COURSE GUIDE

DNT 410
ORTHODONTIC TECHNOLOGY I

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INTRODUCTION

Orthodontics as a branch of dental science, seeks to correct the irregularities associated with the teeth and jaws in order to improve aesthetics and function. When a patient suffers from misaligned teeth, the problem is best corrected with Orthodontic treatment, which utilises minor forces to slowly move teeth to a more correct position, fixing the bite of patients and making them happier about their smile.

Orthodontics is needed to correct a variety of problems: the most common of which is crowding. Beside aesthetic issues, crowded teeth are difficult to maintain and often lead to periodontal disease and decay. Extreme situations can cause poor occlusion (bite) and Temporal Mandibular Joint problems. Other reasons for needing Orthodontics include but are not limited to, excess space, flared anterior (front) teeth, cross bites, and skeletal issues.

WHAT YOU WILL LEARN IN THIS COURSE

This course guide, briefly, gives you an idea of what the course is about, what course materials you need and how to work with such materials. It also gives you some guideline for the time you are expected to spend on each unit in order to complete it successfully.

It guides you concerning your tutor-marked assignment which will be placed in the assignment file. Regular tutorial classes related to the course will be conducted and it is advisable for you to attend these sessions. It is expected that the course will prepare you for challenges you are likely to meet in the field of Dental Technology.

COURSE AIM

The course aims at helping you to understand the materials and techniques employed in the design and fabrication of orthodontic appliances in order to give the patient the confidence to smile in public by providing appliances that adequately meet patient’s demands.

COURSE OBJECTIVES

To achieve the aim set out, the course has a set of objectives. Each unit has specific objectives which are stated at the beginning of the unit. You are advised to read the objectives before you study the unit because you may need to make reference to them during your study to check on your own progress. It is also good that you endeavour to check the unit objectives after completion of each unit to decipher level of accomplishment.

At the end of this course, you should be able to:

- narrate the history, development and essentials of Orthodontics
- understand the definitions and terminologies in orthodontics
- appreciate orthodontics in contemporary dental practice
- enumerate the goals of orthodontic treatment
- explain the classification of orthodontic cases
- understand Orthodontic model making and trimming
- describe Biomechanics of tooth movements
- explain the classification of orthodontic appliances
- mention the Muscles of mastication and expression (facial)
- describe the principles and procedures for the construction of orthodontic appliances and
- undertake practical construction of orthodontic appliances.

WORKING THROUGH THE COURSE

To complete this course you are expected to read each study unit, read the textbooks and other materials which may be provided by the National Open University of Nigeria. In the course you would be required to submit assignment for assessment. At the end of the course there is final examination. The course should take about 15 weeks to complete.

Listed below are the components of the course, what you have to do and how to allocate your time to each unit, in order to complete the course successfully and timely.

The course demands that you should spend good time to read and my advice for you is that you should endeavour to attend tutorial session where you will have the opportunity of comparing knowledge with colleagues.

COURSE MATERIALS

The main components of the course are:

1. The Course Guide
2. Study Units
3. Textbooks
4. Assignment
5. Presentation Schedule

STUDY UNITS

There are 21 units organised into 5 modules in this course as follows:

Module 1 History, Development and Essentials of Orthodontics

Unit 1 General Overview of Orthodontics
Unit 2 History of Orthodontics
Unit 3 Definition of Orthodontic Terminologies
Unit 4 Classification of Malocclusion

Module 2 Orthodontics in Contemporary Dental Practice

Unit 1 Recent Advances in Orthodontics
Unit 2 Detrimental Effects of Orthodontic Treatment
Unit 3 Diagnostic Aids in Orthodontic Treatment
Unit 4 Orthodontic Study Model
Unit 5 Classification of Orthodontic Cases

Module 3 Biomechanics of Tooth Movement

Unit 1 Introduction to Biomechanics
Unit 2 Muscles of Mastication and Expression
Unit 3 Orthodontic Tooth Movement and Associated Tissue Changes
Unit 4 Anchorage in Orthodontics
Unit 5 Retention and Relapse in Orthodontic Treatment

Module 4 Classification of Orthodontic Appliances

Unit 1 General Overview of Orthodontic Appliance
Unit 2 Removable Orthodontic Appliances
Unit 3 Fixed Orthodontic Appliances
Unit 4 Functional Appliances

Module 5 Principles and Procedure for Construction of Orthodontic Appliances

Unit 1 Goals of Orthodontic Treatment
Unit 2 Materials Used for Fabrication of Orthodontic Appliances
Unit 3 Fabrication of various Components of Orthodontic Appliances

ASSESSMENT

There are three parts to the course assessment and these include self-assessment exercises, Tutor- marked assignments and the written examination or end of course examination. It is advisable that you do all the exercises. In tackling the assignments, you are expected to use the information, knowledge and techniques gathered during the course. The assignments must be submitted to your facilitator for formal assessment in line with the deadlines stated in the presentation schedule and assignment file. The work you submit to your tutor for assessment will count for 30% of your total course work. At the end of the course, you will need to sit for a final end of course examination of about three hours duration. This examination will count for 70% of your total course mark.

TUTOR-MARKED ASSIGNMENT (TMA)

The TMA is a continuous assessment component of your course. It counts for 30% of the total score. You will be given four (4) TMAs to answer. Three of this must be answered before you are allowed to sit for the end of course examination. The TMAs will be given to you by your facilitator and returned after you have done the assignment. Assignment questions for the units in this course are contained in the assignment file. You will be able to complete your assignment from the information and material contained in your reading, references and study units. However, it is desirable in all degree level of education to demonstrate that you have read and researched more into your reference, which will give you a wider view point of the subject.

Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you cannot complete your work on time, contact your facilitator before the assignment is due to discuss the possibility of an extension. Extension will not be granted after the due date unless there are exceptional circumstances.

FINAL EXAMINATION AND GRADING

The end of course examination for orthodontic technology I will be for about 3 hours and it has a value of 70% of the total course work. The examination will consist of questions, which will reflect the type of self-testing, practice exercise and tutor-marked assignment problems you have previously encountered. All area of the course will be assessed.

Use the time between finishing the last unit and sitting for the examination to revise the whole course. You might find it useful to

review your self-test, TMAs and comment on them before the examination. The end of course examination covers information from all parts of the course.

PRESENTATION SCHEDULE

Your course materials have important dates for the early and timely completion and submission of your TMAs and attending tutorials. You are expected to submit all your assignments by the stipulated time and date and guard against falling behind in your work.

COURSE MARKING SCHEME

The table below shows the breakdown of marks for the course.

Table 1.1: Course Marking Scheme

Assignment	**Marks**
Assignment 1-4	Four assignments, best three marks of the four counts 10% each of the 30% course marks.
End of course examination	70% of overall course marks
Total	**100% of course materials**

FACILITATORS/TUTORS AND TUTORIALS

There are 15 hours of tutorials scheduled in support of this course. You will be notified of the dates, times and location of the tutorials as well as the name and the phone number of your facilitator, as soon as you are allocated a tutorial group.

Your facilitator will mark and comment on your assignments, keep a close watch on your progress and any difficulties you might face and provide assistance to you during the course. You are expected to mail your tutor-marked assignment to your facilitator before the schedule date (at least two working days are required). They will be marked by your tutor and returned to you as soon as possible. Do not delay to contact your facilitator by telephone or e-mail if you need assistance.

The following might be circumstances in which you would find assistance necessary, hence you would have to contact your facilitator if:

- You do not understand any part of the study or the assigned readings.
- You have difficulty with self-tests.

- You have a question or problem with an assignment or with the grading of an assignment.

You should endeavour to attend the tutorials. This is the chance to have face to face contact with your course facilitator and to ask question which are answered instantly. You can raise any problem encountered in the course of your study.

To gain more benefit from course tutorials, prepare a question list before attending them. You will learn a lot from participating actively in discussions.

COURSE OVERVIEW

The table below shows the study units, the number of weeks required to complete them and the assignments.

Table 1.2: **Course Organiser**

Unit	**Title of work**	**Weeks activity**	**End of unit assignment**
MODULE 1 History, Development and Essentials of Orthodontics			
Unit 1	General Overview of Orthodontics	Week 1	Assignment 1
Unit 2	History of Orthodontics	Week 2	Assignment 2
Unit 3	Definition of Orthodontic Terminologies	Week 2	Assignment 3
Unit 4	Classification of Malocclusion	Week 3	Assignment 4
Module 2 Orthodontics in Contemporary Dental Practice			
Unit 1	Recent Advances in Orthodontics	Week 4	Assignment 5
Unit 2	Detrimental Effects of Orthodontic Treatment	Week 4	Assignment 6
Unit 3	Diagnostic Aids in Orthodontic Treatment	Week 5	Assignment 7
Unit 4	Orthodontic Study Model	Week 6	Assignment 8
Unit 5	Classification of Orthodontic Cases	Week 6	Assignment 9
Module 3 Biomechanics of Tooth Movement			
Unit 1	Introduction to Biomechanics	Week 7	Assignment 10
Unit 2	Muscles of Mastication and Expression	Week 8	Assignment 11
Unit 3	Orthodontic Tooth Movement	Week 9	Assignment 12

	and Associated Tissue Changes		
Unit 4	Anchorage in Orthodontics	Week 9	Assignment 13
Unit 5	Retention and Relapse in Orthodontic Treatment		Assignment 14
Module 4 Classification of Orthodontic Appliances			
Unit 1	General Overview of Orthodontic Appliance	Week 10	Assignment 15
Unit 2	Removable Orthodontic Appliances	Week 10	Assignment 16
Unit 3	Fixed Orthodontic Appliances	Week 11	Assignment 17
Unit 4	Functional Appliances	Week 12	Assignment 18
MODULE 5 Principles and Procedure for Construction of Orthodontic Appliances			
Unit 1	Goals of Orthodontic Treatment	Week 13	Assignment 19
Unit 2	Materials Used for Fabrication of Orthodontic Appliances	Week 14	Assignment 20
Unit 3	Fabrication of Orthodontic Appliances	Week 15	Assignment 21

SUMMARY

This course guide has been able to expose you to an overview of what to expect in DNT 410. I wish you success as you go through the course.

MAIN COURSE

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MODULE 1 HISTORY, DEVELOPMENT AND ESSENTIALS OF ORTHODONTICS

UNIT 1 GENERAL OVERVIEW OF ORTHODONTICS

CONTENTS

1.0 INTRODUCTION

Orthodontic technology is a specialty of dental technology that is concerned with the design and fabrication of dental appliances for the treatment of malocclusions, which may be a result of tooth irregularity, disproportionate jaw relationships, or both.

Orthodontics as a branch of dental science, seeks to correct the irregularities associated with the teeth and jaws in order to improve aesthetics and function. When a patient suffers from misaligned teeth, the problem is best corrected with orthodontic treatment, which utilises minor forces to slowly move teeth to a more correct position, fixing the patient's bite and making them happier about their smile.

Orthodontics is needed to correct a variety of problems: the most common of which is crowding. Beside esthetic issues, crowded teeth are difficult to maintain and often lead to periodontal diseases and

decay. Extreme situations can cause poor occlusion (bite) and Temporal Mandibular Joint problems. Other reasons for needing orthodontics include but are not limited to: excess space, flared anterior (front) teeth, cross bites, and skeletal issues.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define orthodontics and orthodontic technology
- list the aims of orthodontic treatment
- state the scope of orthodontic treatment
- enumerate the benefits of orthodontic treatment.

3.0 MAIN CONTENT

3.1 Definition of Orthodontics

Orthodontics can be defined as the specialty of dentistry concerned with growth and development of the face and dentition, and the diagnosis, prevention and correction of dental and facial irregularities (Daljit S. Gill 2009).

Salzmann (1943) defined orthodontics as a branch of science and art of dentistry which deals with the developmental and positional anomalies of the teeth and the jaws as they affect oral health and the physical aesthetic and mental well being of the person.

American Board of Orthodontics (ABO) proposed the following definition, which was adopted by American Association of Orthodontics:

orthodontics is that specific area of dental profession that has as its responsibility, the study and supervision of the growth and development of the dentition and its related anatomical structures from birth to dental maturity, including all preventive and corrective procedures of dental irregularities requiring the repositioning of teeth by functional and mechanical means to establish normal occlusion and pleasing facial contours.

From the definitions above, we can now define orthodontics as a branch of dentistry concerned with the study of the growth and development of the face, the jaw and teeth, and their associated irregularities with their preventive and corrective measures.

3.1.2 What is Orthodontic Technology?

Dental technology has several branches, one of which is orthodontic technology. Orthodontic technology is the branch of dental technology that deals with the design and fabrication of different appliances for correction or prevention of the irregularities associated with the teeth and jaws in order to improve aesthetics and function.

It is the branch of dental technology that deals with the design and fabrication of appliances for correction or prevention of dento-facial anomalies, within limits set by certain biological factors. These appliances are fabricated based on prescription arising from clinical diagnosis.

3.2 Aims of Orthodontic Treatment

The three basic aims of orthodontic treatment are: functional efficiency; structural balance and Aesthetic harmony.

3.2.1 Functional Efficiency

The teeth and their supporting structures perform certain functions. Orthodontic treatment thus should increase the efficiency of these functions.

3.2.1 Structural Balance

Orthodontic treatment should maintain a balance between the teeth and surrounding structures. This means that the correction of one should not be detrimental to the health of another.

3.2.3 Aesthetic Harmony

The treatment should yield results that gel with patient's personality and make him/her to look more aesthetically presentable.

3.3 Scope of Orthodontic Treatment

Orthodontic treatment covers the following:

- Moving teeth into more ideal locations without any deleterious effect;
- Orthopedic change by using functional appliances and the latest orthognathic technique to move the entire jaw into a more favourable position;

- Altering the soft tissue envelop by altering the position of teeth or jaws;
- Management of obstructive sleep apnoea and
- Management of cleft lip and palate

3.4 Benefits of Orthodontic Treatment

The benefits of orthodontic treatment are itemised below.

- Improved confidence;
- Well aligned teeth that are easier to keep clean and healthy;
- Ideally positioned teeth that reduce the risk of gum diseases;
- Better chewing and food ingestion and
- Closed spaces to avoid the use of bridges or dentures.

4.0 CONCLUSION

In this unit, you have learnt the definition of orthodontics and orthodontic technology; the aims and scope of orthodontic treatment and the benefits of orthodontic treatment.

5.0 SUMMARY

Orthodontics as a branch of dental science, seeks to correct the irregularities associated with the teeth and jaws in order to improve aesthetics and function.

Different definitions abound but we can simply define orthodontics as a branch of dentistry concerned with the study of the growth and development of the face, the jaw and teeth, and their associated irregularities with their preventive and corrective measures.

Orthodontic technology is the branch of dental technology that deals with the design and fabrication of different appliances for correction or prevention of the irregularities associated with the teeth and jaws in order to improve aesthetics and function.

The three basic aims of orthodontic treatment are: functional efficiency; structural balance and aesthetic harmony. Orthodontics has a wide scope and the benefits associated with orthodontic treatment include:

- improved confidence;
- well aligned teeth that are easier to keep clean and healthy;
- ideally positioned teeth that reduce the risk of gum diseases;
- better chewing and food ingestion and
- closed spaces to avoid the use of bridges or dentures.

6.0 TUTOR-MARKED ASSIGNMENT

1. Give the definition of orthodontics according to ABO and explain this definition.
2. Explain the benefits derivable from orthodontic treatment.

7.0 REFERENCES/FURTHER READING

Daljit, S. G. (2009). *Orthodontics at a Glance*. Singapore: Markono Print Media Pte Ltd.

Gurkeerat, S. (2007). *Textbook of Orthodontics*.(2nd ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

UNIT 2 HISTORY OF ORTHODONTICS

CONTENTS

1.0 INTRODUCTION

Orthodontics as a branch of dentistry seeks to correct irregularities in the oral cavity so as to improve aesthetics and function. This unit looks at the history of orthodontics with reference to different scholars and their contributions to the development of orthodontics as a science.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- describe the history of development of orthodontics
- discuss the contribution of different scholars at the various stages of development.

3.0 MAIN CONTENT

3.1 Orthodontics during Ancient Civilisation

From the beginning of human history, man understood at the basic level that without proper bite or chewing ability, feeding well would be difficult. Archeological findings revealed from the remains of ancient Egyptians and Romans as well as Etruscans that these societies used different types of wires to straighten or adjust their teeth.

Among the major contributions to orthodontics during the ancient civilisation are as follows:

- Description of irregularities by Hippocrates (460-377 BC) who was the first to draw attention towards association of teeth to the jaw structure; He opined that people with long shaped heads may have thick neck, strong members and bones so that teeth are disposed to irregularities and crowding and are molested by headache and otorrhea.
- Aulius Cornelius Celsus (25BC-50AD) who described finger pressure to move teeth in his work "De Re Medicine". According to him, if a permanent tooth erupts before the shedding of the milk teeth, the later should be drawn out and the former should be pushed with finger, day by day until it has occupied the position of the extracted tooth;
- Gaius Philinus Secundus (AD 23-79), who advocated filing of elongated teeth to produce proper alignment.

