Reading Material for

Dental Technician

Paper-B

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Subjects

- Prosthodontics-II
- Orthodontics
- Implantology

PREFACE

A two years post matric teaching program of Dental Technician for the students of Allied Health Sciences. The purpose of this reading material is to provide basic education to the paramedics about Prosthodontics, Implantology and Orthodontics. This reading material attempts to cover almost all the basic theoretical knowledge required by students in these subjects so that they can perform their work better in Dental Laboratories.

Table of Contents

Prosthodontics- II

BRIDGE (FIXED PARTIAL DENTURE)

DEFINITION

It is a fixed dental prosthesis which replaces and restores the function and esthetic of one or more missing natural teeth. It cannot be removed from the mouth by the patient. It is primarily supported by natural teeth or roots.

TYPES OF BRIDGES

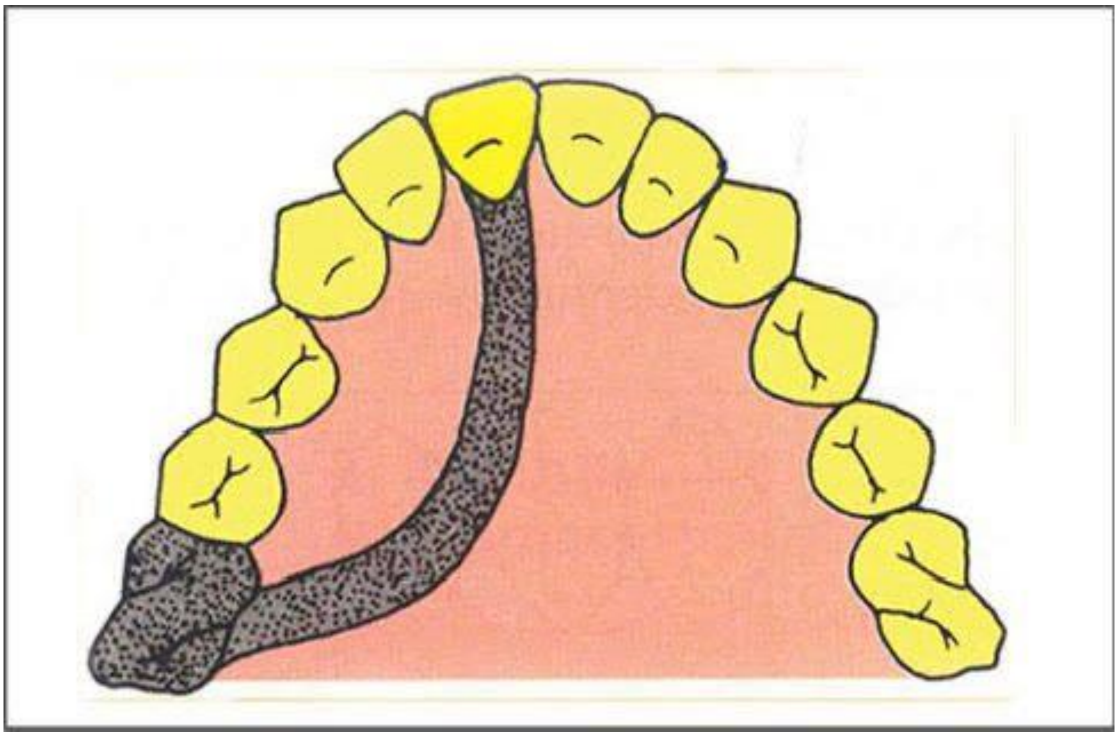
1. **Conventional fixed partial dentures**
   They are the most used type of fixed partial dentures. The design involves fabrication of a fixed partial denture, which takes support from abutments on either side of the edentulous space. The design may vary according to the condition of the abutments but the abutments on either side should be able to support the fixed partial denture.

2. **Cantilever fixed partial dentures**

Cantilever fixed partial denture is used when support can be obtained only from one side of the edentulous space.

