. Without Light Color Does Not Exist

Color & Light

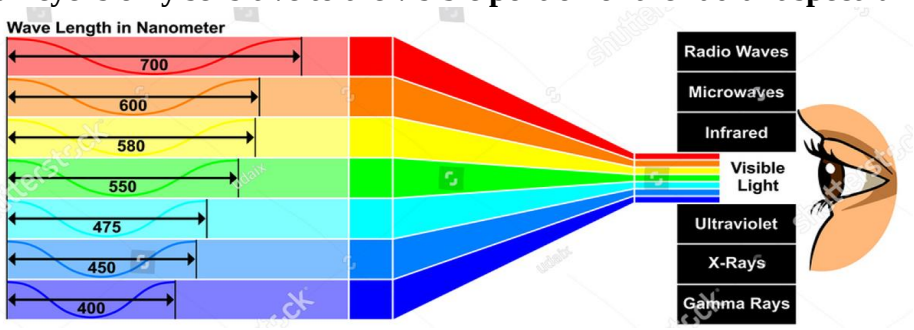
- The color of an object is determined by the light that enters the human eye from that object
- What is commonly called "the color of a tooth" is actually the color of the reflected light.



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



Human eye is only sensitive to the visible portion of the radiant spectrum energy



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. Thi led to the development of the Munsell Color System, which is presently a widely used visual colo 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)

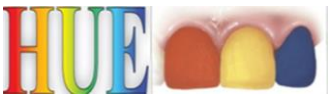
Used to describe a definite color system in a visual order system.

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 hu color families; **1.R-red 2.YR-yellowgreen 3.Y-yellow 4.GY-greenyellow 5.G-gree 6.BG-bluegreen 7.B-blue 8.PB-purpleblue 9.P-purple 10.RP-redpurple.***

Each of these ten hues is further subdivided into ten numbered segments. The middle red would thus be 5R

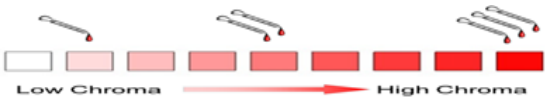




2.Chroma

Quality of color by which wedistinguish 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





3. Value

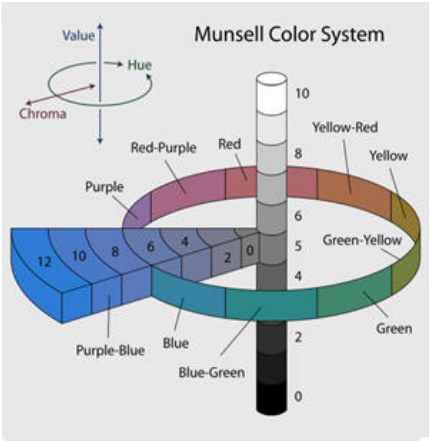
Quality by which we ***distinguish a light color from a dark one or the relative brightness o object*** *(lightness or darkness), range from zero to ten, black is zero(o) and white is ten (10).* The value of color is
determined by which one of the grays it matches on the scale. Colors with low value numbers are termed dark colors, and one with high value numbers are called light colors. A black-and-white television tube emits only a range of values 9.





Value is generally considered to be the most important of the three dimensions of color • One reason is that lightness and darkness differences are readily detected by individuals untrained in color perception • Another reason is that value differences are more easily detected at a variety of viewing distances (both close-up and at a distance), whereas differences in hue and chroma become more difficult to quantify as the viewing distance increases.

Munsell Color System
It compose of central core representing
Value (as you move from bottom to the top of the core value increase from 0 to 10)
Hue is represent by circle that surround the central core (it involve ten hues that is further subdivided into ten numbered segments. The middle red would thus be 5R and so on for other hue).
As you move from the central core to the outside Chroma increase (each colour 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 6YR **to** 9.3Y **)** **(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 (Opalescence):

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 Gumy gingival mask*** *(color contrastor) was developed to neutralize the influence of the color environment on our color perception during visual shade selection.*

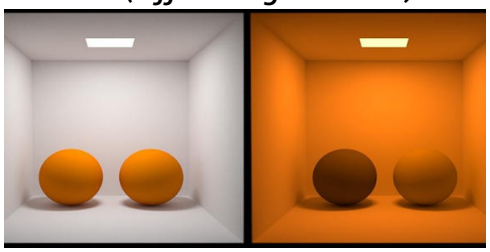


Metemerism

Phenomenon occurring when the color of the two objects appear to match under one lighting source but not under a different source.