3.2 Contribution to Orthodontics in 18th Century

- In 1723, Pierre Fauchard, who is today known as the father of modern dentistry developed the first expansion appliance called "Bandelette". He published his two-volume book titled "The Surgeon Dentist, A Treatise in the Teeth".
- John Hunter (1728-1793) an English Surgeon and a teacher of Anatomy, published his book, "the Natural History of the Human Teeth," 1771. He demonstrated the growth and development of the jaws, internal structure of teeth and functions of teeth.

3.3 Contribution to Orthodontics in 19th Century

Foundations were laid in the 19th century to Orthodontics, the oldest specialty in dentistry. In 1840, JS Gunnel introduced chin strap as occipital anchorage for the treatment of mandibular protrusion while William Lintott in 1841introduced the use of screws.

Emerson C angel in 1860 was first to introduce Arch expansion by opening mid-palatal suture. This earned him father of expansion appliances. As early as 1871, the molar band was developed by William and Magill.

John Nutting Farrar often referred to as the Father of American Orthodontics published his two-volume text book titled "Irregularities of teeth and their corrections." He laid the foundation for scientific orthodontics.

Henry Baker, in 1893 introduced the use of intermaxillary elastics with rubber bands called Baker's anchorage.

3.4 Contribution to Orthodontics in 20th Century

What is today known as modern orthodontics revolves round Edward Hartley Angle because of his immense contributions to the specialty of orthodontics. His contributions are summarised as follows:

- Textbook of irregularities of the teeth 1887, 91st edition.
- Classification of malocclusion 1889
- Expansion-Arch appliance 1900
- Pin and Tube appliance 1901
- Ribbon Arch appliance 1910
- Edgewise appliance 1925

4.0 CONCLUSION

Having carefully studied this unit, it is believed that you can now trace the history of orthodontics as a specialty with reference to the contributions of various scholars.

5.0 SUMMARY

In this unit, you learnt the history of orthodontics with reference to different scholars and their contribution to the development of orthodontics as a science.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss briefly, the contributions of the following scholars to the development of orthodontics: Hippocrates; Aulius Cornelius Celsus; Pierre Fauchard and Henry Baker.

7.0 REFERENCES/FURTHER READING

Gurkeerat, S. (2007). *Textbook of Orthodontics.* (2nd ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

Phulari, B.S. (2011). *Orthodontics: Principle and Practice*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

UNIT 3 DEFINITION OF ORTHODONTIC TERMINOLOGIES

CONTENTS

1.0 INTRODUCTION

Having gone through an overview of orthodontics, and its emergence, it is necessary that you know the key terminologies associated with this specialty for better comprehension. Thus, this unit looks at the terminologies you may need to know in the course of your study.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define the various terminologies associated with orthodontics as a profession
- apply these terms in your day to day professional communication.

3.0 MAIN CONTENT

3.1 A-E Orthodontic Terms

Anterior - Front

Appliances - Any device, attached to the teeth or removable, designed to move the teeth, change the position of the jaw, or hold the teeth in their finished positions after braces are removed.

Arch - Upper or lower jaw.

Archwire -The metal wire that is attached to the brackets and used to move the teeth.

Band - The metal ring that is cemented to a tooth for strength and anchorage.

Braces - A word commonly used to describe a fixed orthodontic appliance, usually comprised of brackets, bands and wires. These are the names of each part of a typical set of braces.

Brushing - Brushing the teeth is part of an individual's daily home dental care. Patients with braces should follow the orthodontist's instruction on how often to brush.

Bruxism - Grinding the teeth, usually during sleeping. Bruxism can cause abnormal tooth wear and may lead to pain in the jaw joints.

Buccal - The cheek side of the back teeth in either arches or jaws.

Buccal Tube - A small metal part of the bracket welded to the cheek side of the molar band. The tube may hold an archwire, lip bumper, headgear facebow or other appliances an orthodontist may use to move the teeth.

Cephalometric Radiograph - A lateral (side view) x-ray of the head.

Chain - A stretchable series of elastic o-rings connected together and placed around each bracket to hold the archwire in place and move the teeth.

Class I Malocclusion - A malocclusion with the proper molar relationship and teeth that are crowded together, spaced apart, an overbite, an openbite, a posterior crossbite or an anterior crossbite.

Class II Malocclusion - A malocclusion with the upper front teeth protruding or due to the lower teeth and/or jaw positioned back relative to the upper teeth and/or jaw.

Class III Malocclusion - A malocclusion with the lower front teeth protruding or due to the lower teeth and/or jaw positioned ahead, relative to the upper teeth and/or jaw.

Closed Bite/Deep Bite - Also known as deep overbite, this occurs when the upper front teeth overlap the bottom front teeth an excessive amount.

Comprehensive Treatment - Complete orthodontic treatment performed to correct a malocclusion.

Congenitally Missing Teeth - A genetic occurrence in which the expected number of permanent teeth do not develop.

Crossbite - Upper posterior (back) teeth are in crossbite if they erupt and function inside or outside of the arch in the lower posterior teeth. Lower anterior (front) teeth are in crossbite if they erupt and function in front of the upper anterior teeth. A crossbite can be individual teeth or groups of teeth.

Diagnostic Records - The material and information that the orthodontist needs to properly diagnose and plan a patient's treatment.

Ectopic Eruption - Term used to describe a tooth or teeth that erupt in an abnormal position.

Eruption - The process by which teeth enter into the mouth.

Extraction - The removal of a tooth.

Elastics - Rubber bands. During certain stages of treatment, small elastics or rubber bands are worn to provide individual tooth movement or jaw alignment.

3.2 F-J Orthodontic Terms

Facebow - A wire appliance used with a night brace, or headgear; primarily used to move the upper first molars back, creating room for crowded or protrusive front teeth.

Fiberotomy - A surgical procedure designed to sever fibers of attachment around the tooth, usually performed to reduce the potential for relapse or post-orthodontic treatment tooth movement.

Fixed appliances - An orthodontic appliance that is bonded or cemented to the teeth and cannot be or should not be removed by the patient.

Flossing - An important part of daily home dental care. Flossing removes plaque and food debris from between the teeth, brackets and wires. Flossing keeps teeth and gums clean and healthy during orthodontic treatment.

Frenectomy - The surgical removal or repositioning of the frenum, the lip and tongue attachment located between the upper and lower front teeth.

A large frenum attachment can cause spacing between top front teeth or cause the tongue to be tied.

Functional appliances - Appliances that utilise the muscle action produced when speaking, eating and swallowing to produce force to move the teeth and align the jaws. They are also known as orthopedic appliances with names such as orthopedic corrector, activator, bionator, Frankel, Herbst or twin block appliances.

Gingiva - Soft tissue around the teeth, also known as the gums.

Gummy smile - Showing an excessive amount of gingival (gum) tissue above the front teeth when smiling.

Headgear - An appliance worn outside of the mouth to provide traction for growth modification and tooth movement.

Herbst appliance - This appliance is used to move the lower jaw forward. It can be fixed or removable. When it is fixed, it is cemented to teeth in one or both arches using stainless steel crowns. An expansion screw may be used simultaneously to widen the upper jaw.

Impaction - A tooth that does not erupt into the mouth or only erupts partially is considered impacted.

Interceptive treatment - Orthodontic treatment performed to intercept a developing problem; usually performed on younger patients that have a mixture of primary (baby) teeth and permanent teeth.

Interproximal reduction - Removal of a small amount of enamel from between the teeth to reduce their width; also known as reproximation, slenderising, stripping, enamel reduction or selective reduction.

3.3 K-O Orthodontic Terms

Labial - The surface of the teeth in both arches that faces the lips.

Ligating modules - A small elastic o-ring, shaped like a donut, used to hold the archwire in the bracket.
Lingual - The tongue side of the teeth in both arches.

Lip bumper - A wire appliance used to move the lower molars back and the lower front teeth forward, creating room for crowded front teeth. The lower lip muscles apply pressure to the bumper creating a force that moves the molars back.

Lip incompetence - The inability to close the lips together at rest, usually due to protrusive front teeth or excessively long faces.

Malocclusion - The term used in orthodontics to describe teeth that do not fit together properly. From Latin, the term means "bad bite."

Mandible - Lower jaw.

Maxilla - Upper jaw.

Mixed dentition - The dental developmental stage in children (approximately ages 6-12) when they have a mix of primary (baby) and permanent teeth.

Mouth guard - A removable device used to protect the teeth and mouth from injury caused by sporting activities. The use of a mouth guard is especially important for orthodontic patients.

Night guard - A removable appliance worn at night to help an individual minimize the damage or wear while clenching or grinding teeth during sleep.

Open bite - A malocclusion in which teeth do not make contact with each other. With an anterior open bite, the front teeth do not touch when the back teeth are closed together. With a posterior open bite, the back teeth do not touch when the front teeth are closed together.

Orthodontics - The specialty area of dentistry concerned with the diagnosis, supervision, guidance and correction of malocclusions. The formal name of the specialty is orthodontics and dento-facial orthopedics.

Orthodontist - A specialist in the diagnosis, prevention and treatment of dental and facial I rregularities.

Orthopedic appliance - A removable functional appliance designed to guide the growth of the jaws and face.

3.4 P-Z Orthodontic Terms

Panoramic radiograph - An x-ray that shows all the teeth and both jaws on one film.

Palatal expander - A fixed or removable device used to make the upper jaw wider.

Periodontal - Refers to the hard and soft tissue, or supporting structures, around the teeth.

Plaque - Plaque is a colorless, sticky film of bacteria, food particles and saliva that constantly forms in the mouth. Plaque combines with sugars to form an acid that endangers teeth and gums. Plaque causes tooth decay and gum disease.

Posterior - Back.

Preventive treatment - Orthodontic treatment to prevent or reduce the severity of a developing malocclusion (bad bite).

Removable appliance - An orthodontic appliance that can be removed from the mouth by the patient. Removable appliances are used to move teeth, align jaws and to keep teeth in their new positions when the braces are removed (retainers).

Retainer - A fixed or removable appliance worn after the braces are removed. A removable retainer attaches to your upper and/or lower teeth and holds them in their finished positions.

Rubber bands - During certain stages of treatment, small elastics or rubber bands are worn to provide individual tooth movement or jaw alignment.

Safety strap - The safety strap prevents the facebow of the headgear from coming loose and causing injury.

Separators - An elastic o-ring or small wire loop placed between the teeth to create space for placement of bands. Separators are usually placed between the teeth a week before bands are scheduled to be cemented to the teeth.

Serial extraction - Selective or guided removal of certain primary (baby) teeth and/or permanent teeth over a period of time to create room for permanent teeth.

Space maintainer - A fixed appliance used to hold space for an unerupted permanent tooth after a primary (baby) tooth has been lost prematurely, due to accident or decay.

Supernumerary teeth - A genetic occurrence in which there are more teeth than the usual number. These teeth can be malformed or erupt in abnormally.

Tongue crib - A fixed appliance used to help a patient stop habits or undesirable tongue forces exerted on the teeth and bone that supports the teeth.

Tongue thrust - An individual's tongue pushes against the teeth when swallowing. Forces generated by the tongue can move the teeth and bone and may lead to an anterior or posterior open bite.

Wax - Wax is placed on the brackets or archwires to prevent them from irritating the lips or cheeks.

Wires - Also known as archwires, they are held in the brackets using small elastic o-rings or stainless steel wire ligatures. Wires are used to move the teeth.

4.0 CONCLUSION

Explanations of the commonly used orthodontic terminologies have been given in this unit, and I believe you are now conversant with them.

5.0 SUMMARY

In this unit, you have studied the A-Z orthodontic terms.

6.0 TUTOR-MARKED ASSIGNMENT

Explain the following terms:

i. Panoramic radiograph
ii. Congenitally missing teeth
iii. Mouth guard
iv. Night guard
v. Serial extraction.

7.0 REFERENCE/FURTHER READING

Glossary of Orthodontic Terms. (2012). Retrieved on 15th April, 2014 from http//:www.mylifemysmile.org.

UNIT 4 CLASSIFICATION OF MALOCCLUSION

CONTENTS

1.0 INTRODUCTION

Malocclusion is a misalignment of the upper and lower teeth; also known as "bad bite". It is a deviation from normal occlusion of the upper and lower teeth. Classification of malocclusion describes the dento-facial deviations according to a common characteristic or norm. Different classifications have been proposed by different scholars based on their experiences and depending on what they find to be clinically relevant.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define malocclusion
- identify the causes of malocclusion and
- classify malocclusion.

3.0 MAIN CONTENT

3.1 What is Malocclusion?

Malocclusion is a misalignment of the upper and lower teeth; also known as "bad bite". It is a deviation from normal occlusion of the upper and lower teeth.

3.1.1 Causes of Malocclusion

Malocclusion may result from a variety of factors or causes; most prominent among these are: skeletal factors, soft tissue factor, local factors or habits.

Skeletal Factors

Skeletal malocclusion can be caused by defects in size, position or relationship between upper and lower jaws. Skeletal malocclusion can occur in sagittal, vertical or transverse planes.

Skeletal Malocclusion in Sagittal Plane

This occurs in the form of prognathic jaws (forward placement of the jaw) or retrognathic jaws (backward placement of the jaw).

Skeletal malocclusion in vertical plane

This occurs in the form of skeletal deep bite or skeletal open bite.

Skeletal malocclusion in transverse plane

Narrowing or widening of the jaws may result in an abnormal relationship between upper and lower jaws in transverse plane. These include skeletal cross bite or skeletal scissors bite.

Soft tissue factor

The teeth lie in apposition of muscular balance determined by prolonged and light resting forces of the lips and cheeks on the outside and the tongue on the inside. Lack of muscular tone in the lips can lead to proclined incisors. On the other hand, when the lips are tense, the incisors may be retroclined. The size, position and function of the tongue may influence dental development. Macroglossia (large tongue) and an anterior tongue position may impede incisor eruption and lead to development of an anterior open bite.

Local factors

Local factors also referred to as dento-alveolar factors have a more localised effect on the occlusion compared with skeletal or soft tissue factors. Local factors that can cause malocclusion include:

- Variation in the number of teeth such as supernumerary teeth or anodontia (missing teeth);
- Anomalies in tooth size;
- Anomalies in tooth shape;
- Abnormal labial frenum;
- Premature loss of deciduous teeth;
- Prolong retention of deciduous teeth;
- Delayed eruption of permanent teeth;
- Abnormal eruptive path;
- Ankylosis;
- Dental caries and
- Improper dental restoration.

Habits

Abnormal pressure habits such as digit sucking, tongue thrusting, lip biting; and functional aberrations such as mouth breathing may cause a variety of malocclusion.

3.2 Classification of Malocclusion

Classification of malocclusion is an essential prerequisite for determining the severity of malocclusion. Although numerous scholars have proposed different classification, we are going to look at the broad classification by Phulari (2011), which classified malocclusion into three as follows: intra-arch, inter-arch and skeletal malocclusion.

3.2.1 Intra-arch Malocclusion

This is the type of malocclusion in which there is misalignment of individual tooth within the same dental arch, either maxillary or mandibular arches. This could be in the form of abnormal inclination, rotation, displacement, transposition or abnormal position of the tooth. Intra-arch malocclusion can be further classified into:

- **Abnormal inclination** which involves abnormal tilting of the crown with root being in normal position. This could be buccal, lingual, mesial or distal inclination.
- **Displacement** which involves bodily movement of the crown as well as the root of the tooth in the same direction to occupy an abnormal location. This could be in form of buccal, lingual, mesial or distal displacement.
- **Rotation** which is the rotation of a tooth about its long axis. A tooth may be rotated in two directions namely: mesiolingual (distolabial) and distolingual (mesiolabial) rotation.

- **Transposition** in which two teeth have exchanged places (positions).
- **Infra/supraversion** which involves under eruption or over eruption of a tooth.

3.2.2 Inter-arch malocclusion

This form of malocclusion occurs between the opposite jaws in sagittal, vertical or transverse planes.

3.2.2.1 Sagittal plane malocclusion

This is an abnormal relationship between upper and lower jaws in the sagittal plane such as pre-normal and post-normal occlusions.

3.2.2.2 Vertical plane malocclusion

This is when abnormal vertical relationship occurs between the teeth of upper jaw and those of the lower. E.g. deep bite and open bite.

3.2.2.3 Transverse plane malocclusion

This is an abnormal relationship between upper and lower arches in transverse plane. These include different types of cross bite and scissors bite.

3.2.3 Skeletal Malocclusion

Skeletal malocclusion is the type caused by defects in size, position or relationship between the upper and lower jaws.

4.0 CONCLUSION

In this unit, we have been able to define malocclusion and the various factors that can cause malocclusion, such as skeletal factors, soft tissue factor, local factors or habits. Classification of malocclusion was also well discussed.

5.0 SUMMARY

In this unit, you learnt that malocclusion is a misalignment of the upper and lower teeth; also known as "bad bite", and may result from a variety of factors or causes such as- skeletal factors, soft tissue factor, local factors or habits.

Skeletal malocclusion can be caused by defects in size, position or relationship between upper and lower jaws. Skeletal malocclusion can occur in sagittal, vertical or transverse planes.

