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College of Dentistry

Orthodontic Diagnosis and Treatment Plan in Mixed Dentition

A Project Submitted to
The College of Dentistry, University of Baghdad, Department of pedodontics and prevention in Partial Fulfillment for the Bachelor of Dental Surgery

By

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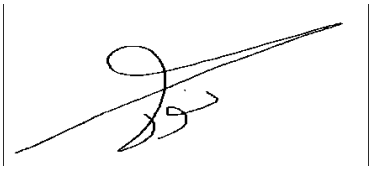
Certification of the Supervisor

I certify that this project entitled **"orthodontic diagnosis and treatment plan in mixed dentition"** was prepared by the fifth-year student **Maryam Ayoub Hassan** under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

Signature: 

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Date: 25/5/2022

Dedication

Every work needs self-efforts as well as guidance and support of elders.

I dictate this project first to "Allah", for giving me all the strength.

To my family and friends for their patience, support and efforts; without them, I wouldn't have reached what I am today

Acknowledgment

First of all, I thank **"Allah"** almighty for granting me the will and strength to accomplish this project, and I pray that his blessings upon me may continue throughout my life.

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List of Abbreviation

AOB	Anterior open bite
FMPA	Frankfort mandibular plane angle
ICP	Intercuspal position
RME	Rapid maxillary expansion

Introduction

It is essential to have a sound understanding of facial growth and dental development, and the ability to recognize the rate and direction of facial and dental growth. . Many situations of apparent malocclusion in the mixed dentition are actually manifestations of the normal process of dental and facial development. Minor incisor irregularities, spacing and ectopic eruption of teeth, which may show up during the mixed dentition, could self-correct with growth and development. The primary aim of orthodontic assessment in a growing child is to differentiate between a developing normal occlusion and a potential malocclusion, including any abnormal growth of the face and function of the stomatognathic system. **(Geran *et al*., 2006).**

Correction of dental arch irregularities, occlusal and jaw relation abnormalities and elimination of functional interferences may be classified as preventive or interceptive. The term 'preventive orthodontics' implies steps undertaken for elimination of factors that may lead to malocclusion in an otherwise normally developing dentition. While,'Interceptive orthodontics' implies that corrective measures may be necessary to intercept a potential irregularity from progressing into a more severe malocclusion like dental class III to become skeletal or to reduce the risk of injuries to the upper incisors in patients with malocclusion cl II . Neither the appliances used nor the treatment itself should interfere with the often rapid changes in eruption of permanent teeth and the dynamic nature of occlusal adjustment **(John Fricker *et al*., 2005).**

Many benefits in achieving the goals of occlusal harmony and function and dentofacial esthetics. The responsibility of early detection and management of developing malocclusion rests with the pedodontists

because they see the patient at a very young age at various intervals like preschool age, school age and the teenage period. **(Aka *et al*., 2005).**

Aim of the project

This project represents an overview of diagnostic strategies used for orthodontic assessment of pediatric patients in mixed dentition stage, in order to suggest an accurate treatment plan for correcting any developing malocclusion that may affect the growth and function of dentofacial structures.

Review of literature

1. Orthodontic Assessment

An orthodontic diagnosis must be carried out in a series of logical steps. The combination of three sources of information will lead to a proper orthodontic diagnosis, these source are: the patient interview/ consultation; the clinical examination by the clinician; and the evaluation of the diagnostic records that include dental casts, radiographs and clinical images. Each of these sources of information is critical to the diagnosis and, ultimately, the patient's orthodontic treatment **(McDonald, 2007).**

The purpose of an orthodontic assessment is to evaluate and record the features of a malocclusion in preparation for planning treatment, the child should be assessed for both skeletal and dental problems in order, to build an accurate diagnosis and treatment planning **(Mageet, 2016).**

1.1 Skeletal classification

This describes the relationship between the maxilla and mandible relative to the cranial base **(Littlewood and Mitchell, 2019).**

Skeletal Class I – the maxilla and mandible are in a normal relationship (orthognathic).

Skeletal Class II – the mandible appears small relative to the maxilla

(retrognathic).

Skeletal Class III – the mandible appears larger than the maxilla (prognathic).