3. Spring cantilever fixed partial dentures

This is a special cantilever bridge exclusively designed for replacing maxillary incisors, but these dentures can support only a single pontic. Support is obtained from posterior abutments, usually a single molar.



4. **Resin bonded bridge**

It is also called resin retained bridge. It is a type of fixed dental prosthesis for the replacement of a single missing tooth. The design of the bonded bridge consists of an artificial tooth with the wing-like extension which is bonded to the neighboring tooth or teeth.

DENTAL CERAMIC

Dental ceramic is a dental material that is used by dental technicians to create dental restorations such as crowns, bridges and veneers. They are esthetic, biocompatible, insoluble and hard.

Composition of Dental ceramic

Ceramic used in dental application differs in composition from conventional ceramic to achieve optimum aesthetic components such as translucency.

An example of the composition of dental feldspathic porcelain is as follows:

- Kaolin 3-5%
- Quartz (silica) 12-25%
- Feldspar 70-85%
- Metallic colorants 1%Glass up to 15%

Types of dental ceramics

The range of dental ceramics determined by their respective firing temperatures are:

Ultra-low-fusing Fired below 850 °C - mainly used for shoulder ceramics (aims to combat the problem of shrinkage, specifically at the margins of the prep, when the early sintered ceramic state is fired to produce the final restoration), to correct minor defects and to add colour/shading to restorations.

Low fusing Fired between 850 and 950 °C - to prevent the occurrence of distortion, this type of ceramic should not be subjected to multiple firings.

High fusing This type is used mainly for denture teeth.

Laboratory procedure

The *dentist* will usually specify a shade or combination of shades for different parts of the restoration, which in turn corresponds to a set of samples containing the porcelain powder.
There are two types of porcelain restorations:

- Porcelain fused to metal

- Complete porcelain

Ceramic restorations can be built on a **refractory die**.

Refractory die is a reproduction of a prepared tooth. It is made of a strong material with the ability to withstand high temperatures, or it can be constructed on a metal coping or core.

For ceramic fused to metal restorations:

1. The black color of metal is first masked with an opaque layer giving it a shade of white.
2. Consecutive layers are built up. The powder corresponding to the desired shade of dentine base is mixed with water before it is fired. Further layers are built up to mimic the natural translucency of the enamel of the tooth.
3. The porcelain is fused to a semi-precious metal or precious metal, such as gold, for extra strength.
4. Systems which use an aluminium oxide, zirconium oxide or zirconia core instead of metal, produces complete porcelain restorations.

Firing

- Once the mass has been built up, it is fired to allow fusion of the ceramic particles which in turn forms the completed restoration; the process by which this is done is referred to as 'firing'.
- The first firing forces water out and allows the particles to coalesce. During this initial process, a large amount of shrinkage occurs until the mass reaches an almost void-free state; to overcome this the mass is built-up to a size larger than the final restoration will be.
- The mass is then left to cool slowly to prevent cracking and reduced strength of the final restoration.
- Adding more layers to build up the restoration to the desired shape and/or size requires the ceramic to undergo further rounds of firing.

- Staining Ceramic can also be stained to show tooth morphology such as occlusal fissures and hypoplastic spots. These stains can be incorporated within the ceramic or applied onto the surface.

Glazing

- Glazing is required to produce a smooth surface and it's the last stage of sealing the surface as it will fill porous areas and prevent wear on opposing teeth.
- Glazing can be achieved by re-firing the restoration, which fuses outer layers of the ceramic.

- It can also be done by using glazes with lower fusing temperatures; these are applied on the outer surface of the restoration in a thin layer. Any adjustments are then made with polishing rubbers and fine diamonds.

Use of CAD-CAM

Recent developments in CAD/CAM dentistry uses following ceramic materials:

- Special partially sintered ceramic (zirconia)
- Glass-bonded ceramic or
- lass-ceramic (lithium disilicate)

Ceramic is formed into machinable blocks, which are fired again after machining.

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By utilising in-office CAD/CAM technology, clinicians are able to design, fabricate and place all-ceramic inlays, on lays, crowns and veneers in a single patient visit.