Lack of muscular tone in the lips can lead to proclined incisors. On the other hand, when the lips are tense, the incisors may be retroclined. The size, position and function of the tongue may influence dental development. Local factors that can cause malocclusion include:

- Variation in the number of teeth such as: supernumerary teeth or anodontia (missing teeth);
- Anomalies in tooth size;
- Anomalies in tooth shape;
- Abnormal labial frenum;
- Premature loss of deciduous teeth;
- Prolong retention of deciduous teeth;
- Delayed eruption of permanent teeth;
- Abnormal eruptive path;
- Ankylosis;
- Dental caries and
- Improper dental restoration.

Abnormal pressure habits such as digit sucking, tongue thrusting, lip biting; and functional aberrations such as mouth breathing may cause a variety of malocclusion. Classification of malocclusion is an essential prerequisite for determining the severity of malocclusion.

Although numerous scholars have proposed different classification of malocclusion, we adopted the broad classification by Phulari (2011), which classified malocclusion into three as follows: intra-arch, inter-arch and skeletal malocclusion.

6.0 TUTOR-MARKED ASSIGNMENT

1. Skeletal malocclusion can occur in sagittal, vertical or transverse planes. Discuss.
2. Explain the following terms: Macroglossia, malocclusion, prognathic jaw and retrognathic jaw

7.0 REFERENCES/FURTHER READING

Daljit, S. G. (2009). *Orthodontics at a Glance*. Singapore: Markono Print Media Pte Ltd.

Gurkeerat, S. (2007). *Textbook of Orthodontics*. (2nd ed.). New Delhi : Jaypee Brothers Medical Publishers (P) Ltd.

Phulari, B.S. (2011). *Orthodontics: Principle and Practice*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

MODULE 2 ORTHODONTICS IN CONTEMPORARY DENTAL PRACTICE

UNIT 1 RECENT ADVANCES IN ORTHODONTICS

CONTENTS

1.0 INTRODUCTION

In recent times, there have been tremendous advancements in the field of orthodontic sciences. This unit is designed to give you the highlights of recent development in the profession. This unit will keep you abreast of recent practices in orthodontic technology as a profession. If you really take this unit seriously, you will be able to develop yourself as better dental technologist.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain what is meant by advancement in orthodontics
- identify recent advancement in orthodontics and
- state the reasons for recent advancement in orthodontics.

3.0 MAIN CONTENT

3.1 Advancement as a Concept

Advancement simply means development, improvement, increase in rank or moving forward. It also means making progress or making new inventions in techniques that have tangible advantages over the existing practices. For example, the photographers in the past have to take their films to the photo laboratory to develop the film prior to printing. However, due to advancement in photo industry, photographs can be taken digitally, viewed and printed within few minutes with even better qualities.

3.2 Advances in Orthodontic Practice

Some things that were apparently impossible in the past are now realistic in orthodontic sciences as a result of research and development in the profession. Some of these recent advances made orthodontic technology include: adult orthodontics, implants, Invisalign technique and the use of laser in orthodontics.

3.2.1 Adult Orthodontics

In the past orthodontic treatment was seen as a treatment for children and adolescence. In recent time however, a great number of adults seek orthodontic treatment. The success in adult orthodontics can be attributed to increased understanding of how bone cells react to orthodontic forces.

3.2.1.1 Reasons for Increased Number of Adult Patients

- Increased public awareness
- Consciousness of aesthetic demands in the society
- Increased social acceptance due to decreased fear of embarrassment associated with the use of orthodontic appliances
- Recent advances in appliance design and techniques increased patient's acceptance
- Advancement in surgical orthodontics has widened the possibility of correcting severe skeletal discrepancies in adults who have past growing age
- Awareness by general dentists makes them to refer adult patients for orthodontic consultation.

3.2.2 Implants in Orthodontics

In recent time, Osseo-integrated implants have helped in orthodontic anchorage. The ankylosed nature of endosseous implants creates an immovable platform for total anchorage.

3.3 Invisalign Technique

Both practitioners and patients alike have been searching for an appliance that can be used inconspicuously in the mouth. The introduction of Invisible Aligners (Invisalign) has made the dream realistic. This technique was introduced in 1999 and incorporates series of invisible (clear) plastic aligners that fit comfortably over the teeth. They are designed to move teeth gradually into positions. Invisalign can be used to correct the following mild malocclusions:

- Mild overcrowding
- Mild spacing and
- Mild relapse after treatment.

3.3.1 Benefits of Invisalign

Here, note the following:

- it is invisible, hence no unwanted attention is drawn to patient's mouth
- because it is removable, patient can eat, brush and flux easily
- it does not carry brackets to accumulate food debris and plaque
- healthier gum from properly aligned teeth and
- good oral hygiene can be maintained as it is easy to clean.

3.4 Laser in Orthodontics

LASER is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation. Dental lasers are used to treat dental pathology involving hard and soft tissues with minimal vibration and pain.

Application of soft tissue lasers in orthodontics include:

- Gingivectomy
- Frenectomy
- Opercutectomy
- Papilla flattening
- Uncovering temporary anchorage devices and
- Debonding of brackets etc.

4.0 CONCLUSION

Just like any other profession, orthodontic technology has been making substantial advances in techniques and designs. Among the recent advances made in orthodontic sciences are the adult orthodontics, implants, Invisalign technique and Laser in orthodontics.

5.0 SUMMARY

The following were highlighted in this unit:

- In recent times, there have been tremendous advancements in the field of orthodontic sciences.
- Advancement simply means development, improvement, and increase in rank or moving forward.
- In recent times, some things that were apparently impossible in the past are now realistic in orthodontic sciences as a result of research and development in the profession. Some of these recent advances made in orthodontic technology include: adult orthodontics, implants, Invisalign technique and the use of laser in orthodontics.
- The success in adult orthodontics can be attributed to increased understanding of how bone cells react to orthodontic forces.
- In recent time, Osseo-integrated implants have helped in orthodontic anchorage. This technique was introduced in 1999 and incorporates series of invisible (clear) plastic aligners that fit comfortably over the teeth. They are designed to move teeth gradually into positions.

  LASER is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation. Dental lasers are used to treat dental pathology involving hard and soft tissues with minimal vibration and pain.

6.0 TUTOR-MARKED ASSIGNMENT

In not more than two hundred words, highlight the recent advances in orthodontic technology.

7.0 REFERENCE/FURTHER READING

Daljit, S. G. (2009). *Orthodontics at a Glance*. Singapore: Markono Print Media Pte Ltd.

UNIT 2 DETRIMENTAL EFFECTS OF ORTHODONTIC TREATMENT

CONTENTS

1.0 INTRODUCTION

Orthodontic treatment is associated with a number of adverse effects, such as root resorption, pain, pulpal changes, periodontal disease, and Temporomandibular Dysfunction (TMD). Orthodontists should be aware of these effects and associated risk factors. Risk factors linked to root resorption include the duration of treatment, length and shape of the root, trauma history, habits and genetic predisposition.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain what is meant by detrimental effect
- identify the types of detrimental effects and
- explain the various types of detrimental effects of orthodontic treatment.

3.0 MAIN CONTENT

3.1 What is Detrimental Effect?

Detrimental effect means the negative consequences or outcomes that adversely affect the patient or the practitioner. In orthodontic treatment, these are side-effects of or negative reaction to orthodontic appliance. Put differently, detrimental effects are adverse effects associated with the execution of treatment.

3.2 Types of Detrimental Effects

The adverse effects that emanate from orthodontic treatment include: decalcification, Enamel Fractures during Debonding; root resorption, Gingival Inflammation; pain, pulpal changes, periodontal disease, and Temporomandibular Dysfunction (TMD). Orthodontists should be aware of these effects and associated risk factors. Risk factors linked to root resorption include the duration of treatment, length, and shape of the root, trauma history, habits, and genetic predisposition

3.2.1 Decalcification

An orthodontic appliance could not, within itself, be a cause of caries. However, oral hygiene problems do occur when fixed appliances are worn. Meticulous attention to oral hygiene is mandatory during the entire treatment period to avoid the risk of enamel decalcification. Banded or bonded teeth, exhibited significantly more white spot lesions compared to the controls without braces.

Patients undergoing orthodontic treatment have significant changes in the oral environment, including an increase in *Streptococcus mutans* counts, low salivary pH, and increased retention of food particles on the appliance as well as teeth. This may lead to post-orthodontic treatment decalcification in certain patients in the absence of adequate oral hygiene. Daily administration of topical fluoride and the use of fluoridated toothpaste and mouth rinses is an effective protection against white spot formation. Mouth rinses containing 0.05% sodium fluoride and stannous fluoride can be used as a daily regimen during the treatment period. Fluoride varnishes and fluoride gels are also highly effective in preventing enamel demineralisation.

3.2.2 Enamel Fractures during Debonding

Debonding ceramic brackets is comparatively more problematic, due to the higher bond strength as a result of both mechanical and chemical retention of the bracket base to the tooth. Moreover, shearing forces used for debonding ceramic brackets is likely to cause enamel fractures.

3.2.3 Gingival Inflammation

Plaque is the major etiologic factor in the development of gingivitis. In the presence of plaque, orthodontic forces and tooth movements are capable of inducing angular bone defects and gingival inflammation.

3.2.4 Attachment Loss

In many orthodontic patients, the principal reason for the associated gingival and periodontal inflammation involves mechanical irritation caused by the band or cement, in addition to trapped plaque. The risk of attachment loss can be anticipated when such iatrogenic irritations are present.

3.2.5 Gingival Recession

Gingival recession has been known to occur as an adverse effect during the orthodontic treatment or after treatment completion and has been noted more frequently during buccal orthodontic tooth movements

3.2.6 Black Triangle

Black triangle or open gingival embrasure can occur as potential complication in about $^{1}/_{3}^{rd}$ (one-third) of all adult orthodontic patients and should be discussed with patients prior to initiating orthodontic treatment.

3.2.7 Root Resorption

Root resorption is an unwanted side effect seen with certain type of tooth movements, particularly intrusion. It starts initially as either surface resorption or transient inflammatory resorption and if left unchecked, it further proceeds to progressive inflammatory resorption. Such resorption should not compromise the long-term health of the teeth.

3.2.8 Pulp Damage and Loss of Tooth Vitality

Orthodontic forces affect the dental pulp inducing vascular changes that are inflammatory in nature. Orthodontic patients may suffer from transient pulp ischemia, causing pain, and discomfort in the first few days after activation of an appliance. This usually settles within a week although pulp death following orthodontic treatment is occasionally reported.

3.2.9 Dentin Hypersensitivity after Interproximal Enamel Reduction

Interproximal tooth stripping is an alternative to tooth extraction or expansion of alveolar arches and might be necessary in some situations during orthodontic treatment. Interproximal Enamel Reduction (IER) is used to adjust disproportioned tooth widths and for the correction of mild to moderate crowding. Enamel reduction may lead to complications such as hypersensitivity of interproximal surfaces of stripped teeth. The sensitivity is usually not severe and mostly transient and the symptoms are known to subside over time.

3.2.10 Damage to Intra-Oral Tissues

Mucosal trauma is fairly common during the orthodontic treatment and can be caused by many factors including ulceration by the brackets and the protruding archwires near the molar region, chemical burns from the acid-etchant and clumsy instrumentation.

4.0 CONCLUSION

Orthodontic treatment is a discipline in dentistry. Like many other disciplines it can have adverse effects associated with the execution of treatment. These effects can be related to the patient or practitioner. Some of these effects are not fully understood, such as root resorption, and others are associated with orthodontic treatment without supporting evidence.

5.0 SUMMARY

You have learnt from this unit that Orthodontic treatment like many other disciplines in dentistry can have adverse effects associated with the execution of treatment. These effects can be related to the patient or practitioner.

The adverse effects emanating from orthodontic treatment include: decalcification, Enamel Fractures during Debonding; root resorption,

Gingival Inflammation; pain, pulpal changes, periodontal disease, and temporomandibular dysfunction (TMD). Orthodontists should be aware of these effects and associated risk factors. Risk factors linked to root resorption include the duration of treatment, length, and shape of the root, trauma history, habits, and genetic predisposition.

6.0 TUTOR-MARKED ASSIGNMENT

Explain six of detrimental effects associated with orthodontic treatment.

7.0 REFERENCES/FURTHER READING

‘Adverse of Orthodontic treatment: A clinical perspective.’ *The Saudi Dental Journal,* Volume 23, Issue 2, April 2011, pp. 55–59.

Meeran, N.A. (2013). ‘Iatrogenic Possibilities of Orthodontic Treatment and Modalities of Prevention.’ *Journal of Orthodontic Science*. Retrieved on 29 April, 2014 from: http://www.jorthodsci.org/ text.asp? 2013/2/3 /73/119678.

UNIT 3 DIAGNOSTIC AIDS IN ORTHODONTIC TREATMENT

CONTENTS

1.0 INTRODUCTION

Diagnosis is the most crucial aspect of orthodontic treatment. Diagnosis involves investigations geared towards unveiling the causative factors so that factors such as initial malocclusion, growth, patient's primary concern, treatment limitations and objectives are identified.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define diagnostic aids in orthodontic treatment
- classify diagnostic aids
- list the essential diagnostic aids and
- enumerate the supplemental diagnostic aids.

3.0 MAIN CONTENT

3.1 Diagnostic Aids in Orthodontic Treatment

Diagnostic aids are relevant information or data needed for appraisal of the condition and its etiology for treatment planning. Data needed for orthodontic treatment are derived from essential and supplemental aids.

3.2 Classification of Diagnostic Aids

According to Graber (1994), Diagnostic Aids can be categorised into two namely: Essential and Supplemental Diagnostic aids.

3.2.1 Essential Diagnostic Aids

These are indispensable aids that help the orthodontist to appreciate the kind of malformations and their etiology and adopt appropriate treatment plan. They are *sine qua non* to treatment plan and include:

- Case history
- Clinical examination
- Study models
- Certain radiographs such as: periapical radiographs, bitewing radiographs and orthopantomograms.

3.2.2 Supplemental Diagnostic Aids

Supplemental Diagnostic Aids may be needed in certain cases and usually require specialised equipment. Supplemental Diagnostic Aids include:

- Specialised radiographs such as occlusal views of maxilla and mandible; selected lateral jaw views and lateral cephalograms
- Hand wrist radiographs and other maturity indicators
- Electromyography to assess muscle activity
- Endocrine tests
- Estimation of basal metabolic rate and
- Occlusograms.

4.0 CONCLUSION

In this unit, you have learnt that diagnosis is the most crucial aspect of orthodontic treatment and that data needed for orthodontic treatment are derived from essential and supplemental aids.

5.0 SUMMARY

Now that you have gone through this unit carefully, it is believed that you now understand the following:

Diagnosis involves investigations geared towards unveiling the causative factors so that factors such as initial malocclusion, growth, patient's primary concern, treatment limitations and objectives are identified.

According to Graber (1994), Diagnostic Aids can be categorised into two namely: Essential and Supplemental Diagnostic aids.

Data needed for orthodontic treatment are derived from essential and supplemental aids.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the need for diagnostic aids in orthodontic treatment.

7.0 REFERENCES/FURTHER READING

Graber, T.M. et al. (1994). *Orthodontics Current Principle and Techniques*. Year Book Inc.

Phulari, B.S. (2011). *Orthodontics: Principle and Practice*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

UNIT 4 ORTHODONTIC STUDY MODEL

CONTENTS

1.0 INTRODUCTION

Orthodontic study models serve as a three-dimensional record of the arrangement of teeth and the patient's occlusion prior to treatment. They are essential diagnostic records that help the orthodontist and orthodontic technologist to study occlusion and dentition from all the three dimensions. They are accurate plaster reproduction of the teeth and their soft tissues.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define orthodontic study model
- state the ideal requirements of orthodontic study models
- enumerate the uses of study models
- identify the parts of study models and
- explain the fabrication and trimming of orthodontic study models.

3.0 MAIN CONTENT

3.1 What are Orthodontic Study Models?

Orthodontic study models are accurate plaster reproduction of the teeth and their soft tissues, which serve as a three-dimensional record of the arrangement of teeth and the patient's occlusion prior to treatment.

3.2 Ideal Requirements of Orthodontic Study Model

Here, you are to note the following:

- Models should accurately reproduce the teeth and their surrounding soft tissues;
- They should be trimmed to achieve symmetry and aesthetics;
- Their trimming should permit dental occlusion to show;
- They should reproduce the measurements and angles proposed for them;
- They should be clean, smooth and bubble-free with sharp angles and
- They should have a glossy finish.

3.3 Reasons for Fabrication of Orthodontic Models

Here, you are to note the following:

- They are the only three-dimensional records of the patient;
- Occlusion can be visualised from the lingual aspect;
- They provide a permanent record of the intermaxillary relationships and occlusion at the start of the therapy. This helps in assessment of the progress made in the treatment;
- They serve as visual aids, helping the practitioner to monitor the changes taking place during tooth movement;
- They are needed for comparison at the end of treatment;
- They serve as reminder to the parents or patient of the condition present at start of treatment;
- They serve as important records if patient is transferred to another practitioner.

3.4 Uses of Orthodontic Study Models

They are used to:

- assess and record dental anatomy;
- assess and record intercuspation;

- assess and record arch form;
- evaluate occlusion with the aid of articulator;
- measure progress during treatment;
- detect abnormality;
- calculate total space requirement/discrepancies;
- provide records before and after treatment for the purpose of studying treatment procedures.