Clinical significance of Metemerism

Tooth & crown restorative material of a differing shade may appear matched under certain light conditions , but may show discrepancy in day light, 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 and 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 Methods

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.

*Visual shade selection by comparison of a patient's tooth with a color standard (i.e. commercially available shade guide) .**A Dental Shade Guide** is a set of simulated teeth used to select prosthetic teeth by color. 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***
- ***c) VITA Linearguide 3D-MASTER***

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***
3. ***View patient at eye level***
4. ***Evaluate shade under multiple light sources***
5. ***Make shade comparisons at beginning of appointment***
6. ***Shade comparisons should be made quickly to avoid eye fatigue.***
7. ***selection distance- a selection made at 3-6 feet from the oral cavity is often more useful, since it is representative of the conditions under which the patient teeth will most often be observed.***
8. ***Use of color Contrastors ; The color environment play important role in our color perception of the grey tooth significantly***
9. ***Shade tap position; Shade tap should be held above the mand tooth or Below the max tooth to be match and aligned as close as possible to the plane of orientation of the facial surface Of the tooth being matched. Holding the shade tab over the tooth can give a false impression of the color as the background of the tab is the tooth color rather than the oral***

a) Vita Classic Shade Guide

Very popular shade guide, Tabs of similar hue are clustered into letter groups;

A (red-yellow) , B (yellow) , C (grey) , D (Gray / red-yellow)



How to use Vita Classic Shade Guide

Manufacturer recommended sequence for shade matching as follow

1. Hue Selection 2.Chroma Selection

3. Value Selection: Because value level is not involve in this shade guide, *Use of second, value ordered shade guide is recommended (**Value oriented shade guide**)*

Value oriented shade guide

B1, A1, B2, D2, A2, C1, C2, D4, A3, D3, B3, A3.5, B4, C3, A4, C4,

(bright >>>>>>>>>>>>decrease>>>>>>>>>>>>>>>>>> dark)

***4.** Final Check / Revision*

b) Vita-3D –Master shade guide

More precise shade guide, tooth color divided into 5 level of value, for each value group deviation from medium hue towards yellow or red. In the medium (M) hue there are three levels of color samples for the chroma , deviation toward more yellowish hues (L) or more reddish hue (R) exist in 2 chroma

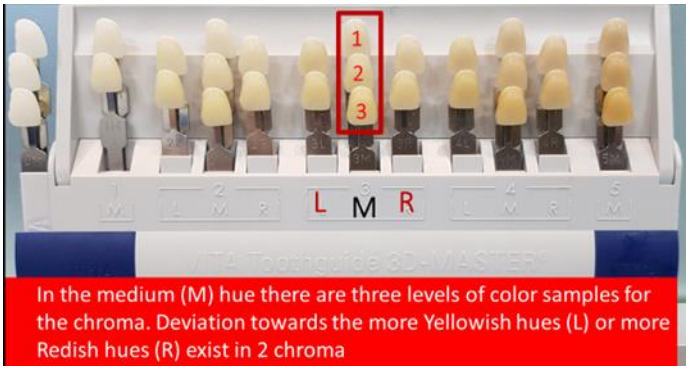


How to use Vita-3D –Master shade guide

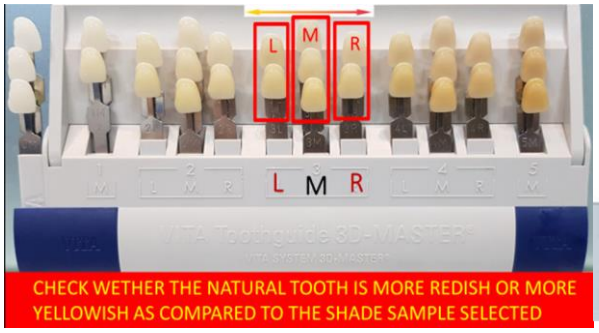
Step 1 Determine *the lightness level (value).Hold shade guide to patient's mouth and start with darkest group moving to left. Select Value group 1, 2, 3, 4, or 5*