1.2 Dental Classification

A malocclusion is a misalignment or incorrect relation between the teeth of the two dental arches when they approach each other as the jaws close. Angle

believed that the anteroposterior dental base relationship could be assessed reliably from first permanent molar relationship, as its position remained constant following eruption **(Yadav *et al*., 2014):**

A. Angle classification of malocclusion is based on the relation of the upper and lower first permanent molar **(Dutra *et al*., 2009) :**

- Class I molar relationship **:**

The mesiobuccal cusp of the maxillary first molar occluding in line with the buccal groove of the mandibular first molar (as shown in fig.1) i.e. the maxillary first molar is slightly posteriorly positioned relative to the mandibular first molar.

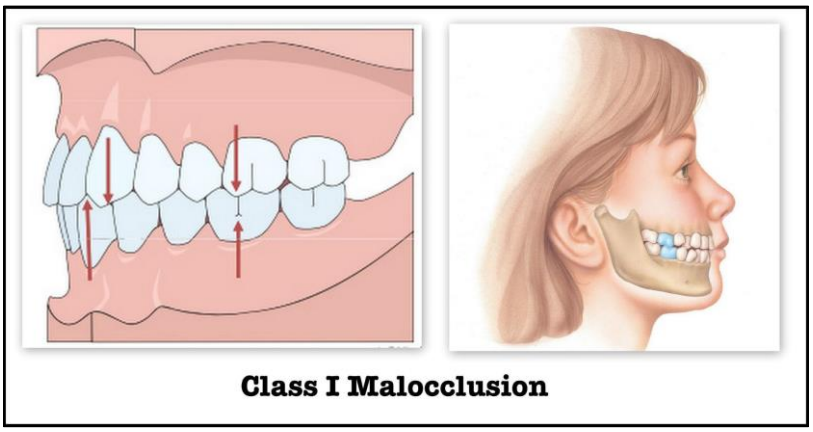

Figure1: class I malocclusion **(Littlewood and Mitchell, 2019)**.

Class II Molar relationship:

The mesiobuccal cusp of the maxillary first molar occluding anterior to the buccal groove of the mandibular first molar (as shown in fig.2) i.e. the maxillary first molar is in line with or anteriorly positioned relative to the

mandibular first molar ,This most commonly causes a retrognathic facial profile **(Dutra *et al*., 2009).**

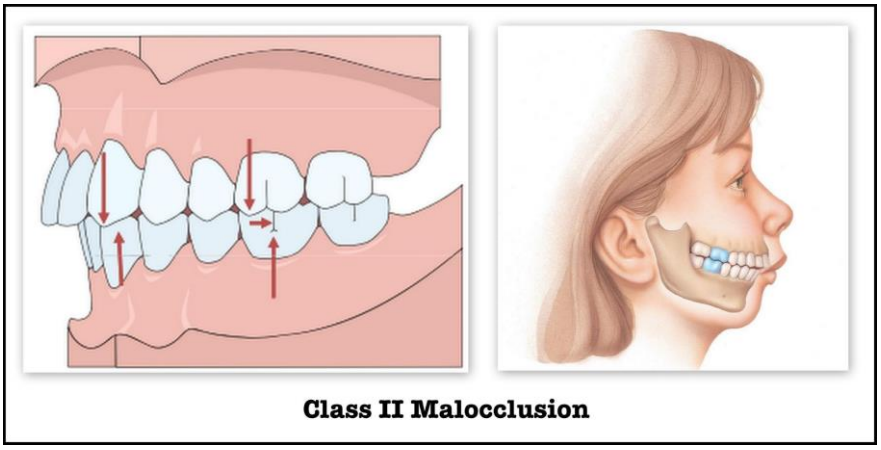

Figure 2: malocclusion class II **(Littlewood and Mitchell, 2019).**

- Class III Molar relationship:

The mesiobuccal cusp of the maxillary first molar occluding posterior to the buccal groove of the mandibular first molar (as shown in fig.3) i.e. the maxillary first molar is severely posteriorly positioned relative to the mandibular first molar, This causes a prognathic facial profile. **(Dutra *et al*., 2009).**