3.5 Parts of Orthodontic Study Model

For the purpose of description, orthodontic study model is dived into two parts namely: anatomic and artistic portions.

3.5.1 Anatomic Portion

The anatomic portion is the actual impression of the dental arch and its surrounding soft tissues. This part must be preserved when trimming the model.

3.5.2 Artistic Portion

The artistic portion is the stone base supporting the anatomic portion. This portion is trimmed in a manner which depicts the dental arch form and is aesthetically pleasing.

3.6 Fabrication and Trimming of Orthodontic Study Models

Fabrication and trimming of orthodontic study models can be undertaken through the following steps- impression making; taking a wax bite; disinfection of the impression; casting the impression; basing and trimming; finishing and polishing.

3.6.1 Impression Making

Impression is taken by the clinician after trays have been selected and loaded with mixed impression material to reproduce the negative replica of the teeth and associated soft tissues. The impressions are disinfected and sent to the laboratory with the wax bite.

3.6.2 Taking a Wax Bite

A bite registration is an occlusal representation of how the maxillary and mandibular teeth intercuspate. Bite registration is essential for the subsequent articulation of the maxillary and mandibular study models. The bite registration is routinely obtained immediately following the

maxillary impression. If the bite registration is taken prior to tray selection, the registration can aid in choosing the appropriate size of the impression tray. This time-saving technique eliminates the need for the sterilisation of improperly sized trays.

3.6.3 Disinfection of the Impression

Rinse the impression under gently running, room temperature tap water. Spray the impression and tray with an immediate-level hospital grade (capable of killing tuberculocidal activity) disinfectant of choice (The most accurate casts are associated with disinfection of alginate impressions by spray rather than by immersion.). Place the sprayed impression in a plastic bag, seal the bag tightly, and allow the impression to remain for the amount of contact time recommended by the manufacturer. A label can be affixed to the bag for proper identification. After the required amount of time, remove the impression from the bag and, under room temperature tap water, gently rinse the disinfectant away. Pour as usual. If disinfection of the impression is not completed properly, the gypsum cast will be contaminated and capable of transmitting disease.

3.6.4 Casting the Impression

Dental stone is mixed in the correct powder/water ratio and poured into the impression while been vibrated on a mechanical vibrator to eliminate the air bubbles.

The base/art portion of the cast can be produced through one of the following methods:

i. **Inverted technique:** a separate mix of gypsum is made with a W/P of 2:5 using the conventional mixing technique already outlined for pouring the anatomical portion impression. This increased W/P provides a thicker mix and stronger model base. A mass of material is placed onto a ceramic tile approximately 1 inch in height. The diameter of the mass should exceed the circumference of the impression to allow for subsequent trimming of the base with appropriate angles. Invert the impression tray or anatomical portion of the cast and place over the (gypsum mass) base material. Using a stiff, wet spatula, mold the plaster to the initial pour, making certain not to imbed the tray in plaster (Figure 13) Be sure to add plaster to the heels of the base. The handle should maintain a parallel position to the countertop. Leave undisturbed for 45-60 minutes to allow complete setting of the plaster.

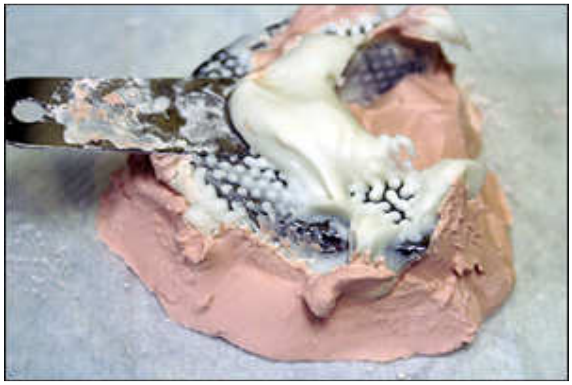

Fig.4.1: Poured Impression on Base (Retrieved from Google.com)

ii. **Rubber model base former:** a separate mix of gypsum is made with a W/P of 2:5. With the vibrator on low and the rubber base former resting on the vibrator platform, fill the commercial base former with plaster. Invert the initial pour onto the gypsum in the mold making certain that no voids exist between the initial pour and the base material. The advantage of using a model base former is that it eliminates time-consuming model trimming.

Fig.4.2: Standard Base Formers

(Retrieved from Google.com)

iii. **Boxing method:** boxing wax is used to create a wall around the circumference of the unpoured impression to create one unit to be poured. First, the anatomical portion of the impression is poured. Subsequently, the operator continues to fill the gypsum material to the top of the boxing wax. The boxing wax acts like a retaining wall to support the art portion of the cast created in this manner. This wax wall eliminates the need for inverting the poured impression to create a base.

3.6.5 Basing and Trimming

Basing can be done as already described above using standard base formers, boxing in or reversed methods. The maxillary and mandibular casts are then trimmed in the following manner.

i. Trimming the mandibular cast

- Determine the occlusal plane of the model. This is considered to be the highest three points of the erupted teeth.
- Trim the base parallel to the occlusal plane.
- Trim the back of the model to be at right angle to the base making sure there is bilateral symmetry.
- Make buccal cuts on the edge of the vestibules at 60^0 angles to the back. The buccal sulcus must be left intact and no tooth should be trimmed.
- Trim the anterior segment of the lower arch into a curve, which should follow the arch of a circle.
- Cut the hills to approximately 115^0 angles to the back.
- Level the floor of the mouth and smoothen it to form a flat surface.

ii. Trimming the maxillary cast

- Determine the occlusal plane of the model and trim the base and back in the manner done for the lower.
- Make buccal cuts on the edge of the vestibules at 60^0 angles to the back.
- Make the anterior cuts (about 5-6 mm from the labial surfaces of the anterior teeth) so that the ends are at the midlines and approximately in the canine areas.
- Form the heels by occluding with lower model and trace the heels of the lower so that both flush. The lengths of the upper heels may, however, not be the same with that of the lower.
- The finished heights of the occluded models should be 7 cm.

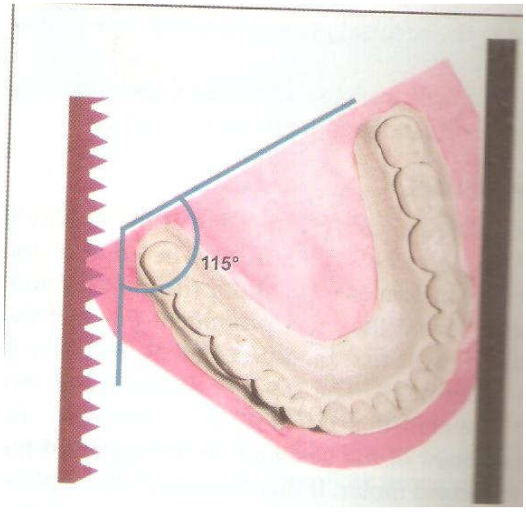

Fig. 4. 3: Cut the Hills to Approximately 115^0 Angles to the Back

Gurkeerat Singh (2007)

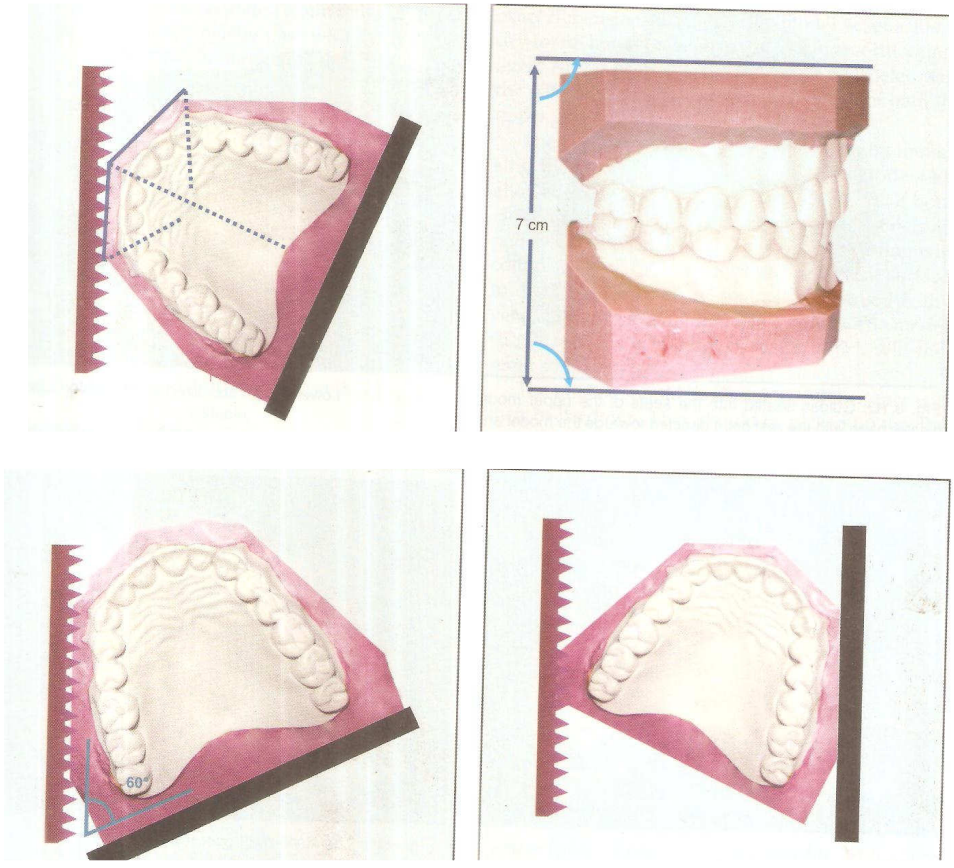

Fig. 4.4: Trimming Upper Model
Gurkeerat Singh (2007)

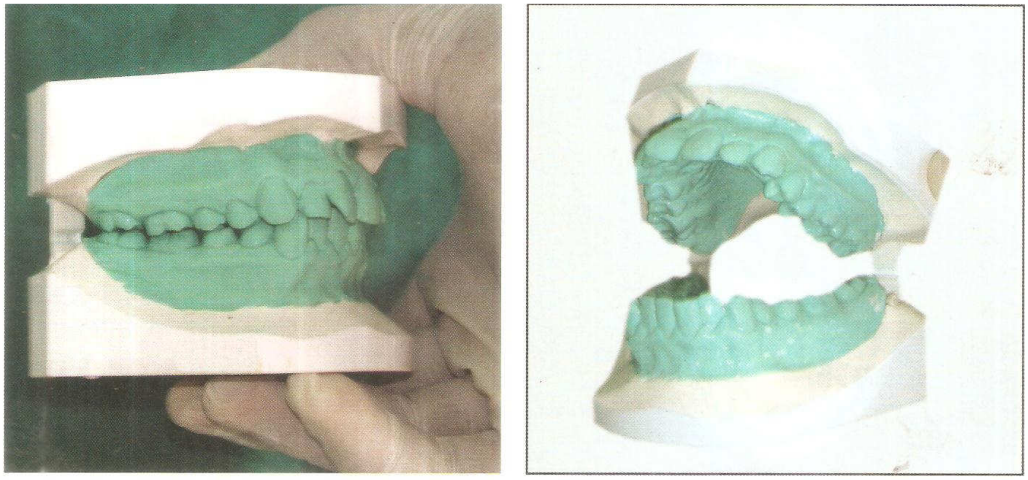

Fig.4.5: Orthodontically Trimmed Models
Gurkeerat Singh (2007)

3.6.6 Finishing and Polishing

The surface of the models must be made smooth without altering the dimensions and the sharp angles. The model is rubbed over a carborandum stone with even pressure under a stream of water until smooth surface results. After the surface has been finished and exact dimensions achieved, the models are set aside to dry for 48 hours or dried in an orthodontic oven overnight. The models are then labeled with the patient's name and date on the back.

4.0 CONCLUSION

Having studied the unit carefully, you now understand that orthodontic study models are essential diagnostic records and help in understanding the occlusion and dentition from all three dimensions. Ideal orthodontic models are expected to meet certain requirements. For description purposes, they are divided into two portions namely: anatomic and artistic portions.

5.0 SUMMARY

Orthodontic study models serve as a three-dimensional record of the arrangement of teeth and the patient's occlusion prior to treatment. They are essential diagnostic records that help the orthodontist and orthodontic technologist to study occlusion and dentition from all the three dimensions. They are accurate plaster reproduction of the teeth and their soft tissues.

Ideal Requirements of orthodontic study model include:

- Models should accurately reproduce the teeth and their surrounding soft tissues
- They should be trimmed to achieve symmetry and aesthetics
- Their trimming should permit dental occlusion to show
- They should reproduce the measurements and angles proposed for them
- They should be clean, smooth and bubble-free with sharp angles and
- They should have a glossy finish.

Orthodontic study models are fabricated for the following reasons:

- They are the only three-dimensional records of the patient;
- Occlusion can be visualised from the lingual aspect
- They provide a permanent record of the intermaxillary relationships and occlusion at the start of the therapy. This helps in assessment of the progress made in the treatment
- They serve as visual aids, helping the practitioner to monitor the changes taking place during tooth movement
- They are needed for comparison at the end of treatment
- They serve as reminder to the parents or patient of the condition present at start of treatment
- They serve as important records if patient is transferred to another practitioner.

Orthodontic study models are used to:

- assess and record dental anatomy
- assess and record intercuspation
- assess and record arch form
- evaluate occlusion with the aid of articulator
- measure progress during treatment
- detect abnormality
- calculate total space requirement/discrepancies
- provide records before and after treatment for the purpose of studying treatment procedures.

For the purpose of description, orthodontic study model is dived into two parts namely- anatomic and artistic portions.
Fabrication and trimming of orthodontic study models can be undertaken through the following steps- impression making; taking a wax bite; disinfection of the impression; casting the impression; basing and trimming; finishing and polishing.

6.0 TUTOR-MARKED ASSIGNMENT

1. State the ideal requirements of orthodontic study models.
2. Explain the fabrication and trimming of orthodontic study models.

7.0 REFERENCE/FURTHER READING

Gurkeerat, S. (2007). *Textbook of Orthodontics.* (2nd ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

UNIT 5 CLASSIFICATION OF ORTHODONTIC CASES

CONTENTS

1.0 INTRODUCTION

When a patient suffers from misaligned teeth, the problem is best corrected with orthodontics. Bonding, Veneers and Crowns can camouflage the shifted position of teeth, but below the surface, the root structure is still misaligned and likely to continue shifting. Orthodontics uses minor forces to slowly move teeth to a more correct position, fixing the patient's bite and making them happier about their smile. This unit deals with the different types of orthodontic cases that can be treated and how the treatment can be achieved.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- state the reasons for orthodontic treatment
- identify the various type of orthodontic cases
- explain how these cases can be treated.

3.0 MAIN CONTENT

3.1 Why Orthodontic Treatment?

Orthodontics is needed to correct a variety of problems: the most common of which is crowding. Beside aesthetic issues, crowded teeth are difficult to maintain and often lead to periodontal disease and decay.

Extreme situations can cause poor occlusion (bite) and Temporomandibular Joint problems. Other reasons for needing orthodontics include but are not limited to: Excess Space, Flared Anterior (front) Teeth, Crossbites, and Skeletal issues.

3.2 Orthodontic Cases

All orthodontic cases are as individual as the patient. From the patient records, an **orthodontic case presentation** can be developed. Sitting down with the patient (and their parents), the treatment plan is explained in detail, and the patient's questions are answered. Then, the orthodontist can order the appliances and orthodontic **brackets** needed for a specific case. It is difficult to project how long a patient will be in braces. Concentration, thus, should be more on getting the treatment right rather than completing the case quickly.

The most important part of an orthodontic case comes after the brackets are removed, and the patient is placed in a **Retainer System**. The word *retain* means to hold in place, and a retainer helps to hold the teeth in their new position. The patient begins wearing a retainer full time and gradually evolves to night-time wear. It is recommended patients going off to college take a well fitting retainer with them, and adult patients should continue to wear a night-time retainer indefinitely because adult cases tend to revert back faster than teen cases.

3.2.1 Types of Orthodontic Cases

There are different types of orthodontic cases. The ones discussed in this course material include: two phase orthodontics, single phase and adult orthodontics.

3.2.1.1 Two Phase Orthodontics

When a child has an extreme problem, such as excessive crowding due to narrow arches or a posterior crossbite, it is best to start Orthodontics early to take advantage of growth patterns. By using **Expanders**, the arches of young children can be molded to develop to the adult width needed to support their permanent teeth.

3.2.1.1.1 Phase One Treatment

Phase one can occur as early as age 6. The goal for Phase one is to correct any skeletal issues, including narrow arches and crossbites. The anterior (front) adult teeth will be placed in an esthetically pleasing position. Once the goals are complete, the patient is put into a retainer

system while they continue to grow. As posterior teeth erupt, what needs to be completed in phase two becomes evident.

3.2.1.1.2 Phase Two Treatment

Phase two occurs once all adult teeth are present. The goal is to correct any misalignment of the posterior (back) teeth and to create a beautiful smile. Phase II is often shorter. Occasionally, the posterior teeth erupt in an acceptable position, and Phase II is not necessary.