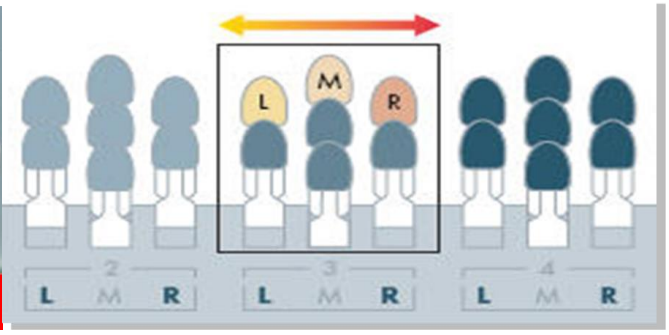


Step 2 *Select the chroma from your selected Value group, remove the middle tab (M) and spread the samples out like a fan Select one of the three shade samples to determine chroma.*



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





c) *VITA Linearguide 3D-MASTER SHADE GUIDE*

The all-new VITA 3D-Master Linearguide enables the quick determination of precise tooth shades and uses the same scientific principles and 29 shades found in the popular VITA 3D-Master shade guide. The Linearguide features a sleeker, linear design that makes the process of precise shade determination even faster and easier. In two simple steps the final shade is achieved, first by selecting from five value tabs, then by choosing the proper mix of chroma and hue within the selected value range.

With the VITA Linearguide 3D-MASTER you can determine the correct tooth shade swiftly and accurately. The modern design and systematic structure of the VITA Linearguide enable the appropriate 3D-MASTER shade to be found quickly.

Shade taking in two steps:

Step 1:Remove the VITA Value guide 3D-MASTER from the top of the Linearguide.

The correct degree of lightness can now be determined by removing the Valueguide. Make an initial choice using the Value guide. In doing so, you determine the correct degree of lightness 0 to 5.

***Step 2: Make** a detailed choice within the determined degree of lightness from step 1 using the corresponding VITA Chroma/Hue guide.*





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)*

To be able to take the color with objective methods, there are nowadays Digital devices that available that can be used to select the teeth shade. ***The advantages*** of a digital shade-matching system include ***objective readings and accuracy***. *There are several devices some of them are colorimeters, spectrophotometers, digital color analyzers and hybrid instruments, which combine all technologies. These are electronic instruments to facilitate the taking of color in a reliable, accurate and repeatable way for different professionals.* There are ***two types*** of digital shade-matching devices commonly used in dentistry: the ***spectrophotometer and the colorimeter***.. *Colorimeters are objectively measuring instruments of color which have a light source and a small tip to make it possible to take color in several areas of the same tooth. Spectrophotometers are the instruments that currently have more precision in color taking. These measure the color by emitting a defined light. In addition, they have the ability to measure the reflection of a color by translating it to numerical values, which are interpreted.*

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. T

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 key difference between the two is that the spectrophotometer measures the transmittance and reflectance as a function of wavelength, whereas the colorimeter measures the absorbance of specific colors.

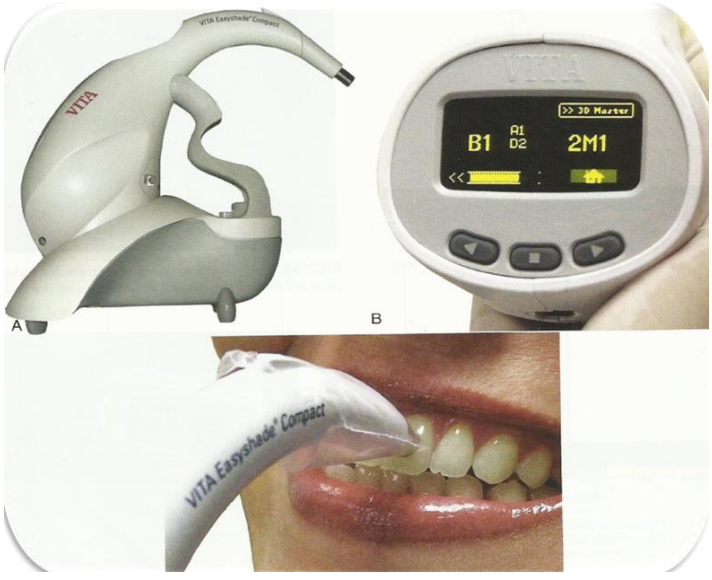
The current **best approach** to shade taking is the **spectrophotometer**. It provides the ***most accurate method*** for matching the coloration of the tooth. Some systems provide readings of translucence and reflectivity as well. Spectrophotometers ***provide consistent shade measurement regardless 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*