Ceramic restorations produced by this method have demonstrated excellent fit, strength and longevity. Two basic techniques can be used for CAD/CAM restorations:

- Chairside single-visit technique
- Integrated chairside–laboratory CAD/CAM procedure

USES OF DENTAL CERAMICS

Ceramic restorations

Ceramic material is used in the multiple dental restorations such as:

- Veneers, Inlays
- Onlays
- Crowns, Bridges
- Implant supra- and sub-structures
- Denture teeth

However, each system will have its own set of specific indications and contraindications which can be obtained from the manufacturers guideline.

Other uses

Denture teeth

- Poly(methyl methacrylate) (PMMA) is the material of choice for denture teeth, however, ceramic denture teeth have been, and still are used for this purpose.

- The main benefit associated with the use of ceramic teeth is their superior wear resistance.
- There are, however, a number of disadvantages in using ceramic for denture teeth, including their inability to form chemical bonds with the PMMA denture base; rather, ceramic teeth are attached to the base via mechanical retention which increases the chance of debonding during use over time. Additionally, they are more likely to fracture due to their brittle nature.

Endodontic posts

- Ceramic can be used in the construction of non-metallic posts, however, it is a brittle material and as such may fracture within the root canal or may cause fracture of the root due to its increased strength.
- Another disadvantage is that once placed, removal may not be possible.

ACRYLIC RESINS

- Acrylic resins are hard, brittle, glassy polymers.
- Acrylic resin is clear and colorless, making it an excellent replacement material for glass in storm doors.
- Acrylic resins are easily colored.
- Technically, acrylic resins are classified as thermoplastic materials, and many commercial products are made by injection molding acrylic materials.
- In dentistry, however, acrylic resins are handled more like a thermoset material; after it sets, it is not heated and molded.
- The most common acrylic monomer is methyl methacrylate.

Acrylic Resins as Biomaterials

Acrylic resins were developed in the 1930s and were first used in dentistry in the 1940s. They quickly replaced materials previously used in the construction of dentures.

Acrylic Resin Systems Used in Dentistry

Acrylic resin systems set by addition polymerization in the same manner as dental composites.

A. Cold-Cure or Chemically Activated Acrylic Resins

Cold-cure or **chemically activated** acrylic resin systems are supplied as a powder and a liquid.

Components of an Acrylic Resin System

1. Liquid

- The liquid is mostly **monomer**, methyl methacrylate.
- A cross-linking agent, such as glycol dimethacrylate, is added.
- An inhibitor is always added to methyl methacrylate to prevent premature polymerization; hydroquinone is most commonly used.

2. Powder

- The powder is predominantly polymethyl methacrylate resin with added colorants and benzoyl peroxide.

- It is usually composed of very small beads of acrylic resin.
- When activated, benzoyl peroxide forms free radicals to initiate polymerization.

	Cold (Chemical) Cure	Heat Cure
Liquid	Methyl methacrylate	Methyl methacrylate
	Hydroquinone	Hydroquinone
	Ethylene glycol	Ethylene glycol
	Tertiary amine	
Powder	Acrylic resin powder	Acrylic resin powder
	Benzoyl peroxide	Benzoyl peroxide
	Fibers and colorants	Fibers and colorants

Physical Changes During Setting

When the powder and liquid of an acrylic resin system are mixed, several stages in the setting process occur.

- During the initial stages, the changes are physical. The mixed powder and liquid have a “grainy” or “sandy” feel. The powder and liquid are separate phases.
- As some powder dissolves, the mixed material becomes thicker and less “runny.”
- As more powder is dissolved, the material reaches the “dough” stage. At this point, the material is easy to handle and mold, and up to this point, the changes are mainly physical.

Polymerization Reaction

- A cold-cure or chemically activated system has an activator, typically a tertiary amine, added to the liquid.
- When the powder and liquid are mixed, the benzoyl peroxide and the tertiary amine react to produce free radicals.