3.2.1.2 Single Phase Orthodontics

When a child or teen has slight to moderate orthodontic problems which do not heavily effect their occlusion (bite) or esthetics, Orthodontics is done in a Single phase. These cases start as the patient is going into full adult dentition. In the early teen years, growth spurts can still aid in molding the arch bone. The patient can be expanded and jaw relationships can be modified; however, if the patient is starting Single phase with major issues, they may unfortunately be in braces for an extended time.

3.2.1.3 Adult Orthodontics

In the past, it was believed that adult bone was unable to expand, affecting the success of Adult Orthodontic Case. This has been proven false. Although Adult bone can be more difficult to work with, Adults 20 - 60 can have the smile they always wanted through orthodontics. An adult case is really not much different from that of a teenager. Cases may take slightly longer time, and often cosmetic restorative needs must be taken into account. Adults need to know in advance that they will need to wear retainers for long time because their cases tend to reverse quickly without retention.

4.0 CONCLUSION

In this unit, you have learnt about different types of orthodontic cases which include two phase, single phase and adult orthodontic cases and I am confident that you can now conveniently communicate about this.

5.0 SUMMARY

In this unit, you learnt that orthodontics is needed to correct a variety of problems chiefly among which is crowding. All Orthodontic cases start with detailed dental records, including x-rays, photos, and **Diagnostic Cast**, but each orthodontic case is as individual as the patient.

The types of orthodontic cases include: two-phase, single phase and adult orthodontic treatment.

Two phase orthodontic treatment involves phase one in which goal is to correct any skeletal issues, including narrow arches and crossbites; and phase two, which occurs once all adult teeth are present. The goal is to correct any misalignment of the posterior (back) teeth and to create a beautiful smile.

When a child or teen has slight to moderate orthodontic problems which do not heavily effect their occlusion (bite) or esthetics, orthodontics is done in a single phase.

An adult case is really not much different from that of a teenager but cases may take slightly longer time, and often cosmetic restorative needs must be taken into account.

6.0 TUTOR-MARKED ASSIGNMENT

Identify the various types of orthodontic cases and explain how these cases can be treated.

7.0 REFERENCE/FURTHER READING

Freeman, M. et al. (2014). *Cosmetic Dentistry*. Retrieved on 05 May, 2014 from http://www.richmonddentalgroup.com/braces.php.

MODULE 3 BIOMECHANICS OF TOOTH MOVEMENT

UNIT 1 INTRODUCTION TO BIOMECHANICS

CONTENTS

1.0 INTRODUCTION

Biomechanics is commonly used in discussions of the reaction of the dental and facial structures to orthodontic force. Mechanics is reserved for the properties of the strictly mechanical components of the appliance system.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define biomechanics
- describe the scope of biomechanics
- explain the concept of dental biomechanics
- explain useful concepts in biomechanics.

3.0 MAIN CONTENT

3.1 Biomechanics as a Concept

Biomechanics is the study of the structure and function of biological systems such as humans, animals, plants, organs, and cells by means of the methods of mechanics. Biomechanics is closely related to engineering, because it often uses traditional engineering sciences to analyse biological systems. Some simple applications of Newtonian mechanics and/or materials sciences can supply correct approximations to the mechanics of many biological systems.

3.2 Scope of Biomechanics

Mechanics is the study of forces and their effects. The application of these mechanical principles to human and animal bodies in movement and at rest is called biomechanics. Biomechanics is one of the disciplines in the field of Human movement and Exercise science and it can be divided into three broad categories namely: clinical biomechanics; occupational biomechanics and biomechanics in sport. However, this course is concerned with dental biomechanics which is a subsidiary of clinical biomechanics.

Mechanics covers two basic areas namely statics and dynamics.

3.2.1 Statics

Statics is the study of a body at rest or equilibrium as a result of forces acting on it.

3.2.2 Dynamics

Dynamics is the study of moving bodies and or objects. This can be divided further into kinematics and kinetics.

3.2.2.1 Kinematics

This involves the study of motion without reference to mass or force.

3.2.2.2 Kinetics

This deals with moving bodies and the forces acting to produce such movement.

3.3 Dental Biomechanics

Dental Biomechanics provides a comprehensive, timely, and wide-reaching survey of the relevant aspects of biomechanical investigation within the dental field. It is the relationship between the biologic behaviour of oral structures and the physical influences of dental restorations/appliances.

A variety of elastic materials such as springs and rubber bands are used to provide resistance to dislodging forces in dental appliances and restorations. The line of the resisting force lies along the length of the elastic material.

3.4 Useful Concepts in Biomechanics

- **Kinesiology** – the study of motion developed from fascination of human being with animal motion.
- **Motion** – this is a continuous change of position or displacement of a body.
- **Force** – force can be described as a pull or push. To produce force, one object must act on another. A force must have magnitude, line of action, point of application and direction.
- **Vector quantity** – a vector quantity is that which has both magnitude and direction.
- **Scalar quantity** – scalar quantity has magnitude but no direction.
- **Matter** – Matter is anything that has weight and occupies space. In biomechanics, we deal with the quantity of matter or mass to which force of gravity is applied.
- **Centre of mass** – the centre of mass is that pint at the exact centre of an object mass often called centre of gravity.
- **Weight** – the weight of a body is the pull of gravity on it.

4.0 CONCLUSION

In this unit, you learnt that biomechanics is commonly used in discussions of the reaction of the dental and facial structures to orthodontic force. Mechanics is reserved for the properties of the strictly mechanical components of the appliance system. Biomechanics is the study of the structure and function of biological systems such as humans, animals, plants, organs, and cells by means of the methods of mechanics.

5.0 SUMMARY

You have learnt the following in this unit:

Biomechanics is the study of the structure and function of biological systems such as humans, animals, plants, organs, and cells by means of the methods of mechanics. Biomechanics is closely related to engineering, because it often uses traditional engineering sciences to analyse biological systems.

Mechanics is the study of forces and their effects. The application of these mechanical principles to human and animal bodies in movement and at rest is called biomechanics, which is divided into three broad categories namely: clinical biomechanics; occupational biomechanics and biomechanics in sport. Dental biomechanics is the relationship between the biologic behaviour of oral structures and the physical influences of dental restorations/appliances.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the terms mechanics, biomechanics and dental biomechanics.
2. Describe the scope of biomechanics.

7.0 REFERENCES/FURTHER READING

Hatze, H. (1974). "The meaning of the Term Biomechanics". *Journal of Biomechanics* ,7: 189–190. doi: 10.1016/0021-9290(74)90060-8.

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UNIT 2 MUSCLES OF MASTICATION AND EXPRESSION

CONTENTS

1.0 INTRODUCTION

Muscles of mastication are powerful muscles acting on the masticatory movements. They are inserted upon the mandible and are concerned with the process of biting and chewing. On the other hand, the muscles of facial expression are superficial sphincters and dilators of the openings of the head. They arise from the facial bone and insert into skin. These muscles help in both retention and functioning of the orthodontic appliances.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain muscles of mastication and facial expression
- list the muscles of mastication and facial expression
- state the origin and insertion of masticatory muscles
- highlight the origin and insertion of facial muscles and explain the relevance of these muscles to orthodontic treatment.

3.0 MAIN CONTENT

3.1 Muscles of Mastication

They are powerful muscles acting on the masticatory movements. All muscles of mastication are inserted upon the mandible and are concerned with the process of biting and chewing. They are innervated by cranial nerve V and include: masseter ; temporal, medial pterygoid; lateral pterygoid – grates the teeth and digastric muscle.

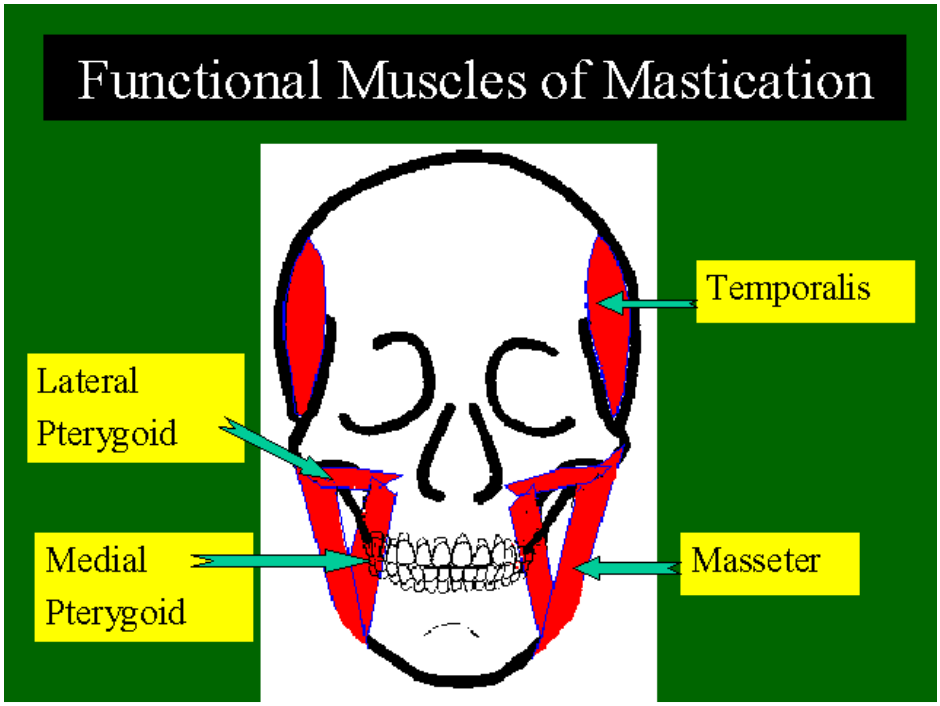

Fig.2.1: Principal Muscles of Mastication
(Retrieved from google.com)

3.1.1 The Masseter Muscle

This is a broad muscle which is attached to the zygomatic arch and the angle of mandible. It is very powerful and exerts great pressure during chewing.

Origin: lower border and medial side of zygomatic arch.

Insertion: lateral surface of the ramus of mandible and coronoid process.

Principal action: Elevates (closes the jaw).
Innervations: deep temporal branch of mandibular nerve (CNV^3).

3.1.2 Temporal Muscle

Fan-shaped muscle which spread out from the temporal bone on either side of the skull.

Origin: floor of temporal fossa and deep surface of temporal fascia.

Insertion: coronoid process and anterior border of ramus of mandible.

Nerve supply: deep temporal branch of mandibular nerve (CNV^3).

Principal action: elevates mandible, closing the jaws. Its posterior fibres retracts mandible after protrusion.

3.1.3 Medial Pterygoid Muscle

This is deeply embedded in within the cheeks with deep and superficial heads.

Origin: deep head-medial surface of lateral pterygoid plate and pyramidal process of palatine bone; superficial head of tuberosity of maxilla.

Insertion: medial surface of ramus of mandible inferior to mental foramen,

Innervations: mandibular nerve (trigeminal nerve) through medial pterygoid nerve.

Principal action: closes the jaws and produces grinding movement by acting alternately.

3.1.4 Lateral Pterygoid Muscle

Has inferior and superior heads.

Origin: superior head- greater wing of sphenoid; inferior head – lateral surface of lateral pterygoid plate.

Insertion: neck of mandible, articular disc and capsule of TMJ.

Innervations: mandibular nerve through lateral pterygoid nerve from anterior trunk, which enters its deep surface.

Principal action: protrusion, depression and side to side movement of mandible.

3.1.5 Digastric muscle

This lies anteriorly and posteriorly below the mandible to form part of the floor of the mouth.

Origin: anteriorly and posteriorly below the mandible and the hyoid bone.

Insertion: mandible and maxilla.

Innervations: mandibular nerve.

Principal action: elevates and retract the hyoid and opens the mouth.

3.2 Muscles of Facial Expression

The muscles of facial expression are superficial sphincters and dilators of the openings of the head. They are all supplied by the facial nerve (CNVII). They arise from the facial bone and insert into skin. Facial muscles are arranged around the mouth; nose; ear (extrinsic); scalp (epicranius and Neck)

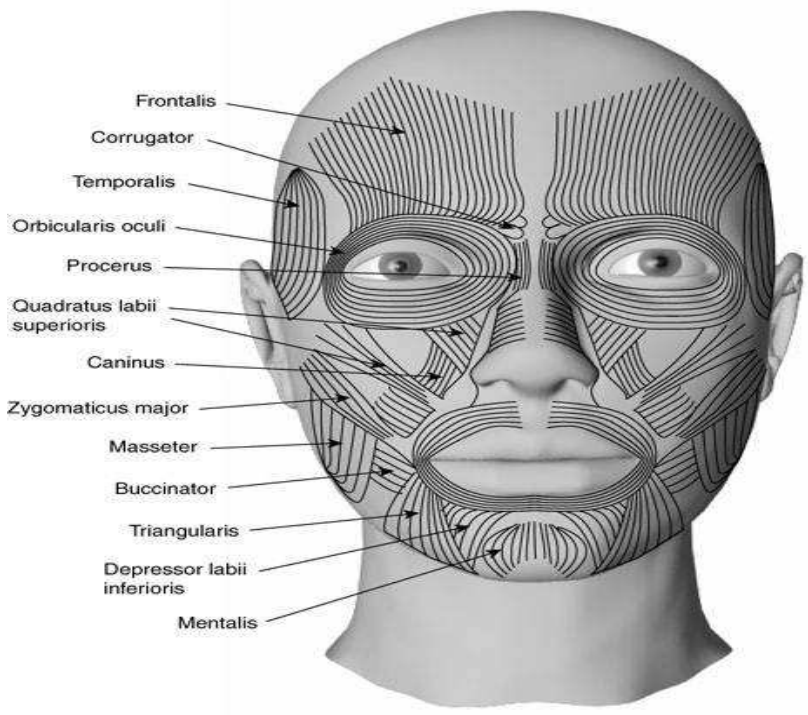

Fig.2. 2: Muscles of Facial Expression
(Retrieved from Googlesearch.com)

The table below shows the major muscles of facial expression, their origin, insertion and actions.

Table 2.1: Major Muscles of Facial Expression

Mouth			
Buccinator	Alveolar processes of maxillary bone and mandible	Blends into fibers of orbicularis oris	Compresses cheeks
Depressor labii Inferioris	Mandible between the anterior midline and the mental foramen	Skin of lower lip	Depresses lip
Levator labii Superioris	Lower margin of orbit, superior to the infraorbital foramen	Orbicularis Oris	Elevates upper lip
Mentalis	Incisive fossa of Mandible	Skin of chin	Elevates and protrudes lower lip
Orbicularis oris	Maxillary bone and Mandible	Lips	Compresses, purses lips
Risorius	Fascia surrounding parotid salivary gland	Angle of Mouth	Draws corner of mouth to the side
Depressor anguli Oris	Anterolateral surface of mandibular body	Skin at angle of mouth	Depresses corner of Mouth
Zygomaticus Major	Zygomatic bone near the zygomaticomaxillary suture	Angle of Mouth	Retracts and elevates corner of mouth
Zygomaticus Minor	Zygomatic bone posterior to zygomaticotemporal suture	Upper lip	Retracts and elevates corner of mouth
Eye			
Levator palpebrae Superioris	Tendinous band around optic foramen	Upper Eyelid	Elevates upper eyelid
Orbicularis oculi	Medial margin of Orbit	Skin around Eyelids	Closes eye

	Nose		
Procerus	Nasal bones and lateral nasal cartilages	Aponeurosis at bridge of nose and skin of forehead	Moves nose, changes position and shape of nostrils
Nasalis	Maxillary bone and alar cartilage of nose	Bridge of Nose	Compresses bridge, depresses tip of nose; elevates corners of nostrils
Ear (extrinsic)			
Temporoparietalis	Fascia around external ear	Galea aponeurotica	Tenses scalp, moves pinna of ear
Scalp (Epicranius			
Frontalis	Galea aponeurotica	Skin of eyebrow and bridge of nose	Raises eyebrows, wrinkles forehead
Occipitalis	Superior nuchal line	Galea aponeurotica	Tenses and retracts scalp
Neck			
Platysma	Upper thorax between cartilage of second rib and acromion of scapula	Mandible and skin of cheek	Tenses skin of neck, depresses mandible

3.3 Relevance of Muscles of Mastication and Facial Expression in Orthodontic Tooth Movement

The muscles of mastication and expression play significant role in orthodontic tooth movement. Functional appliances receive muscular pressure from the muscles of mastication and transmit such forces to the teeth to cause tooth movement. In like manners, the facial muscles play key role in the retention of the appliance.

4.0 CONCLUSION

This unit has unveiled to you the principal muscles of mastication and muscles of facial expression, their origin, insertion and actions. The relevance of these muscles on orthodontic tooth movement has also been dealt with.

5.0 SUMMARY

The muscles of mastication are powerful muscles acting on the masticatory movements. All muscles of mastication are inserted upon the mandible and are concerned with the process of biting and chewing. They are innervated by cranial nerve V and include: masseter; temporal, medial pterygoid; lateral pterygoid and digastric muscle.

The muscles of facial expression are superficial sphincters and dilators of the openings of the head. They are all supplied by the facial nerve (CNVII). They arise from the facial bone and insert into skin. Facial muscles are arranged around the mouth; nose; ear (extrinsic); scalp (epicranius and Neck.