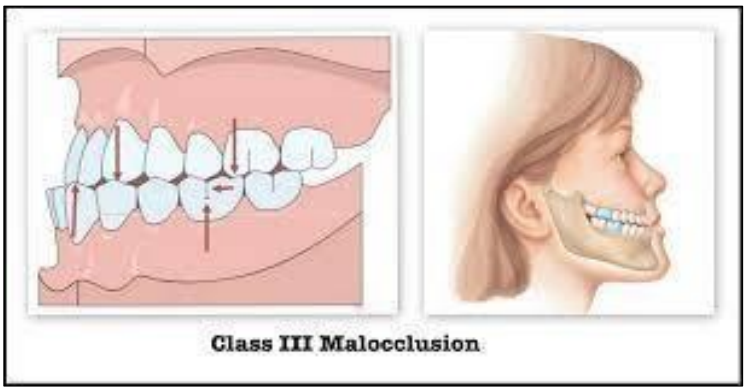

Figure 3: class III malocclusion **(Littlewood and Mitchell, 2019).**

B. Canine classification (as shown in Fig.4) **(Behbehani *et al*., 2012)**:

- Class I: It is a normal canine relation, when the tip of the upper canines is located in the embrasure area between lower canine and first premolar (or the mesial slope of the upper canine coincide with the distal slope of lower canine) in occlusion.
- Class II: Abnormal canine relation in which the lower canine will be more backward from normal canine relation in occlusion.
- Class III: Abnormal canine relation, when the lower canine will be more forward than from normal canine relation.

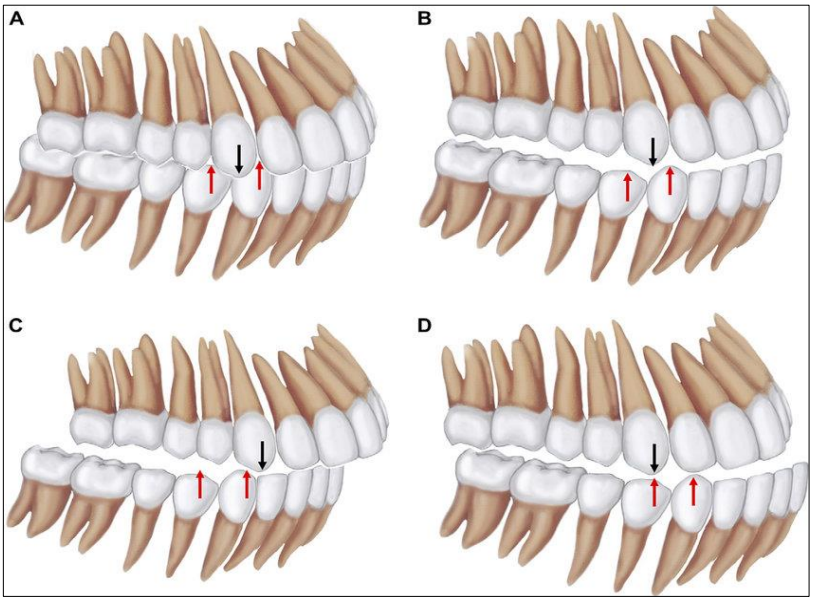

Figure 4: Canine classification A: CL, B: CL

C: CL II, D: CL III **(Kau *et al*, 2009).**

2. Orthodontic Examination

2.1 Extra oral Examination

The facial analysis is conducted with the patient either sitting upright or standing, not reclining in a dental chair. The analysis must consider the frontal plane, facial midlines and lip competency **(McDonald, 2007).**

A) Frontal View

There are several criteria that should be followed in examining the frontal view of the patient these are (as shown in Fig.5) **(Fricker *et al*., 2013):**

- Shape of face – long and thin/normal/short and square.
- Symmetry – initial assessment from the front. Looking at the child fromabove and behind will confirm asymmetry. It is important to look at the position of the chin at rest and in occlusion. A deviation would suggest a functional shift is occurring rather than a true asymmetry.
- Facial proportions – from the front the face can be divided vertically into thirds. The height of the midface (supraorbital ridge to base of nose) should therefore equal that of the lower face (base of nose to chin) However, it may be increased or decreased.

Figure 5: frontal view **(Netter and Norton, 2007).**

B) Lateral View

The following should be assessed **(Fricker *et al*, 2013):**

- Profile – convex/straight/concave.
- Skeletal pattern – Class I, II, III.
- Nose – small/normal/prominent.
- Chin – recessive/normal/prominent.
- Nasolabial angle – acute/normal/obtuse. If the angle is obtuse, orthodontic treatment involving the extraction of permanent teeth will have a detrimental effect on the profile.
- Lip position – competent (closed), incompetent (apart).
- Lower lip – normal/everted.
- Labiomental sulcus – normal/deep.
- Frankfort-Mandibular Plane Angle (FMPA) – imagine a line connecting the ear to the eye (Frankfort horizontal)and construct an angle with the lower border of the mandible. This angle (FMPA) will help to assess growth direction.