- The inhibitor in the liquid destroys the free radicals that are initially produced and working time results. This occurs while the material goes from a grainy to a dough stage.
- When the inhibitor is used up, typically during the dough stage, chemical changes occur, and the polymerization reaction proceeds.
- The doughy material thickens and becomes stiffer.
- The reaction generates heat as well, and the material becomes warm.
- Many times, when a mass of material is mixed as in the construction of a custom tray, the material becomes hot to the touch.
- The material becomes rigid and solid as polymerization reaches completion.

Residual Monomer

Initially, the set material contains some residual monomer. Any monomer that does not polymerize soon evaporates, leaving little or no monomer or unreacted double bonds in the set material.

Cross-Linking

- Cross-linking the resin improves mechanical properties.
- A linear resin without any cross-linking agent is brittle.
- Addition of a cross-linking agent improves the toughness of the material.

B. Heat-Activated Acrylic Resins

Heat-activated acrylic resin systems are very similar to chemically activated systems. The major exception is that no chemical activator is present in the liquid. A minor difference is that less inhibitor is present in the liquid. The inhibitor is not needed to provide working time; it functions as a preservative, reacting with free radicals to prevent polymerization during storage.

- **Heat-activated** systems are supplied as powder/liquid systems similar to those of cold-cure resins.
- When the powder and liquid are mixed, they go through the same initial stages of the setting process.
- Because no chemical activator is present, the mixed material stays in the dough stage for an extended period of time. Therefore, working time is much longer than it is for heat-cure acrylic resins.
- After the material is formed into the desired shape (to be explained later), the material is heated in a water bath. The heat breaks down the benzoyl peroxide, forming free radicals.

- Polymerization proceeds by changing the dough into a rigid material.
- Products that are properly heat cured are a bit stronger and tougher than cold-cure acrylic resins.

C. Light-Activated and Dual-Cure Acrylic Resins

- Light-activated and dual-cure acrylic resin systems are available, but they are not as popular as light-activated and dual-cure composites.
- Recently, light-activated and dual-cure composite materials for temporary crowns, custom trays, and other acrylic resin uses have been introduced. Because these composite materials are stronger, they are gaining acceptance.
- As prices decrease, they may completely replace acrylic resins for some uses.

D. Acrylic Resin Systems and Porosity

Regardless of the type of activation of an acrylic resin system, porosity is a major concern. Methyl methacrylate and other monomers evaporate easily at room temperature. If monomer evaporates during handling or processing, the resulting material will be porous. Porosity weakens the material.
Also, the denture is likely to collect debris in pores and develop an offensive odor and taste.
A great deal of effort is made to prevent porosity when acrylic resins are processed.
Pressure and temperature controls are used to minimize porosity.

Denture Teeth

Denture teeth come in a variety of shapes, sizes, and shades. The shape is chosen to match that of the patient's natural teeth, usually as judged from an old photograph. Another technique is to use the shape of the face to select the tooth shape. The size is determined by the size of the patient's arch. The shade of the teeth is chosen to match the patient's natural complexion. Often, the patient desires white teeth and must be counselled as to the true color of natural teeth, because bright white teeth will look artificial.

1. Acrylic Resin Teeth

Today, most denture teeth are made from acrylic resin much like that used to construct the denture base. Denture teeth have more cross-linking agents added. Because the teeth are constructed under tightly controlled conditions at a manufacturing plant, they are stronger than the acrylic material used for the denture base. Acrylic denture teeth are “chemically” bonded to the acrylic denture base during processing of the denture.

2. Porcelain Teeth

Porcelain teeth are made by manufacturers in much the same shapes, sizes, and shades as acrylic teeth. Porcelain teeth are much harder and more stain-resistant compared to acrylic teeth. Porcelain teeth are rarely used, however, both because they excessively wear the opposing teeth and because it is generally believed they cause trauma and bone loss in the supporting and opposing alveolar ridges. Porcelain teeth are held in the denture by the mechanical undercuts of pins that are embedded in the back of the denture tooth.