The muscles of mastication and expression play significant role in orthodontic tooth movement. Functional appliances receive muscular pressure from the muscles of mastication and transmit such forces to the teeth to cause tooth movement. In like manners, the facial muscles play key role in the retention of the appliance.

6.0 TUTOR-MARKED ASSIGNMENT

Discuss two muscles of mastication and two muscles of facial expression under insertion, origin and action.

7.0 REFERENCE/FURTHER READING

Muscles of Mastication. Retrieved on 22nd April, 2014 from wikipedia.org/wiki/Muscles_of_mastication.

UNIT 3 ORTHODONTIC TOOTH MOVEMENT AND ASSOCIATED TISSUE CHANGES

CONTENTS

1.0 INTRODUCTION

Teeth are embedded in the alveolar sockets of the jaws. The joints between the teeth and the jaws are fairly loose and allows the sideways or back and forth movement of the teeth when pressure is applied to the crown of the tooth.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define orthodontic tooth movement
- enumerate the types of orthodontic tooth movement
- explain the various theories of orthodontic tooth movement
- list the phases of tooth movement.

3.0 MAIN CONTENT

3.1 What is Orthodontic Tooth Movement?

Orthodontic tooth movement is a movement of a tooth which occurs due to the pressure applied to the tooth by an orthodontic appliance. This pressure is transmitted to the clinical crown of the tooth, down to the root, and ultimately to the periodontal ligament (the tissue that attaches the tooth to the bone) and alveolar bone surrounding the root. Slow, continuous force provides the most efficient tooth movement.

3.3.1 Types of Orthodontic Movement

Orthopedic forces are used to affect the shape and growth of the facial bones, while Orthodontic forces are used to move teeth within the arches.

The types of orthodontic movement include the following:

- Extrusion – to move a tooth in the direction away from the gingiva
- Intrusion – to move a tooth in the direction toward the gingiva
- Rotation – to move a tooth by spinning the tooth on its axis
- Torquing – force causing movement of a root either buccally or lingually
- Tipping – movement of a tooth/root mesially or distally
- Retraction – moving teeth distally to close space
- Advancing – moving teeth forward

3.2 Theories of Orthodontic Tooth Movement

Various theories have been proposed over the years to explain the mechanism of orthodontic tooth movement. Some of these theories include: pressure tension, blood flow and piezoelectric theories.

3.2.1 Pressure Tension Theory

According to this theory which was propounded by Schwartz (1932), areas of pressure and tension are created whenever a tooth is subjected to orthodontic force. The area of periodontium in the direction of force is under pressure while that opposite the direction of force is under tension. Bone resorption takes place in the area of pressure while new bone is deposited in the areas of tension.

3.2.2 Blood Flow Theory

This theory was formulated by Bien (1966) and is also called Fluid Dynamic Theory. According to this theory, tooth movement occurs as a result of alternations in fluid dynamics in periodontal ligament located in periodontal ligament space. PDL space contains a fluid system made up of interstitial fluid, cellular elements, blood vessels and viscous ground substances in addition to PDL fibres. It is a confined space and passage of fluid in and out of this space is limited.

The contents of PDL create a unique hydrodynamic condition resembling a hydraulic mechanism and shock absorber. When force is removed, the fluid is replenished by diffusion from capillary walls and recirculation of interstitial fluids. Squeeze film effect by Bien. When orthodontic force is applied, there is a compression of the ligament. Blood vessels of PDL get trapped between the principle fibres and this results in stenosis. Vessels above the stenosis then balloons resulting in formation of an aneurysm causing blood gases to escape into interstitial fluids, creating favourable local environment for resorption.

3.2.3 Piezoelectric Theory

This theory by Picton et al (1960) suggested that the effects of physical distortion on the alveolar bone by forces from orthodontic appliances may be responsible for the tissue reaction observed during tooth movement. According to the theory, when orthodontic force is applied to the tooth, it causes deformation or bending of the alveolar bone. It has been shown that bones which have been deformed by stress become electrically charged and exhibits a phenomenon known as piezoelectricity. The distorted bone forms concave and convex areas and bone deposition occurs at the concave area which is negatively charged while bone resorption occurs at the area of convexity which is positively charged.

3.3 Phases of Tooth Movement

Orthodontic tooth movement is composed of three phases: initial tipping, lag phase and progressive tooth movement.

3.3.1 Initial Phase

Initial tipping occurs when a force (tipping) is applied to a crown of a tooth. The periodontal ligament (PDL) is compressed near the alveolar margin on the side toward which the tooth is moved. On the opposite side, the PDL is widened or is under tension.

3.3.2 Lag Phase

The lag phase represents a delay in movement, which reflects recruitment of cells and the establishment of a microenvironment that will allow the PDL and bone to remodel. This is when osteoclasts are recruited to the area and osteoblasts are activated.

The final phase represents tissue turnover, which allows reduction of the applied strain terminating in tooth movement and appliance deactivation. Bone resorption is dominant in pressure areas, and bone formation is dominant in areas of tension. The length of each phase is partially dependent on the amount of force applied. If excessive forces are applied, the root approaches the alveolar wall effectively to reduce vasculature to the area. As a result, a cell-free zone or hyalinised area is formed. The hyalinised tissue must be removed for tooth movement to occur. This occurs by a process termed undermining resorption, where osteoclasts present within the adjacent bone marrow spaces begin bone resorption on the underside opposite the cell free area. This lag phase can last from several days to several weeks. The use of light forces can minimise the appearance of hyalinised tissue.

3.3.3 Post Lag Phase

During this phase, tooth movement progresses at a rapid rate during which osteoclasts are formed over a large surface area, directly resorbing the bone surface facing the periodontal ligament.

4.0 CONCLUSION

In this unit you have learnt that orthodontic tooth movement is a movement of a tooth which occurs due to the pressure applied to the tooth by an orthodontic appliance. This pressure is transmitted to the clinical crown of the tooth, down to the root, and ultimately to the periodontal ligament (the tissue that attaches the tooth to the bone) and alveolar bone surrounding the root. Slow, continuous force provides the most efficient tooth movement. They are three phases of tooth movement and certain theories have been formulated by different scholars to explain the mechanism of orthodontic tooth movement.

5.0 SUMMARY

In this unit, you have learnt the following:

Orthodontic tooth movement is a movement of a tooth which occurs due to the pressure applied to the tooth by an orthodontic appliance.

There are different types of orthodontic movement which include: the shaping and growth of the facial bones by means of orthopedic forces; movement of teeth within the arches by orthodontic forces; extrusion; intrusion; rotation; tipping; torque; retraction and advancing.

Various theories have been proposed over the years to explain the mechanism of orthodontic tooth movement. Some of these theories include: pressure tension, blood flow and piezoelectric theories.

Orthodontic tooth movement is composed of three phases: initial tipping, lag phase and progressive tooth movement.

6.0 TUTOR-MARKED ASSIGNMENT

1. Differentiate between orthopedic and orthodontic forces.
2. Define orthodontic movement and briefly describe the three phases of orthodontic tooth movement.

7.0 REFERENCES/FURTHER READING

Calogero, D. (2014). *Goals of Orthodontic Treatment.* Retrieved on 03 May 2014 from http://www.dentalcare.com/en-US/dental-education/continuing.

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UNIT 4 ANCHORAGE IN ORTHODONTICS

CONTENTS

1.0 INTRODUCTION

Anchorage is the resistance to movement which the tooth and tissue can afford. Resistance to movement must be greater than the force being used to move the teeth. This is because if it were equal, the teeth been moved and the ones been used for anchorage would move equal distances, which is undesirable.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define anchorage
- identify sources of anchorage
- classify anchorage in orthodontics.

3.0 MAIN CONTENT

3.1 What is Anchorage?

Anchorage can be defined as the resistance to movement which the tooth and tissue can afford. Resistance to movement must be greater than the force being used to move the teeth. According to Graber, anchorage is defined as the nature and degree of resistance to displacement offered by the anatomic unit when used for the purpose effecting tooth movement.

3.2 Sources of Anchorage

Anchorage can be obtained from either intra-oral or extra-oral sources.

3.2.1 Intra-Oral Anchorage

Intra- oral sources of anchorage include: teeth, alveolar bones basal jaw bone and musculature.

3.2.1 Extra-Oral Anchorage

Extra- oral sources of anchorage include: cranial bone. Facial bones and cervical bone (back of the neck).

3.3 Classification of Anchorage

There are numerous systems of anchorage classification based on different criteria. However, for understanding anchorage, it is convenient to classify anchorage into intra oral and extra oral anchorage, each of which are further divided.

3.3.1 Intra-Oral Anchorage

This is the type of anchorage in which all the anchorage units are present in the mouth. They are further divided into intramaxillary and intermaxillary anchorage.

3.3.1.1 Intra-Maxillary Anchorage

This is the type of anchorage in which both the teeth to be moved and the anchorage units lie within the same jaw. Intra- maxillary anchorage can be divided further into three namely: simple, stationary and reciprocal anchorage.

3.3.1.2 Inter-maxillary Anchorage

This is the type of anchorage in which anchorage unit situated in one jaw are used to provide the force needed to move teeth in the opposite jaw. They are also divided further into three namely: simple, stationary and reciprocal anchorage.

3.3.1.2.1 Simple Anchorage

Simple anchorage is obtained by engaging more number of teeth than are to be moved. This type of anchorage tends to change the axial inclination of the tooth/teeth that form anchorage unit in the plane of space in which force is being applied. The resistance to tipping of the anchorage units can therefore be utilised to retract certain other teeth. Examples of simple anchorage are anterior retraction with the aid of Hawley's appliance or movement of a single tooth using screw appliance.

3.3.1.2.2 Stationary Anchorage

In this type of anchorage, the application of force tends to displace the anchorage units bodily in the plane of space in which the force is being applied.

3.3.1.2.3 Reciprocal Anchorage

This is the type in which two teeth or set of teeth move to an equal extent in an opposite direction. The root surface area of the anchorage unit is equal to that of the tooth to be moved. Examples are: cross elastics to correct molar cross bite, arch expansion using midline screw and the molar rotator.

3.3.2 Extra-Oral Anchorage

Just as the name implies, the anchorage units are situated outside the oral cavity or extra orally. Examples of extra- oral anchorage are: cervical pull headgear, occipital pull head-gear and face mask etc.; apparent lack of patient cooperation, bulky and conspicuous assembly and poor aesthetics are major disadvantages of extra oral anchorage.

4.0 CONCLUSION

As you have studied in this unit, you can now appreciate the relevance of anchorage in orthodontics. It is hoped that you can now apply the knowledge in the design and fabrication of different appliances.

5.0 SUMMARY

In this unit, you have learnt that:

Anchorage can be defined as the resistance to movement which the tooth and tissue can afford. Anchorage can be obtained from either intra-oral or extra-oral sources.
There are numerous systems of anchorage classification based on different criteria. However, for understanding anchorage, it is convenient to classify anchorage into intra-oral and extra-oral anchorage, each of which are further divided into sub classes.

Intra-oral anchorage is one in which all the anchorage units are present in the mouth. They are further divided into intra-maxillary and inter-maxillary anchorage.

Extra-oral anchorage is type of anchorage where the anchorage units are situated outside the oral cavity or extra orally.

6.0 TUTOR-MARKED ASSIGNMENT

1. In simple terms, explain the classification of anchorage in orthodontics.

7.0 REFERENCES/FURTHER READING

Gurkeerat, S. (2007). *Textbook of Orthodontics.* (2nd ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

Phulari, B.S. (2011). *Orthodontics: Principle and Practice*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

UNIT 5 RETENTION AND RELAPSE IN ORTHODONTIC TREATMENT

CONTENTS

1.0 INTRODUCTION

When orthodontic treatment is complete, there is tendency for the corrected teeth to return to their original positions. This phenomenon is regarded as relapse in orthodontic treatment. There is need to prevent this ugly occurrence by making the patient to go through another phase of orthodontic treatment called retention. This unit thus designed to look into the definition of terms, reasons for retention, schools of retention and causes of relapse.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define retention and relapse in orthodontic treatment
- state the reasons for retention in orthodontic treatment
- explain different schools of retention
- list the causes of relapse in orthodontic treatment and
- enumerate the retainers used in orthodontic treatment.

3.0 MAIN CONTENT

3.1 Definition of Terms

- ***Retention*** can be defined as the phase of orthodontic treatment which maintains the teeth in their orthodontically corrected positions, following the cessation of active orthodontic tooth movement.
- ***Relapse*** is the return or tendency to return of teeth to their original position under the influence of periodontal, occlusal and soft tissue forces and continuing dentofacial growth. Orthodontic retainers help to resist this tendency.

3.2 Reasons for Retention in Orthodontic Treatment

Retention in orthodontic treatment is necessary for the following reasons:

- Gingival and periodontal tissues are affected by orthodontic tooth movement and require time for reorganisation when the appliances are removed.
- The teeth may be in an inherently unstable position after the treatment so that soft tissue pressure s constantly produces a relapse tendency.
- Changes produced by growth may alter the orthodontic treatment result.

3.3 Schools of Retention

Different philosophies have been put in place over the years to explain post treatment stability. These philosophies which are referred to as Schools of Retention, include occlusal school, apical base school, mandibular incisor school and musculature school.

3.3.1 Occlusal School

According to occlusal school of retention by Kingsley (in Phulari 2011), proper occlusion is a key factor in determining the stability of the newly moved teeth.

3.3.2 Apical Base School

Alex Lundstrom (in Phulari, 2011), suggested that the apical base is an important factor in the correction of malocclusion and maintenance of stability in treated cases.

3.3.3 Mandibular Incisor School

This school of retention by Grieves and Tweed suggested that post treatment stability was increased when the mandibular incisors were place upright slightly retroclined over the basal bone.

3.3.4 Musculature School

The dentition is encapsulated from outside and inside by muscles. According to Rojers (in Phulari 2011), functional muscle balance is necessary in order to ensure post treatment stability.

3.4 Causes of Relapse in Orthodontic Treatment

There are many causes of relapse in orthodontic treatment. In most cases, relapse occurs due a combination of causes. Some of these causes include:

- Relapse due to growth-related changes
- Bone adaptation
- Muscular forces
- Failure to eliminate the original causes and
- Periodontal ligament traction.

3.5 Retainers Used in Orthodontics

Retainers are fixed or removable appliances that maintain the teeth in their orthodontically corrected positions, following the cessation of active orthodontic tooth movement.

3.5.1 Classification of Retainers

Retainers are classified into removable and fixed.

Removable retainers

These are the types that are designed to be removable by the patient. The removable retainer is conducive for oral hygiene but the success depend entirely on patient's compliance. The following are the types of removable retainers:

- ***Hawley's retainers*** which was designed by Hawley in 1920 is the most widely used removable retainer. It has many modifications such as:

- Hawley's retainer with C clasp on molar teeth
- Hawley's retainer with long labial bow
- Hawley's retainer with contoured labial bow
- Hawley's retainer with light elastic across the incisor teeth
- Hawley's retainer with labial bow soldered to the bridge of Adam's crib
- Hawley's retainer with bite plane
- Hawley's retainer with lingual extension clasps on molars and
- Hawley's retainer with occlusal rest

- ***Begg's retainer***
- ***Clip on retainer or spring aligner***
- ***Wrap around retainer***
- ***Kesling tooth positioned and***
- ***Invisible retainer.***

Fixed retainers

Fixed retainers are designed to be fixed on the teeth and are not removable by the patient at will. Examples of fixed retainers are:

- ***band and spur fixed retainers***
- ***banded canine-to-canine fixed retainers and***
- ***bonded canine-to-canine fixed retainers***.

4.0 CONCLUSION

In this unit, you learnt that if teeth are moved orthodontically, they tend to return to the original position on removal of the active appliance. Therefore, retainers become necessary in order to ensure stability of corrected tissues in their corrected position. Either fixed or removable retainers can be used.

5.0 SUMMARY

Retention can be defined as the phase of orthodontic treatment which maintains the teeth in their orthodontically corrected positions, following the cessation of active orthodontic tooth movement.

Relapse is the return or tendency to return of teeth to their original position under the influence of periodontal, occlusal and soft tissue forces and continuing dentofacial growth. Orthodontic retainers help
Retention in orthodontic treatment is necessary for the following reasons:

- Gingival and periodontal tissues are affected by orthodontic tooth movement and require time for reorganisation when the appliances are removed.
- The teeth may be in an inherently unstable position after the treatment so that soft tissue pressure s constantly produces a relapse tendency.
- Changes produced by growth may alter the orthodontic treatment result.

Different philosophies have been put in place over the years to explain post treatment stability. These philosophies which are referred to as Schools of Retention, include occlusal school, apical base school, mandibular incisor school and musculature school.

There are many causes of relapse in orthodontic treatment. In most cases, relapse occurs due a combination of causes. Some of these causes include:

- Relapse due to growth-related changes
- Bone adaptation
- Muscular forces
- Failure to eliminate the original causes and
- Periodontal ligament traction.

Retainers are fixed or removable appliances that maintain the teeth in their orthodontically corrected positions, following the cessation of active orthodontic tooth movement.

Retainers are classified into removable and fixed. The removable retainer is conducive for oral hygiene but the success depends entirely on patient's compliance.

6.0 TUTOR-MARKED ASSIGNMENT

1. Define retention and relapse in relation to orthodontic treatment.
2. What do you understand by schools of retention? Explain three schools of retention you know.