Instructions for using digital shade scanning devices

- ***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)***



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) Restorations

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 Provisional (temporary) restoration in fixed prosthodontics 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.*

C. Esthetic Requirements

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

- ***IDEAL REQUIRMENTS 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

- *<u>According to method of fabrication:</u>*
  - *Preformed*
  - *Custom made*
- *<u>According to material used:</u>*
- *Resin :*
  - ✓ *Preformed (Polycarbonate, Cellulose acetate)*
  - ✓ *Custom made (Acrylics, Bis-acryl composites)*
- *Metals:*
  - ✓ *Preformed (Aluminium, Tin silver, Nickel chromium)*
  - ✓ *Custom made (Cast metal alloy)*
- *<u>According to duration of use:</u>*
  - *Short term.*
  - *Long term.*
- *<u>According to technique of fabrication:</u>*
  - *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, and 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' teeth before they have been prepared, it may be obtained certain materials (such as 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.*

Most Commonly Used Matrices (Mold) Material for Provisional Restorations are:

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

Advantages: simple, quick, inexpensive.

- *Vacuum formed thermoplastic:*
  - *Clear vinyl sheet on stone duplicate of the wax up.*
  - *Used only in presence of number of adjacent locating teeth*
  - *Could be used with light cured resins.*
- *Proprietary celluloid crown form*

MATERIALS USED FOR CONSTUCTION OF CUSTOMIZED PROVSIONAL RESTORATIONS:

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.

- ***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.

2. ***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.

3. ***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 reinforce, ethylene fiber or glass fiber or metal casting can be used to increase their strength. The indication for such reinforcement are the following:

1) *Long poster 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).*

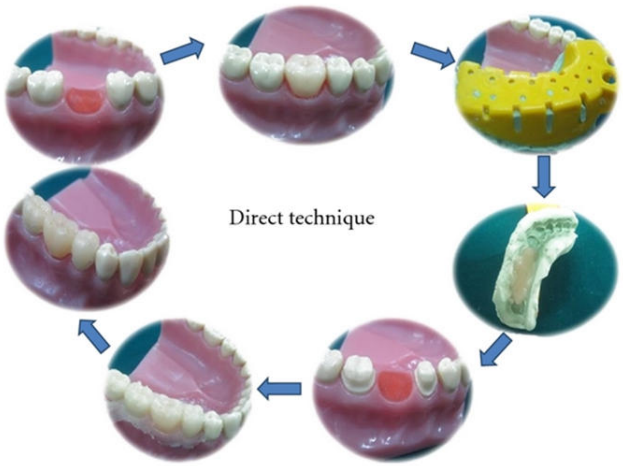
2- *Complete the preparation of the teeth& Coat the prepared tooth with separation medium (saliva or Vaseline)*

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).*

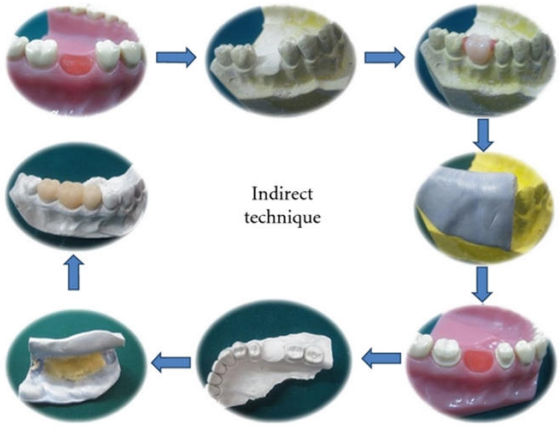
4- *Mix tooth colored acrylic resin, mixed acrylic were then place in the* ***over impression*** *at the area of the prepared tooth only.*

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).*

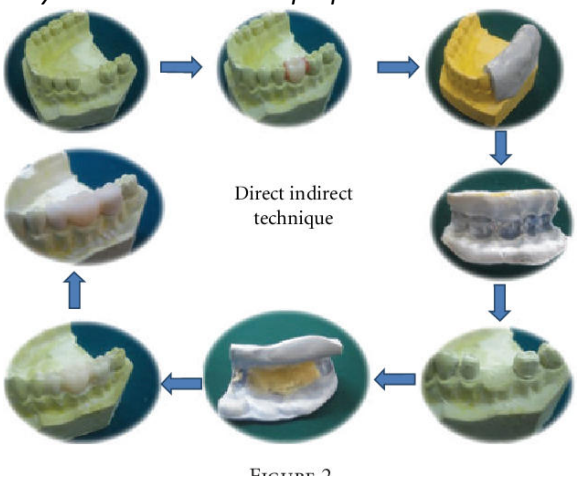
7- *Trim any excess material from the formed crown, the crown were then seat on the prepared tooth , check and adjust occlusal, the crown were then smoothen*