ABRASION AND ABRASIVE AGENTS

Abrasive Agent

“It is a material which is harder than the material which needs to be abraded (restoration or appliance). The abrasive particles should possess sharp edges that cut rough surface of the abraded material. The abrasive particles could be bonded together to form grinding wheel or may be carried across the surface of bristles of a revolving brush or buff or bonded to a piece of cloth or paper and rubbed across the surface.”

Dentists use dental abrasives often for finishing and polishing, Dentures, removable partial dentures, crowns, bridges, and direct dental restorations are among the dental appliances finished and polished.

Factors Affecting Abrasion

Abrasion is affected by the size, irregularity, and hardness of the particles and their number, pressure, and speed.

To control abrasion appropriately, clinicians must be aware of these factors.

Particle Size, Irregularity, and Hardness

An abrasive particle’s size, irregularity, and hardness determine how deeply it scratches the material’s surface and, therefore, how much is removed. For example, pumice can be found in various levels of coarseness, and it can have a significant effect on cementum and amalgam. Also, the rate of the abrasion will depend on the material used, the pressure, and the rotation speed.

Abrasive materials

In dentistry, various natural and synthetic (manufactured) materials can be utilized. The following materials are categorized by how abrasive they are, from most to least.

1. Diamond

- In mohs' hardness scale, a diamond rates 10 out of 10. It makes it suitable for abrading any substance.
- Due to their cost and non-disposability, rotary diamonds are usually bonded to rotating disks or shanks in varying degrees of coarseness.
- Sterilized, they can be reused several times before wearing out.
- Diamond paste is used to polish composite and porcelain restorations.
- Crown and bridge preparations are cut with them, and composite restorations are polished with them.

2. Carbide Finishing Burs

With designs ranging from 7-30 cutting flutes, tungsten carbide finishing burs are available in several shapes.

- A bur with more flutes will have a finer finish.
- On the Mohs' scale, these burs rank between 8 and 9.
- Usually, they are used to finish composite restorations.

3. Silica Carbide

- The material silicon carbide is an abrasive material that has a Mohs' hardness of 9 to 10.

- It is used mostly in finishing procedures that use silicon carbide–coated disks and rotary elements.

4. Aluminium Oxide

- The powdered form of aluminium oxide is usually white or tan.
- Sandblasting and air abrasion are used to prepare restorations for cementation.
- Burlew wheels are made of rubber impregnated with aluminium oxide.
- Abrasives of this type are available in several grits. It smooths enamel, metals, and ceramics.

Finishing and Polishing Materials

Dental restorations are finished and polished before placement in the oral cavity (except for direct filling) to provide:

1. Good oral health.

This is maintained by:

a. Resisting the accumulation of food debris and pathogenic bacteria by reducing the roughness of the restoration surface.

b. Smooth surfaces are easier to maintain in hygienic state.

c. With some metal restoration, tarnish and corrosion activity can be

reduced if the surface is highly polished.

2. Oral function

Function is enhanced because food glides more freely over occlusal

surface and embrasure surface during mastication.

3. Esthetic

Give gloss to the visible surface of restoration.

POLISHING MATERIALS

It is the material which causes the fine scratches to be filled and to

produce smooth surface. The rapid movement of the

polishing agent across the surface heats the top layer of the material and

causes it to flow and fill in the scratches.

Polishing materials are:

1. Rouge (iron oxide):

It is red powder or cake, it is rather dirty to handle, but it produces excellent shine on gold alloy.

2. Whiting (precipitated chalk):

It is mild abrasive used for softer materials and polymers; it is mixed with water.

3. Tripoli:

It is obtained from porous rocks.

4. Tin oxide:

It is extremely fine used for polishing teeth and restoration inside the mouth.

Implantology

Implantology.