7.0 REFERENCE/FURTHER READING

Phulari, B.S. (2011). *Orthodontics: Principle and Practice*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

MODULE 4 CLASSIFICATION OF ORTHODONTIC APPLIANCES

UNIT 1 GENERAL OVERVIEW OF ORTHODONTIC APPLIANCES

CONTENTS

1.0 INTRODUCTION

In the past, finger pressure was advocated for moving teeth into alignment. However, with advancement in orthodontics, researchers have invented different appliances. This unit, therefore, has been designed to give you a general overview of orthodontic appliances.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define orthodontic appliance
- classify orthodontic appliances
- enumerate the ideal requirements of orthodontic appliances.

3.0 MAIN CONTENT

3.1 What is Orthodontic Appliance?

Orthodontic appliance is a dental device that creates and or transmits forces to individual teeth or group of teeth and or maxilla-facial skeletal units so as to bring about changes within the bone with or without tooth movement which will help to achieve treatment goals of functional efficiency, structural balance and aesthetic harmony.

3.2 Classification of Orthodontic Appliance

There are different ways of classifying orthodontic appliances but the simplest way is that based on patient's ability to remove the appliance from the mouth. Based on this criterion, Orthodontic appliances can be classified as: removable, semi-fixed and fixed orthodontic appliances.

3.2.1 Removable Appliances

These are appliances that are removable by the patient. Examples of removable appliance are oral screen, Hawley's retainers etc.

3.2.2 Semi-Fixed Appliances

These are appliances that have some parts fixed to the tooth surface, which the patient cannot remove but the rest of the appliance can be removed, e.g. Lip bumper.

3.2.3 Fixed Appliances

These are appliances that are fixed in the patient's mouth which cannot be removed by him/her. There are further classified into active and passive fixed appliances depending on the ability to generate forces.

3.2.3.1 Active Fixed Appliances

They are attached to the tooth surface and are capable of generating forces that can bring about tooth movement.

3.2.3.2 Passive Fixed Appliances

These appliances do not generate force, but maintain attained position of the teeth. Examples are fixed retainers and space maintainers.

3.2.4 Functional Appliances

Another form of orthodontic appliance is functional appliance. The functional appliances, which could be fixed or removable, transmit natural forces of oral musculature to move the teeth and or alveolar bone. An example is oral screen.

3.3 Ideal Requirements of Orthodontic Appliances

All appliances used for orthodontic movement are expected to fulfill certain ideal requirements such as biologic, mechanical and aesthetic requirements.

3.3.1 Biologic Requirements

- It should be capable of bringing about the desired tooth movement efficiently
- Its function should not be detrimental to the teeth and periodontium
- It should move only the tooth designed
- The appliance should not interfere with normal growth
- It should not impede or interfere with normal function
- It should allow for maintenance of proper hygiene and
- It should function in oral environment without breakage.

3.3.2 Mechanical Requirements

- The appliance should be able to produce continuous controlled forces of the desired intensity and direction
- It should withstand masticatory forces without being damaged
- It should not be bulky or uncomfortable for the patient
- It should be universally applicable and accepted
- It should be versatile; that means it should be able to correct diverse cases

- It should be simple to make and allows for repair in case of damage and
- Activation should be easy.

3.3.3 Aesthetic Requirements

- It should be aesthetically acceptable to the patient
- It should be as inconspicuous as possible not to draw attention and
- The appearance should not interfere with patient's professional or social life during the orthodontic treatment.

4.0 CONCLUSION

You have learnt much about orthodontic appliances in this unit and I believe that you can now attempt questions about the definition, classification and ideal requirements of orthodontic appliances.

5.0 SUMMARY

In this unit, you have been exposed to orthodontic appliance and you have learnt that the following:

Orthodontic appliance is a dental device that creates and or transmits forces to individual teeth or group of teeth and or maxilla-facial skeletal units so as to bring about changes within the bone with or without tooth movement which will help to achieve treatment goals of functional efficiency, structural balance and aesthetic harmony.

There are different ways of classifying orthodontic appliances but the simplest way is that based on patient's ability to remove the appliance from the mouth. Based on this criterion, orthodontic appliances can be classified as: removable, semi-fixed and fixed orthodontic appliances.
All appliances used for orthodontic movement are expected to fulfill certain ideal requirements such as biologic, mechanical and aesthetic requirements.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the classification of orthodontic appliances based on the ability of patient to remove the appliance from the mouth.
2. Enumerate five biological and five mechanical requirements of orthodontic appliance.

7.0 REFERENCES/FURTHER READING

Gurkeerat, S. (2007). *Textbook of Orthodontics.* (2nd ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

Phulari, B.S. (2011). *Orthodontics: Principle and Practice.* New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

UNIT 2 REMOVABLE ORTHODONTIC APPLIANCES

CONTENTS

1.0 INTRODUCTION

Removable orthodontic appliances are so called because they are designed to be fixed and removed by the patient. They are limited to tipping and simple rotatory movements of the teeth. They are ideally used when simple tipping movement of the teeth is sufficient to correct certain type of malocclusion.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- explain what is meant by removable orthodontic appliance
- state the indication and contra-indication for removable orthodontic appliances
- enumerate the advantages and disadvantages of removable orthodontic appliances
- list the components of removable orthodontic appliances.

3.0 MAIN CONTENT

3.1 What is Removable Appliance?

These are appliances that are removable by the patient. Examples of removable appliance are oral screen, Hawley's retainers etc. They are designed to be fitted and removed by the patient. They are ideally used when simple tipping movement of the teeth is sufficient to correct certain type of malocclusion.

3.2 Indication and Contra-Indications for Removable Appliances Indications for removable orthodontic appliances

The use of removable orthodontic appliances requires careful selection. They are:

- Used as adjunct to fixed orthodontic appliance;
- Indicated for tipping movement
- Indicated for rotatory movement of the teeth.

Contra-indications for removable orthodontic appliances

- They are contra-indicated when bodily tooth movement is required,
- They should not be used in circumstances where fixed orthodontic appliance therapy would be more appropriate.

3.3 Advantages and Disadvantages of Removable Orthodontic Appliances

The use of removable orthodontic appliance is associated with certain advantages and disadvantages as you can see below.

Advantages of removable orthodontic appliances

- They permit easy cleaning, hence oral hygiene can be maintained easily
- They require less chair side time
- They are good for overbite reduction
- They can tip the teeth efficiently
- Due to their simplicity, they can be delivered and monitored by the general practitioner
- The patient can remove damaged or uncomfortable appliance
- They are comparatively cheaper than fixed appliances
- They are less conspicuous and more generally acceptable
- They eliminate occlusal interference.

Disadvantages of removable orthodontic appliances

- Treatment can be prolonged if patient fails to comply
- Their utility is limited as they cannot give the dimensional control over the tooth movement
- Multiple movements are difficult

- Patient needs to have certain degree of dexterity and skills to be able to remove and insert the appliance
- The chances of loss or damage of appliance is more
- They have limited scope on lower arch
- They can hamper phonation
- Retention is more difficult compared with fixed appliances.

3.4 Components of Removable Orthodontic Appliances

Removable orthodontic appliance consists of three basic components which include: active component, retentive component and the baseplate/framework. These components are discussed later on.

4.0 CONCLUSION

Removable orthodontic appliances are limited to tipping and simple rotatory movements of the teeth. They are ideally used when simple tipping movement of the teeth is sufficient to correct certain type of malocclusion. They have some basic advantages and disadvantages.

5.0 SUMMARY

In this unit, you have learnt the following about removable orthodontic appliances:

They are designed to be fitted and removed by the patient and are ideally used when simple tipping movement of the teeth is sufficient to correct certain type of malocclusion.

The use of removable orthodontic appliances has the following indications:

- They are used as adjunct to fixed orthodontic appliance;
- They are indicated for tipping movement
- They are indicated for rotatory movement of the teeth.

Their contra-indications include:

- They should not be used in circumstances where fixed orthodontic appliance therapy would be more appropriate.
- They are contra-indicated when bodily tooth movement is required,

The use of removable orthodontic appliance is associated with certain advantages and disadvantages as you can see below.

Removable orthodontic appliance consists of three basic components which include: active component, retentive component and the baseplate/framework.

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss removable orthodontic appliances under the following headings:

    a. Indications
    b. Contra-indications
    c. Advantages and
    d. Disadvantages.

7.0 REFERENCES/FURTHER READING

Gurkeerat, S. (2007). *Textbook of Orthodontics.* (2nd ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

Phulari, B.S. (2011). *Orthodontics: Principle and Practice*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

UNIT 3 FIXED ORTHODONTIC APPLIANCES

CONTENTS

1.0 INTRODUCTION

Now that you are conversant with removable orthodontic appliances, let us move a step further to discuss fixed appliances. Just as removable appliances are removable by the patient, fixed appliances as the name implies are those ones that the patient cannot remove from the mouth because they are fixed on the teeth.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define fixed orthodontic appliance
- state the indications and contra-indications for fixed appliances
- enumerate the advantages and disadvantages of fixed orthodontic appliances
- identify the components of fixed appliances.

3.0 MAIN CONTENT

3.1 What is Fixed Orthodontic Appliance?

Fixed Orthodontic Appliances are the type of appliance that are fixed to the teeth and cannot be removed by the patient. Fixed orthodontic therapy involves the fixing of attachments (brackets) to the teeth and application of forces by archwires or auxiliaries via these attachments.

3.2 Indications and Contra-Indications for Fixed Orthodontic Appliances

The use of fixed orthodontic appliances is associated with certain indications and contra-indications as stated below.

Indications for fixed orthodontic appliances

Fixed orthodontic appliances are indicated where multiple tooth movements are required such as:

- Derotation
- Bodily movement of teeth and
- Controlled space closure.

Contra-indications for fixed orthodontic appliances

Fixed orthodontic appliances are contra-indicated in:

- Poorly motivated patients
- Patients with poor dental health and
- Patients with poor periodontal health.

3.3 Advantages and Disadvantages of Fixed Orthodontic Appliances

Fixed appliances, just like the removable appliances that we discussed in the previous unit, have their own advantages and disadvantages as you can see in the following sub-sections.

Advantages of fixed orthodontic appliances

- The retention is superior to that of removable appliances
- Less skill is required from the patient in the management of the appliance
- Multiple tooth movements are possible
- Chances of loss or damage is less
- Since it is not removable by the patient, interference with treatment by non usage of appliance is less.

Disadvantages of fixed orthodontic appliances

- Maintenance of good oral hygiene is difficult;
- Excessive force damages the supporting structure of the teeth;
- Adverse tooth movements can be produced and
- They can hamper aesthetics.

3.4 Components of Fixed Orthodontic Appliances

The components of fixed orthodontic appliance are categorised into two based on ability to generate forces. They are active and passive components.

3.4.1 Active Component of Fixed Orthodontic Appliances

These components, when used, generate forces to cause tooth movement. They include components such as: separators; archwires; springs; elastics; elastomeric and magnets.

3.4.1.1 Separators

Separators are used to create space between two adjacent teeth for handing procedures. They are four types namely: elastic ring separator, dumb bell separator, brass wire separator and kesling metallic ring separator.

3.4.1.2 Archwires

They are active components of fixed appliance which when used, brings about various tooth movements such as tipping, bodily, torque, rotational and vertical movements through the medium of brackets and welded buccal tubes on the palatal aspects of the molar bands. They are classified based on materials used and cross section.

Classification of archwires based on materials used

Based on materials used, archwires are classified as follows:

- Gold and gold alloys
- Stainless steel
- Nickel-titanium alloys
- Beta-titanium
- Cobalt-chromium-nickel alloys and
- Optiflex archwires

Classification of archwires based on cross section

Based on cross section, we have:

- Round
- Square
- Rectangular and
- Multistranded

3.4.1.3 Springs

There are different types of springs used as components of fixed appliances. They include:

- ***uprighting spring*** used for uprighing teeth
- ***torquing spring*** for torquing roots of teeth
- ***rotating spring*** for derotation of rotated teeth
- ***open coil spring*** for opening the space between teeth and
- ***closed coil spring*** for closing the space between teeth.

3.4.1.4 Elastics

Elastic latex and non latex materials are used in conjunction with fixed appliances to cause different types of tooth movements. They are colour coded for ease of identification and can effect the following types of movements:

- Closure of spaces
- Correction of open bites
- Correction of crossbites and
- Correction of inter-arch molar relationship.

3.4.1.5 Elastomerics

Elastomerics in orthodontics are made of synthetic polyurethane materials and are also used as components of fixed appliances to cause movements such as space closure, anterior spacing etc.; example are Elastic chain (E-chain), Elastic thread, Elastic ligature and Elastic modules.

3.4.1.6 Magnets

Magnets can be used in their attraction mode in conjunction with fixed appliances for space closure and in their repulsion mode to regain lost space between the teeth. The commonly used magnets are Samarium cobalt magnet and Neodymium-iron-boron magnet.

3.4.2 Passive Components of Fixed Orthodontic Appliances

Passive components are the components of fixed orthodontic appliance, themselves are not capable of generating forces that can cause tooth movement but provide attachments for other auxiliaries to the tooth. An example is the stainless steel band. Weldable brackets buccal tubes and other auxiliary are welded or soldered over the bands which are then cemented around the intended teeth.

4.0 CONCLUSION

In this unit we looked at fixed orthodontic appliances and that the appliances are fixed to the teeth and cannot be removed by the patient. Their indications and contra indications as well as their advantages and disadvantages were clearly stated.

5.0 SUMMARY

Now that you are through with this unit, recall that you have learnt the following:

Fixed orthodontic appliances are the type of appliances that are fixed to the teeth and cannot be removed by the patient.

The use of fixed orthodontic appliances is associated with certain indications and contra-indications. Fixed orthodontic appliances are indicated where multiple tooth movements are required such as derotation, bodily movement of teeth and controlled space closure.
Fixed orthodontic appliances are contra-indicated in:

- Poorly motivated patients
- Patients with poor dental health and
- Patients with poor periodontal health.

Fixed appliances, just like the removable appliances have their own advantages and disadvantages.

The components of fixed orthodontic appliance are categorised into two based on ability to generate forces. They are active and passive components.

The active components, when used, generate forces to cause tooth movement and include components such as: separators; archwires; springs; elastics; elastomeric and magnets.

The passive components by themselves are not capable of generating forces that can cause tooth movement but provide attachments for other auxiliaries to the tooth.

6.0 TUTOR-MARKED ASSIGNMENT

1. List the active and passive components of fixed orthodontic appliances.
2. Enumerate the advantages of fixed orthodontic appliances over the removable ones.

7.0 REFERENCE/FURTHER READING

Phulari, B.S. (2011). *Orthodontics: Principle and Practice*. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

UNIT 4 FUNCTIONAL APPLIANCES

CONTENTS

1.0 INTRODUCTION

Now that you have known the basics of removable and fixed appliances, let us now look at another category of orthodontic appliance called functional orthodontic appliance. This type of appliance utilises oral musculatures to generate forces necessary to effect tooth movement.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define functional appliance
- classify functional appliances
- enumerate the advantages and disadvantages of functional appliances
- state the mode of action for functional appliances.

3.0 MAIN CONTENT

3.1 Definition of Functional Appliance

Functional appliances are loose removable appliances designed to alter neuromuscular environment of oro-facial region to improve occlusal development and or craniofacial skeletal growth (Phulari, 2011).

They can also be defined as appliances that harness the muscular forces or by preventing abnormal aberrant muscular forces.

3.2 Classification of Functional Appliances

Functional appliances can be classified or divided into removable and fixed functional appliances.

3.2.1 Removable Functional Appliances

These appliances which are removable by the patient include removable tooth-borne and removable tissue-borne functional orthodontic appliances.

Removable tooth borne appliances

These appliances depend on the stretch of soft tissue caused by the mandible being positioned downward and forward as well as the muscular activity generated by mandible attempting to return to its original position. Examples of removable tooth-borne functional appliances are: activator, bionator and twin block appliances.

Removable tissue- borne appliances

These appliances are used to minimise undesirable tooth movement and to re-contour the facial soft tissue adjacent to the teeth as well as posture of mandible downward and forward. Examples of removable tissue-borne functional appliance include: functional regulator/functional corrector/ frankel appliances.

3.2.2 Fixed Functional Appliances

The fixed functional appliances are also called fixed tooth-borne functional appliances and are fitted on the teeth and cannot be removed by the patient at will. Examples are Herbst appliances.

3.3 Advantages and Disadvantages of Functional Appliances

Advantages of Functional Appliances

- They are effective in vertical control of increased overbite
- They can be used in mixed dentition
- They require minimal chair side adjustment
- They are easy to make.

Disadvantages of functional appliances

- The success of functional appliance solely depends on patient's cooperation
- Precise tooth movement is not possible with functional appliances
- Duration of treatment is often prolonged and
- They often require two phases of treatment.

3.4 Mode of Action for Functional Appliances

Most functional appliances function by utilising one of the following:

- A fixed mandibular posture which transmits forces to the teeth or jaws or
- Bite plane which produce differential eruption.

4.0 CONCLUSION

Now you are well equipped with new ideas about functional orthodontic appliances. These appliances utilise oral musculature to generate forces needed to cause tooth movement.