Figure 6: Evalution of facial profile **(Fricker *et al*., 2013).**

2.2 Intraoral Examination

The intraoral examination is concerned primarily with the teeth in each dental arch, in both isolation and occlusion **(Caglayan and Bayrakdar**, **2018).**

2.2.1 Dental Health

The teeth present clinically should be noted and an assessment made of the general dental condition, including the presence of untreated caries, existing restorations and the standard of oral hygiene. Evidence of previous dentoalveolar trauma, such as chipped or discoloured incisor teeth, should also be recorded. Previous trauma will warrant further investigation in the form of vitality testing and radiographs. Other pathological signs, such as erosion or attrition, should also be noted **(Cobourne and DiBiase, 2015).**

2.2.2 Dental Arches

Each dental arch is assessed independently, with the mandible usually described first. The following features should be recorded for both arches **(Cobourne and DiBiase, 2015):**

- Presence of crowding or spacing in the labial and buccal segments.
- Tooth rotation (as shown in Fig.7).

Figure 7: rotation **(Hahn *et al*., 2010).**

- Tooth displacement in a labial or lingual direction in relation to the line of the arch.
- Presence and position of the maxillary canines, which should be palpable buccally from the age of 10 years.
- Angulation of erupted canines, which should be recorded as mesial, upright or distal.
- Depth of the curve of Spee *the arc of a curved plane that is tangent to the incisal edges and the buccal cusp tips of the mandibular dentition viewed in the sagittal plane* , which is described as normal, increased or decreased This will have a direct bearing on space requirements as an increased curve of Spee is a manifestation of crowding in the vertical plane and, as such, will require space to correct (as shown in Fig.9).

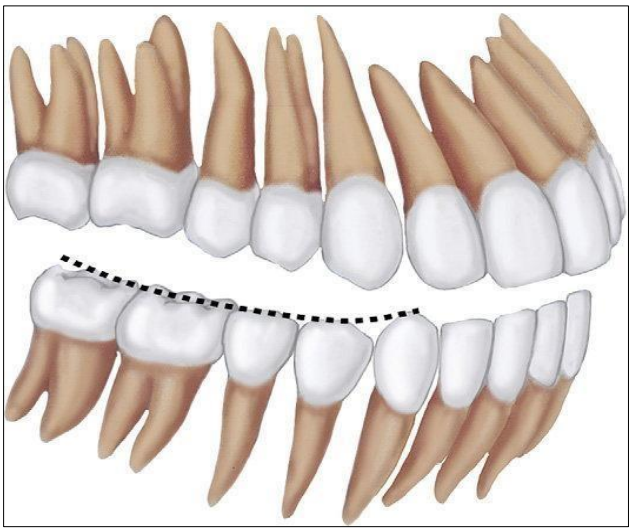

Figure 9: Curve of spee **(Shannon and Nanda, 2004)**

2.2.3 Static Occlusion:

When each dental arch has been assessed the patient is asked to occlude in intercuspal position (ICP) and the static occlusal relationship is recorded.

A) Overjet

The overjet should be measured from the labial surface of the most prominent maxillary incisor to the labial surface of the mandibular incisors. The normal range is 2 to 4-mm. If there is a reverse overjet, as can occur in a class III incisor relationship, this is also measured and given a negative value also, it is a controversial subject in pediatric patient .(as shown in Fig.14) **(johnston *et al*., 2006).**

Treatment:

There are several ways to treat an overjet. The best treatment for depends on several factors: the severity of your overjet, the Orthodontist you choose, whether there are other issues that need to be corrected, as well as your preferences for treatment.so the best one is braces (remain the most common orthodontic treatment to correct overjet without surgery) and of course the retainer. **(Squire *et al*., 2006).**

Figure 10: Treatment of overjet **(Sorooshian and Kamarozaman, 2018).**

B) Overbite

Also known as buck teeth, is a type of malocclusion in which the upper set of teeth overlaps the lower set of teeth. It is caused when the jaws do not align, and the upper teeth protrude more than 2 mm, a usual horizontal distance between the upper and lower teeth In primary tooth **Flush terminal plane** is affected *the most common primary molar occlusion found in the present study which is statistically significant*. Most of the children had primate space present in upper and lower teeth which is statistically significant. And that affect on overbite **(Lindauer *et al*., 2005)** (as seen in figure11).

Figure 11: Overbite **(Lindauer *et al*., 2005).**

Treatment:

Overbite correction is different for children and adults. If an overbite is caught during childhood, treatment may involve **(Bollen *et al*., 2008):**

1-Growth modification devices, or palate expanders, used during growth spurts to reposition the jaw.

2- Braces to slowly move all the teeth into correct alignment.