Fundamentals of Dental Implants

A. Introduction to Implant Dentistry

B. Historical Evolution of Dental Implants

C. Types and Classification of Dental Implants

II. Oral Anatomy and Implantology

A. Comprehensive Understanding of Oral Anatomy

B. Bone Morphology and Characteristics

C. Soft Tissue Considerations in Implant Procedures

III. Diagnostic Tools and Techniques

A. Radiographic Evaluation for Implant Planning

B. Impressions and Diagnostic Casts

C. Computer-Aided Design (CAD) in Implant Dentistry

IV. Treatment Planning and Case Selection

A. Collaborative Approach with Dentists

B. Evaluation of Prosthetic Needs

C. Implant Placement Planning and Guided Surgery

V. Surgical Implant Procedures

A. Surgical Protocols for Implant Placement

B. Implant Site Preparation Techniques

C. Immediate Loading and Temporization

VI. Prosthetic Components and Materials

A. Abutment Types and Selection

B. Crown and Bridge Design for Implants

C. Materials Used in Implant Prosthetics

VII. Laboratory Procedures

A. Model Fabrication and Articulation

B. Waxing and Casting Techniques

C. Digital Workflows in Implant Prosthetics

VIII. Quality Control and Assurance

A. Precision in Implant Prosthetic Construction

B. Verification Protocols for Accuracy

C. Maintenance of High-Quality Standards

IX. Communication and Collaboration

A. Effective Communication with Clinicians

B. Interdisciplinary Collaboration in Implant Cases

C. Managing Patient Expectations

X. Troubleshooting and Complication Management

A. Identifying and Addressing Common Complications

B. Problem-solving in Prosthetic Challenges

C. Collaboration with Clinicians in Complicated Cases

XI. Emerging Technologies and Trends

A. Digital Dentistry and Implant Prosthetics

B. Innovations in Materials and Techniques

C. Future Directions in Implant Dentistry for Technicians

XII. Hands-On Practical Sessions

A. Crown and Bridge Construction on Implants

B. Digital Workflow Simulations

C. Case Presentations and Peer Review

XIII. Continuing Education and Professional Development

A. Stay Updated with Industry Trends

B. Certification Opportunities

C. Participation in Advanced Workshops and Courses

ORTHODONTICS

Orthodontics

Definition: Orthodontics is that specific area of dental profession that deals with the study and supervision of the growth and development of the dentition and its related anatomical structures from birth to dental maturity. It includes diagnosis, prevention and correction of mal-positioned teeth and jaws, as well as misaligned bite patterns.

Appliances used in orthodontics can be categorized as:

Removable appliances

Fixed appliances

Functional appliances

REMOVABLE APPLIANCES

1. MAXILLARY HAWLEY RETAINER:

It contains an acrylic pad covering the palate with a labial bow and Adam's clasps for retention. It is used for retention after comprehensive orthodontic treatment.

2. MANDIBILAR HAWLEY RETAINER:

It contains an acrylic pad covering the palate with a labial bow and Adam's clasps for retention. It is used for retention after comprehensive orthodontic treatment.

3. MAXILLARY ACTIVE REMOVABLE APPLIANCE:

It is essentially a Hawley retainer in which the labial bow is active. It is used to retract flared upper anterior teeth or to close spaces present between upper anterior teeth.

4. MANDIBULAR ACTIVE REMOVABLE APPLIANCE:

It is essentially a Hawley retainer in which the labial bow is active. It is used to retract flared lower anterior teeth or to close spaces present between lower anterior teeth.

5. HAWLEY RETAINER WITH Z SPRINGS:

Z springs incorporated in the Hawley appliance work to push a palatially erupting tooth in the labial direction, hence is used in the treatment of anterior crossbite.

6. BITE BLOCK:

Bite blocks are placed on lower posterior teeth in order to disocclude the anterior teeth and facilitate tooth movement in cases of anterior crossbite. They can also be used to do intrusion of posterior teeth to treat anterior open bite.

7. TWIN BLOCK:

It is a myofunctional appliance that is used in class II patients with retrognathic mandible. It contains ramps on upper and lower appliances that guide the mandible in an advanced position.