5.0 SUMMARY

In this unit, you have learnt the following:

Functional appliances are loose removable appliances designed to alter neuromuscular environment of oro-facial region to improve occlusal development and or craniofacial skeletal growth.

Functional appliances can be classified or divided into removable and fixed functional appliances. Removable functional appliances are removable by the patient and include removable tooth-borne and removable tissue-borne functional orthodontic appliances.

The removable tooth borne appliances depend on the stretch of soft tissue caused by the mandible being positioned downward and forward as well as the muscular activity generated by mandible attempting to return to its original position.

Removable tissue-borne appliances are used to minimise undesirable tooth movement and to re-contour the facial soft tissue adjacent to the teeth as well as posture of mandible downward and forward.

The fixed functional appliances are also called fixed tooth-borne functional appliances and are fitted on the teeth and cannot be removed by the patient at will.

All functional appliances have advantages and disadvantages and function by utilising one of the following:

- A fixed mandibular posture which transmits forces to the teeth or jaws or
- Bite plane which produce differential eruption.

6.0 TUTOR-MARKED ASSIGNMENT

1. Define functional appliance and state the mode of action for functional appliances.
2. Enumerate the advantages and disadvantages of functional appliances.

7.0 REFERENCE/FURTHER READING

Phulari, B.S. (2011). *Orthodontics: Principle and Practice*. New Delhi:Jaypee Brothers Medical Publishers (P) Ltd.

MODULE 5 PRINCIPLES AND PROCEDURE FOR CONSTRUCTION OF ORTHODONTIC APPLIANCES

Unit 1 Goals of Orthodontic Treatment
Unit 2 Materials Used for Fabrication of Orthodontic Appliances
Unit 3 Fabrication of Various Components of Orthodontic Appliances

UNIT 1 GOALS OF ORTHODONTIC TREATMENT

CONTENTS

1.0 INTRODUCTION

In orthodontic treatment, there are certain things that the practitioner intends to achieve. This means that he has some aims or goals before embarking on the treatment plan.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define orthodontic treatment
- explain what is meant by goal in orthodontic treatment
- enumerate the goals of orthodontic treatment.

3.1 Orthodontic Treatment as a Concept

Orthodontic treatment is one of the most common types of dental treatment that involves the application of forces to correct the malformations of the oral apparatus (Teeth) and the associated tissues. It involves the use of different orthodontic appliances which could be fixed or removable.

3.2 What is Goal?

Goal, in this, context is a preconceived desire or result one intends to achieve at the end of certain activity. Before undertaking orthodontic treatment, both the patient and the practitioner expect a positive outcome. This expectation represents the goal of treatment. Treatment can only be said to be successful if these expectations are achieved. Therefore, goal is something that somebody wants to achieve. In this case the practitioner, the patient or both.

3.3 Goals of Orthodontic Treatment

According to Roth, orthodontic treatment goals can be divided into five categories: facial esthetics, dental esthetics, functional occlusion, periodontal health, and stability.

3.3.1 Facial Aesthetics

There is no one standard that can be used to determine ideal facial esthetics. Current desirable characteristics among Caucasians include a slightly convex profile, naso-labial angle of 90-110º and some circum-oral prominence, a symmetrical face, lip closure without stain, 1-2 mm of visible gingival on smile, and high cheekbones.

3.3.2 Dental Aesthetics

Dental esthetics are captured by Andrews' "six keys" class I occlusion. This includes adequate tip and torque on teeth, no rotations, crowding or spacing, as well as central and lateral incisors with flat incisal edges and a pointed cusp tip on the canine. Vertically, the central incisor and canine are at the same level and the lateral incisor is 1 mm shorter. The gingival margins should be symmetrical on the anterior teeth. Recently the esthetics of the smile indicate that buccal corridors (the dark space between the dentition and the corners of the lips) should be modest or reduced, and the arch of the smile (first premolar to first premolar) is most esthetic when following the curvature of the lower lip upon smiling.

3.3.3 Functional Aesthetics

In a functional occlusion, the following criteria should be met: centric occlusion (CO) that coincides with centric relation (CR), cusps that are inter-digitated, equal magnitude of posterior forces present, cuspid guidance in lateral excursions, and anterior guidance with posterior disclosure on protrusion.

3.3.4 Periodontal Health

Periodontal goals include adequate alveolar bone support without dehiscence or fenestrations, good gingival crest height, no pocketing or inflammation of the attachment apparatus, adequate thickness of the attached gingiva, no frenum pulls, and optimum crown-root ratios (JCO).

3.3.5 Stability

Most orthodontic cases exhibit some form of change or settling once the braces are removed. These changes are due to a rebounding of tissues and continued facial growth. Unwanted changes in the occlusion can be minimised by avoiding overexpansion of the mandibular arch, overcorrecting rotations, flattening interproximal contacts and eliminating undesirable neuromuscular habits. Stability in the occlusion can be maximised by adequate retention.

4.0 CONCLUSION

Orthodontic treatment is aimed at achieving certain goals. In this unit, these goals have been extensively discussed.

5.0 SUMMARY

Orthodontic treatment is the application of forces to correct the malformations of the oral apparatus (Teeth) and the associated tissues. It involves the use of different orthodontic appliances which could be fixed or removable appliances.

Goal is a preconceived desire or result one intends to achieve at the end of certain activity. According to Roth, orthodontic treatment goals can be divided into five categories: facial esthetics, dental esthetics, functional occlusion, periodontal health, and stability.

6.0 TUTOR-MARKED ASSIGNMENT

In the design and fabrication of orthodontic appliances, enumerate the treatment goals.

7.0 REFERENCE/FURTHER READING

Calogero, D. (2014). *Goals of Orthodontic Treatment*. Retrieved on 03 May 2014 from http://www.dentalcare.com/en-US/dental-education/continuing.

UNIT 2 MATERIALS USED FOR FABRICATION OF ORTHODONTIC APPLIANCES

CONTENTS

1.0 INTRODUCTION

For the construction of orthodontic appliances, certain materials are needed and these materials are expected to meet certain ideal requirements. In this unit, we are going to discuss the materials that are commonly used for fabrication of orthodontic appliances with their ideal properties and classifications.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- state the ideal properties of materials commonly used for fabrication of orthodontic appliances
- explain the classification of materials used for fabrication of orthodontic appliances
- enumerate the materials commonly used for fabrication of orthodontic appliances.

3.0 MAIN CONTENT

3.1 An Overview of Material Sciences

The rapid advancement witnessed in the field of orthodontics is due, primarily, to advancement in the field of material sciences. The better understanding of biologic problem and advancement in orthodontic materials has led to improved designs and treatment strategies. The study of material science will prepare you as a student to understand the latest means and ways in which orthodontic treatment is done. Due to the fact that the profession is yet to give specifications for orthodontic materials, the classifications given in this unit are mere categorisations for easy study.

3.2 Ideal Properties of Orthodontic Materials

Materials used for fabrication of orthodontic appliances should possess the following ideal properties:

- The chemical nature should not be such that produces harmful toxological or allergic reaction on the patient or the operator.
- It should be resistant to corrosion or physical changes in oral fluid.
- It should be easy to manipulate.
- General properties should be satisfactory and variable for various purposes.
- It should be readily available and relatively cheap.
- It should take and retain high polish.
- Bonding properties should be satisfactory.

3.3 Classification of Orthodontic Appliance Materials

Orthodontic materials can be classified based on their uses as follows: archwire materials; bracket and attachment materials; auxiliary force delivery system; impression materials; luting materials; sealant and adhesion promoters; etching/conditioning and crystal growth system and bonding materials.

3.3.1 Archwire Materials

Archwire materials are the base wires which are engaged in brackets of the various appliance systems. They are used to provide proper arch form and or provide a base to which auxiliaries can be attached to generate the tooth moving forces. Archwire materials are classified based on material constituents, cross section, diameter and microstructural arrangement.

3.3.1.1 Classification Based on Material Constituent

- Gold
- Stainless steel
- Chromium cobalt
- Nickel-Titanium
- Beta-titanium
- Alpha-titanium
- Optiflex archwires, etc.

3.3.1.2 Classification Based on Cross Section

- Round
- Square
- Rectangular and
- Multi-stranded archwires.

3.3.1.3 Classification Based on Diameter of Archwire

Round- 0.08^0, 0.10^0; 0.14^0 etc.
Square- $0.16^0 \times 0.16^0$; $0.17^0 \times 0.17^0$ etc.
Rectangular- $0.17^0 \times 0.25^0$; $0.17^0 \times 0.28^0$ etc.

3.3.1.4 Classification Based on Microstructural Arrangement

- Simple cubic
- Face- centred cubic and
- Body- centred cubic.

3.3.2 Bracket and Attachment Materials

Bracket is a device that projects horizontally to support auxiliaries and is open on one side usually in the vertical or horizontal. Materials used include: metals, polycarbonate, and fibre glass reinforced plastic, polyurethane, ceramics etc.

3.3.3 Auxiliary Force Delivery System

Auxiliary force delivery systems include:

- Elastic and elastic modules
- Springs
- Magnets.

3.3.4 Impression Materials

Many impression materials are available in the market but irreversible hydrocolloids are most frequently used for obtaining accurate models in day-to-day orthodontic practice.

3.3.5 Luting Materials

Luting materials mainly include cements which were used extensively before the advent of bonding agents. They are used for luting (bonding preformed restorations and orthodontic attachments), cavity liners and as restorative materials.

3.3.6 Sealant and Adhesion Promoters

These materials are used for fixation of brackets to teeth.

3.3.7 Etchants/Conditioners

Enamel surface is smooth with little potential for bonding by micromechanical attachments. Certain acids are applied in appropriate concentrations which dissolve away portions of individual enamel rods within 60 seconds. This process is called acid etch technique. Etchants are available in syringes and in bottles. An example of acid used include: Phosphoric and nitric acid (mineral acids); organic acids such as citric, maleic and tartaric acids and polymeric acids such as polyacrylic acids.

The conditioners are materials that make the surface of the substrate more amenable to accepting a bond. They are hydrophilic monomers carried in solvents such as acetone, ethanol or water.

3.3.8 Bonding Materials

Modern bonding agents contain as constituents, etchants, primer/coupling agents and adhesives which may be packaged separately or combined. Examples of bonding agents include: first generation bonding agents such as scotch bond, creation bond, prisma universal bond etc.; the most current are the 6^{th} generation bonding agents such as prompt-L-Pop and One up bond F.

4.0 CONCLUSION

I am confident that having gone through this unit carefully, you now understand the different materials used in orthodontic appliance fabrication.

5.0 SUMMARY

You have learnt the following in this unit:

The better understanding of biologic problem and advancement in orthodontic materials has led to improved designs and treatment strategies.

Materials used for fabrication of orthodontic appliances should possess the following ideal properties:

- The chemical nature should not be such that produces harmful toxological or allergic reaction on the patient or the operator.
- It should be resistant to corrosion or physical changes in oral fluid.
- It should be easy to manipulate.
- General properties should be satisfactory and variable for various purposes.
- It should be readily available and relatively cheap.
- It should take and retain high polish.
- Bonding properties should be satisfactory.

Orthodontic materials can be classified based on their uses as follows: archwire materials; bracket and attachment materials; auxiliary force delivery system; impression materials; luting materials; sealant and adhesion promoters; etching/conditioning and crystal growth system and bonding materials.

6.0 TUTOR-MARKED ASSIGNMENT

1. State the ideal properties of materials commonly used for fabrication of orthodontic appliances.
2. Explain the classification of materials used for fabrication of orthodontic appliances.

7.0 REFERENCE/FURTHER READING

Gurkeerat, S. (2007). *Textbook of Orthodontics*. (2nd ed.). New Delhi: Jaypee Brothers Medical Publishers (P) Ltd.

UNIT 3 FABRICATION OF ORTHODONTIC APPLIANCES

CONTENTS

1.0 INTRODUCTION

Orthodontic technology is a specialty of dental technology that is concerned with the design and fabrication of dental appliances for the treatment of malocclusions, which may be a result of tooth irregularity, disproportionate jaw relationships, or both. The laboratory procedures involved in fabrication of dental appliances are undertaken by a competent dental technologist. This unit guides you on the various stages involved in the fabrication of these appliances.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- define orthodontic appliance
- enumerate the stages involved in fabrication of orthodontic appliances.

3.0 MAIN CONTENT

3.1 An Overview of Orthodontic Appliances

Orthodontic appliance is a dental device that creates and or transmits forces to individual teeth or group of teeth and or maxilla-facial skeletal units so as to bring about changes within the bone with or without tooth movement which will help to achieve treatment goals of functional efficiency, structural balance and aesthetic harmony.

Orthodontic appliance is made up of three basic components, which include: active component, retentive component and the baseplate/framework.

3.2 Production of Models

Rinse the impression under gently running, room temperature tap water. Spray the impression and tray with disinfectant of choice.

Mix Dental stone in the correct powder/water ratio and poured into the impression while been vibrated on a mechanical vibrator to eliminate the air bubbles. Decast when set and go on to the next stage.

3.3 Selection of Appropriate Wire Gauges

Choose your wire gauges base on the nature of appliance you want to make. The following wire gauges are suggested as a guide:

Spring

- **Finger spring:** one anterior – 0.5mm; two anteriors – 0.6mm; one posterior – 0.6mm; for longer spring, add 0.1mm and for shorter spring, subtract 0.1mm
- **Apron spring:** one tooth – o.35mm; for two teeth – 0.4mm; for four teeth – 0.5m
- **Flapper spring** – 0.35mm
- **Safety pin** – 0.4mm
- **Z-spring** – for one tooth -0.4mm; for two teeth – 0.5mm

Retainers

- **Adams crib on anteriors and bicuspid** – o.6mm
- **Adams crib on molars** – 0.7mm
- **Jackson's crib** – 0.7mm
- C-**clasp** – 0.7mm

- **Arrow head** – 0.6mm

Labial Arch

- **Retraction arch** 0.7-0.8mm
- **Supporting arch** – 0.9-1.0mm
- **Retaining arch** – 0.8-0.9mm

3.4 Construction of the Components

Once you have selected your wires and orthodontic instruments, prepare the active or passive and the retentive components by using the selected pliers and wires to make the right bends and cuts. Appropriate siting of the spring is necessary to avoid impinging on other teeth or slipping off the crown of the tooth it is intended to move. Seat the wire components on the cast with adhesive wax and block out functional areas such as screw of an expansion appliance.

3.5 Preparation of Wax Pattern of the Restoration

Soften a sheet of modeling wax over the Bunsen flame and adapt to form the baseplate component of the appliance. Trim to designed outline and smoothen by using air syringe or mouth blow pipe over the flame. Once you are satisfied with the outcome, polish with detergent and cotton wool and rinse in clean water ready for flasking.

3.6 Flasking and Packing

Flasking is the process of placing the cast with the waxed appliance in a flask to create mould that is used to form the acrylic resin base.

Take the following steps when you want to flask your appliance:

- Try the cast in the first half of the flasks to see if it can accommodate the cast.
- Trim if necessary and soak the cast and waxed appliance in water for a few minutes.
- Coat the inner surface of the flasks with Vaseline.
- Spatulate a mix of plaster and water (100g/40ml) and fill the lower half of the flask.
- Embed the cast exposing only the wax area and allow it to set.
- Position the second half of the flask to see that the two halves make metal-to-metal contact.
- Apply sodium alginate solution (cold mould seal) as a separating medium.
- Spatulate a second mix and top as usual.

- Allow to set and eliminate the wax by boiling out.
- Apply separating medium and pack with appropriate mix of clear resin at dough stage.

3.7 Curing

Curing is a thermal process by which polymerisation of the packed resin is achieved. Place the flask in the curing bath and bring to boil in 30 minutes and allow it to boil for 15 minutes. Then allow the flask to cool down before deflasking.

3.8 Deflasking and Finishing

Deflasking means removing the processed job out of the flask. This can be achieved by carefully opening the flask with your plaster knife. You can use the plaster shear to cut out the flasking plaster or make use of fret saw. Plaster shear is more efficient but you must be careful so that you do not cause damage to the job. Trimming and polishing is done by selecting appropriate abrasive and polishing agents. After polishing, the appliance is ready for fitting.

4.0 CONCLUSION

The laboratory procedures involved in fabrication of dental appliances are undertaken by a competent dental technologist. These include production of the model through finishing of the appliance.

5.0 SUMMARY

Below is the summary of what you have learnt in this unit:

Orthodontic appliance is a dental device that creates and or transmits forces to individual teeth or group of teeth and or maxillo-facial skeletal units so as to bring about changes within the bone with or without tooth movement which will help to achieve treatment goals of functional efficiency, structural balance and aesthetic harmony. The laboratory procedures involved in fabrication of dental appliances are undertaken by a competent dental technologist and involves the following stages:

- Production of models
- Selection of appropriate wire gauges
- Construction of the components
- Preparation of wax pattern of the appliance
- Flasking and packing
- Curing and
- Deflasking and finishing.

6.0 TUTOR-MARKED ASSIGNMENT

1. List the stages involved in the fabrication of orthodontic appliance and briefly explain each stage listed.

7.0 REFERENCE/FURTHER READING

Adesope, D.A. (2011). *Quintessence of Dental Laboratory Science*. Lagos. Treasure Foundation.