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 Preparetion 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 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*

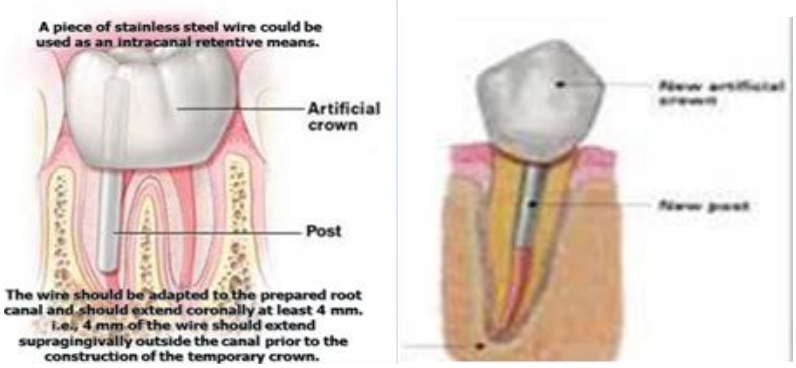


Direct versus Indirect

- *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.



Laboratory-made temporary restoration

We take a preoperative alginate impression and in lab do preparation on the cast after pouring and setting of stone and a temporary crown or bridges is done.

Digital interim fixed prosthesis

(CAD/CAM) production of restorations, definitive restorations can be fabricated the same day as tooth preparation, and interim crowns are not necessary. However, not all clinical situations are amenable to treatment with same-day CAD/CAM restorations, necessitating the use of interim restorations. Such situations include the need for large reconstructions, evaluating the effects of changes in occlusion in the presence of a temporomandibular - disorder, a planned change in occlusal vertical dimension, and the period of healing of pontic or implant site. In these situations, interim restoration can be extremely helpful. The patient can evaluate comfort, function, and appearance before the fabrication of the definitive restorations.

Interim restorations can be fabricated by means of a digital workflow. ***The Tissue surface form (TSF) consists*** *of three-dimensional virtual image of the prepared tooth.*

The External surface from (ESF) consists of one of the following:

- ***a three-dimensional virtual image of the intended tooth before preparation,***
- ***a scan of a preoperative diagnostic waxing,***
- ***a virtual shape proposal generated by computer***

The digital information is sent to a milling machine at the time of tooth preparation and the TSF and ESF are milled from solid blocks/disks of resin. Thus there is no need to have analog representations of the TSF and ESF or to then fill a mold cavity with material Resins available

Materials use for milling interim restorations include PMMA and composite.

The CAD/CAM process reduces the patient's exposure to chemicals dramatically, inasmuch as the commercially produced blanks from which interim restorations are milled contain only approximately 1% residual-free monomer. Therefore, the digital method of fabricating an interim crown is an entirely indirect method. The CAD/CAM interim restorations have been shown to be stronger and more accurate than traditional bis-acryl composite prostheses.

Another advantage of the digital production of interim restorations is that the data file can be used to mill the definitive restoration, if the tooth preparations (and tissue contours) have not been altered.

Advantages:

1. *Efficient.*
2. *No laboratory work needed.*
3. *Easy on tissues.*
4. *Lowest residual monomer.*
5. *Generally more wear resistant.*
6. *No air-inhibited layer.*
7. *No polymerization shrinkage; some can be bonded to tooth structure.*
8. *Definitive restoration can be milled as an exact duplicate of interim.*

Disadvantages*:*

1. *Digital impression and in-office mill needed*
2. *Some blanks are monocolor.*

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 ZOEBA, 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.*

LIMITATIONS OF PROVISIONAL RESTORATION

- *Lack of adequate strength—fracture of provisional is possible in long span FPDs, patient with bruxism and reduced interocclusal clearance.*
- *Inadequate marginal adaptation.*
- *Poor aesthetic in long term provisional restoration.*
- *Plaque accumulation due to poor surface characteristic.*
- *Compromised bonding characteristics.*
- *Mild to moderate tissue irritation*