3- Retainers to keep the teeth in alignment after braces.

In adults, treatment may involve:

1- Braces to move only the teeth affected by the overbite.

2- Surgery to correct jaw alignment.

3- Teeth removal to allow the remaining teeth more room.

C) Centre lines

Midline discrepancies are very common in patient population (people who have come to because of crooked teeth or a bite related problem). Most pre-orthodontic patients have some degree of mid-line discrepancy in either the upper or lower teeth, and sometimes in both **(Alam and Iida, 2013)** (as shown in fig.12).There are the four best treatment options for midline misalignment **(Sarig *et al*., 2013):**

1- Braces: are devices used in orthodontics that align and straighten **teeth** and help position them .

Figure 12: braces **(Koprowski *et al*., 2014).**

2- Invisalign: One of the most common causes of TMJ disorder, however, it is jaw misalignment. The most logical and effective solution to correct this problem is braces. Through Invisalign, the lower jaw and upper jaw are properly repositioned to align smile, making it not only look better but eliminate pain and discomfort **(Robertson *et al*., 2020)** (as shown in fig.13).

Figure 13 Invisalign **(Robertson *et al*., 2020).**

3-veneers: are thin coverings that are placed over the front (visible) part of the tooth.

Figure 14 center lines **(Sarig *et al*., 2013).**

D)crossbite

It is divided it into anterior and posterior crossbite.

Anterior crossbite: is a major esthetic and functional concern to the parents during the developmental stage of a child. It is one of the major responsibilities of a pediatric dentist or orthodontist to guide the developing dentition to a state of normalcy in line with the stage of oral-facial growth and development.The period of mixed dentition offers the greatest opportunity for occlusal guidance and interception of malocclusion. If delayed to a later stage of maturity, treatment may become more complicated **(Jirgensone *et al*., 2008).**

Management:

A) Tongue blade

If there is only one permanent incisor in crossbite without an excessive overbite, a tongue blade may be used to correct this. The stick is placed lingual to the upper tooth in crossbite and the patient instructed to close firmly against the stick while it is held in position against the chin. Repeat this six times per day with an interval of at least half an hour. Correction is often complete within a few days **(Sari *et al*., 2001).**

Figure 15: tongue blade **(Ceyhan and Akdik , 2017).**

B) Incline planes

Where there is a functional shift of the mandible into an anterior crossbite, an acrylic inclined plane can be fitted to the lower incisors to restrict the forward posturing and place pressure on the palatal surface of the maxillary incisors to push them labially. Alternatively a composite build-up of the lower incisors will mimic the action of an incline plane. (It is preferable to choose a shade of composite resin that is easily distinguished from normal tooth structure to facilitate safe removal). Treatment is usually complete within a few weeks. This appliance works best where there is a slight increase in overbite, which helps to retain the incisors in positive overjet once the appliance is removed **(Bahrain and Hassan, 2019).**

Figure 16: Incline plane **(Sari *et al*., 2001).**

C) removable appliance **(Ulusoy and Bodrumlu, 2013)** (as seen in Fig.19) These appliances should only be used to correct crossbites of dental origin.

- A modified Hawley appliance can be used in the maxilla to correct one or two teeth in crossbite.
- Ensure there is adequate space to move the teeth into the desired position and movement will occur rapidly.
- Occlusal surfaces of both the primary and permanent molars should be covered to open the bite and allow free labial movement of the teeth in crossbite.

● Adams' clasps are placed on the first permanent molars.

● If the primary molars are present, ball-ended clasps can be fabricated to engage the interproximal areas of these teeth.

Where a single tooth is in crossbite, a Z-spring placed palatally to the malposed a tooth can be used, or if both central incisors are in crossbite, two springs can be used to provide sweep arms on the palatal surface. Initially, the appliance should be fitted and checked for comfort with the springs passive. The springs are then activated 1– 2 mm at a time. The patient is reviewed after 4 weeks to reactivate the springs as required and to check the retention of the appliance. As with all removable appliances the success of treatment is reliant on cooperation and compliance. If these qualities can be encouraged and the patient takes responsibility for the wearing of the appliance, treatment will progress satisfactorily. Occasionally the crossbite may also be due to a labially placed lower incisor. This must also be corrected, but is dependent on available space. If this is not available definitive treatment may need to be delayed **(Yaseen and Acharya, 2012):**

But we should know the basic requirement of orthodontic appliances **(Grist, 2020):**

- Permit control of the amount, distribution, duration and direction of the force they exert.
- Be atraumatic to the oral tissues and not be adversely affected by oral secretions.
- Allow wearer to maintain oral hygiene.
- Allow movement of individual teeth or of groups of teeth in desirable directions.