8. REMOVABLE TPA:

It is used most commonly to derotate molars in the start of orthodontic treatment. Adjustment of the appliance can also be done to control vertical growth of patient.

FUNCTIONAL APPLIANCES

Definition: Appliances that change the posture of mandible and transfer the pressure created by stretch of muscles and soft tissues to skeletal and dental structures leafing to growth modification.

Indications

- Growing age
- Mixed/early permanent dentition
- Compliance
- Normal /low angle case
- Normal/retroclined LI
- Aligned arches

Classification

Functional appliances are classified as:

Simple

Removable

Fixed

SIMPLE FUNCTIONAL APPLIANCES

1. Vestibular screen
2. Tongue crib
3. Lip bumper

1. Vestibular screen

Uses: Intercepts:

- Mouth breathing
- Thumb sucking
- Tongue thrust habit

Design: Curved shield of acrylic placed in labial vestibule

2. Tongue crib

Uses: Habit breaker of thumb sucking habit.

3. Lip bumper

Uses:

For Lip sucking patient

Hyperactive mentalis

To augment anchorage

Molar distalization

Design: Combined removable and fixed appliance, molar bands, lip pad.

REMOVABLE FUNCTIONAL APPLIANCES

1. Frankle appliance

Tissue borne

Types

- FR1 class 1 deep bite and class 2 div 1 malocclusion
- FR2 class 2div 2
- FR3 class 3
- FR4 open bite FR5 with headgear

Design

Buccal shield, occlusal rest, labial pad, labial bow, palatal arch, canine clasp.

2. Bionator

Tooth borne, less bulky

Uses: Class 2 malocclusion, reverse bionator for class 3 malocclusion, TMJ, open bite

Design: Reverse coffin, Buccal wire shield, Reverse loop, Labial bow, Lower incisor capping

3. Twin block

Tooth borne appliance, bi block

Uses: Class 2 malocclusion, reverse TB class 3

Design: Buccal plate, Bite block, Clasps, Screw, Bows

4. Activator

Monoblock bulky appliance

Uses: Class 2 malocclusion. If HG added into activator, it is called Teuscher appliance.

Class 2 div 1, Class 3, Class 2 div 2, Class 1 open bite.

Design: Labial bow, jack screw, acrylic portion.

FIXED FUNCTIONAL APPLIANCES

1. Herbst

Uses: Class 2 malocclusion

Design: Crowns or bands on upper and lower 1st molar supported by lingual arch type connector for stability.

2. MARA

Uses: Class 2 malocclusion due to mandibular retrognathism

Design: Crown on molars connected by lingual arch rod and tube mechanism required to advance mandible in order to close in class I occlusion. Upper buccal attachments (elbows) are removable.

3. Forsus

Uses: Class 2 malocclusion

Wire Components and Auxiliaries

Components of fixed appliances

1. Active components

- Separators
- Archwires
- Elastics
- Spring

2. Passive components

- Brackets
- Bands
- Accessories
- Molars tubes

Archwires

Tied to all of the brackets and create force to move teeth into proper alignment.

Arch wire Material:

NITI, Stainless steel, beta titanium/TMA

Bands

Cementing ring of metal which wraps around the tooth.

Types: 1. Preformed

2. Custom made

Molar band

Premolar and incisor bands

Brackets

These are connected to bands or directly on the teeth and hold the arch-wire in place.

Types:

- Metal
- Ceramics
- plastic
- Composite
- self-ligating

Separators

Used to create space between teeth for fitting the band. It takes 5-7 days to create space.

Types

- Metal
- Elastics

Ligatures

Means by which arch-wire is held inside the bracket.

Types:

- Elastic
- Metallic

Auxiliaries

- Class 1, class 2 and class 3 elastics
- Elastic modules
- Power chain
- Spring
- Expanders

References

1) Preclinical Manual of Prosthodontics by S Lakshmi. 3rd edition.
2) Removable Orthodontic Appliances by Issacson
3) Fixed Orthodontic Appliances by Issacson
4) Functional Appliances by Issacson