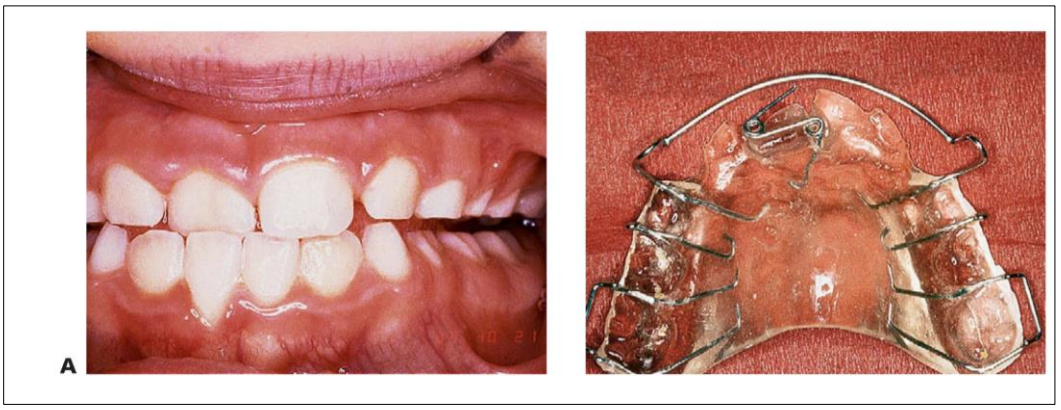

Figure 17:A.Anterior crossbite, B. Removable appliance **(Fricker *et al*., 2013).**

Posterior crossbite:

Is present when buccal cusps of upper molars and premolars, such that the lower teeth surpass buccally the upper teeth during centric occlusion **(Sollenius *et al*., 2020).**

Management:

A) Cross-elastics:

When only a single molar is in crossbite, this can often be corrected with a bonded attachment, button or hook, to the palatal of the maxillary and buccal of the lower molar (As shown in Fig.20) **(Ulusoy and Dogan, 2018)**.

Figure 18: cross elastic **(Ulusoy and Dogan, 2018).**

B) Removable appliance :

Lateral maxillary expansion can be achieved with a parallel expansion screw that is housed in the upper acrylic plate.

To ensure delivery of sufficient force on the teeth and palate the appliance should have excellent tissue contact and anchorage with clasps on teeth **(Bindayel, 2012)** (as shown in Fig.21).

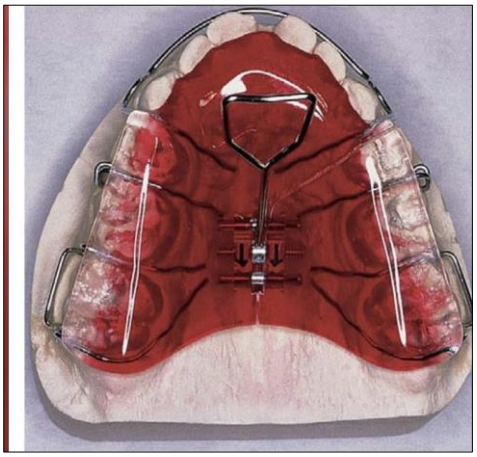

Figure 19: removable appliance **(Fricker *et al*., 2013).**

C) Fixed appliance **(Binder, 2004):**

- Slow maxillary expansion – quad helix/nickel titanium expanders

-A quad helix is attached to molar bands which are then cemented to the first permanent molar.

-Nickel titanium expanders require less adjustment than conventional stainless steel quad helix appliances.

-The crossbite is usually corrected within 4–6 months.

- Rapid expansion – Hyrax screw

Rapid maxillary expansion (RME) is indicated for severe cases of bilateral crossbite in which correction requires skeletal expansion. It involves the

splitting of the midpalatal suture producing an orthopaedic increase in maxillary width. This can easily occur in a growing child, preferably before the age of 9 years. (as shown in Fig.22).

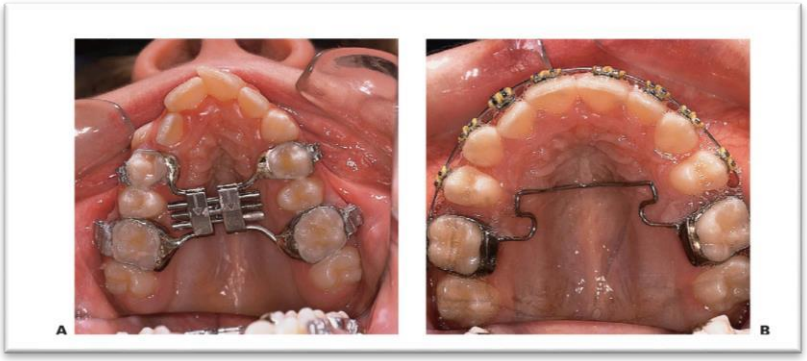

Figure 20 A) Rapid maxillary expansion appliance. B) Following expansion, a rigid retainer (e.g. Transpalatal arch) should be used during the fixed appliance treatment phase to limit relapse **(Fricker *et al*., 2013).**

Figure 9 curve of spee **(Shannon and Nanda, 2004).**

3. Crowding and space management in mixed dentition

Mixed dentition analysis forms an essential part of an orthodontic assessment. Moyer's method is commonly used for this analysis; which is to assess the amount of space required for alignment of unerupted permanent canines and premolars teeth in a dental arch. The difference in values between arch length and tooth size will indicate the amount of crowding or spacing present. . It should also be kept in mind that rotations in the labial segments are a manifestation of crowding, whilst in the buccal segments they represent spacing **(Tahere *et al*., 2007).**

3.1 Crowding: A discrepancy between the size of the dental arch and the size of the teeth. Ideally the mesiodistal widths of the teeth in each dental arch should be measured, added together and compared to the overall size of the arch. During the initial examination this can be done in the patient's mouth using a small metal ruler; however, a more

detailed assessment can be made from the dental study casts during treatment planning. An important aspect of this process is deciding upon a suitable dental arch form. In general, crowding can be described as mild (0 to 4-mm), moderate (5 to 8-mm) or severe (greater than 9-mm) (as shown in Fig.10) **(Proffit *et al*.,2013).**

Figure 21 Types of crowding **(Proffit *et al*., 2013).**

- **Serial extraction for crowding treatment:**

Is the planned extraction of certain deciduous teeth and specific permanent teeth in an orderly sequence and predetermined pattern to guide the erupting permanent teeth into a more favorable position **(Dalea, 2000).**

Procedure:

The procedure of serial extraction is **(Kjellgren, 2007) :**

•First, the primary canines are removed to allow spontaneous alignment of the permanent incisors.

•The primary first molars are removed to allow the eruption of the first premolars.

•Once the first premolars are erupted, they are removed and a space maintainer is issued to allow the permanent canines to erupt.

•Further orthodontic treatment is usually required to align teeth to achieve correct root angulation and incisor torque.

Indications

It is indicated in the following cases **(Muhammad and Watted, 2019):**

1. In cases of class 1 malocclusion that show harmony between skeletal and muscular system.
2. Patients with straight profile and pleasing appearance.
3. Cases which present with arch length deficiency – indicated by the presence of one or more of the following:

- Absence of physiologic spacing.
- Unilateral or bilateral premature loss of deciduous canines with midline shift.
- Markedly irregular or crowded maxillary and mandibular anteriors.
- Ectopic eruption of teeth.
- Mesial migration of buccal segment.
- Abnormal eruption pattern and sequence.

Contraindications

It is contraindicated in the following cases **(Pradhan *et al*., 2020):**

- Class 2 and class 3 malocclusion with skeletal abnormalities.
- Patients with adequate spacing in dentition.
- Cases of anodontia/oligodontia.
- Paients with open bite and deep bite.
- In cases of midline diastema.

- Unerupted malformed teeth e.g. dilacerations.
- Mild disproportion between arch length and tooth material that can be treated by proximal stripping.

3.2 Early primary tooth loss :

Local or systemic factors can cause early loss or early exfoliation of primary teeth such as **(Çolak *et al*., 2013):**

• Extraction due to extensive caries.

• Traumatic injury.

• Early exfoliation due to abnormal root resorption (eg, ectopic eruption)• Systemic disorders or hereditary syndromes, such as hypophosphatasia, rickets, acrodynia, leukemia, juvenile periodontitis, and Papillon-Lefèvre syndrome.

- **Space maintainers:**

Are appliances used in the mouth to preserve and maintain space. They are necessary when one or more primary molars have been prematurely lost due to trauma or disease. Using a space maintainer allows the permanent teeth to erupt, or grow, into the correct alignment with proper tooth-to-tooth contact **(Laing *et al*., 2009).**

Space maintainers can be divided in to **(Watt *et al*., 2018):**

A removable space maintainer: that is only worn at night is often sufficient to hold space and prevent the mesial drift of permanent molars. Night-only wearing of the appliance also reduces the risk of loss or breakage by the patient. (EX : Partial denture)

Fixed space maintainers: Fixed appliances have the advantage that they are worn continuously and do not require patient cooperation in wearing them. It should be noted that the placement of a fixed appliance in a child at high

risk of caries may compromise those teeth which are banded, or even adjacent teeth.

- Band and loop appliance is typically used in cases of unilateral loss. (as shown in Fig.11).

Figure 22: Band and loop appliance (Qudeimat and Sasa, 2015).

Nance appliance or lingual arch can be used if the loss is bilateral (as shown in Fig.12).

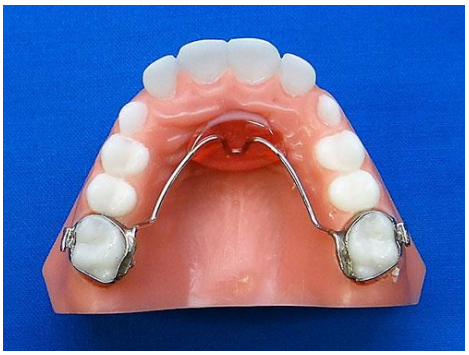

Figure 23: Nance appliance **(Borzabadi-Farahani A *et al*., 2012).**

- Distal shoe appliances can be used if the first permanent molar is not yet erupted, but are not widely used because of risks of infection (as shown in Fig 13).

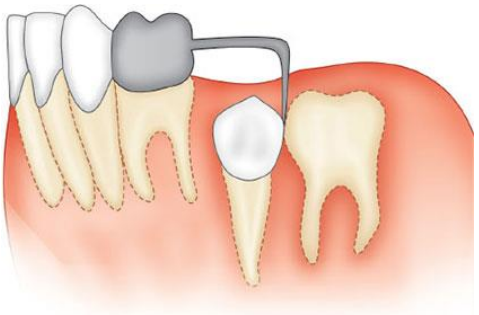

Figure 24: Distal shoe appliance (brill, 2002).

4.Ectopic eruption of permanent canine

The maxillary permanent canine normally erupts at the age of 11-12 years. At this stage, the absence of the canine bulge indicates a significantly higher possibility of palatal displacement. An over retained maxillary primary canine may indicate ectopic position of a permanent maxillary canine or a congenitally missing permanent successor.. Although timely extraction of the primary canine and first primary molar is performed, exposure and orthodontic force may still be required to bring a horizontally impacted maxillary permanent canine into its proper position in the maxillary arch. Distally displaced mandibular premolars are a valuable developmental risk indicator associated with palatally displaced maxillary canines. Observation of bitewing and periapical radiographs may provide an opportunity for earlier diagnosis (as shown in Fig.23) **(Bector *et al*., 2005).**

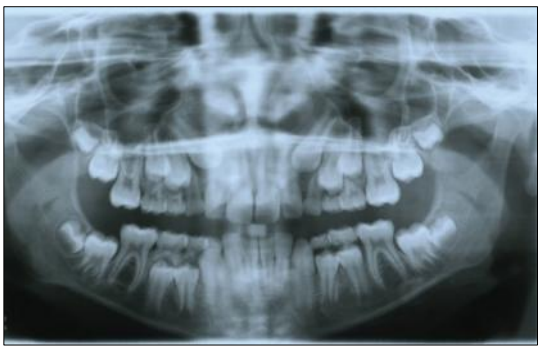

Figure 25: Ectopic eruption of permanent canine **(Canoglu *et al*., 2008).**

5.Treating Over retained primary teeth

Treatment for over-retained primary teeth will depend on the cause of the condition, as well as the structure and appearance of the affected tooth. Several treatment options are available **(Robinson and MF WY, 2009)**:

- **Retain the tooth**: If the affected tooth has good coronal structure (aesthetic appearance) and the tooth's root is intact (proper functionality), your dentist may recommend retaining the tooth and monitoring its progress. If no permanent tooth exists, a functional and aesthetically acceptable primary tooth can be retained for years into adulthood. A benefit of retaining the primary tooth is preservation of the jawbone and soft tissues surrounding the tooth.
- **Retain and modify the tooth:** This procedure is utilized when the primary tooth is submerged, meaning it has less height and dimension than the adjacent teeth. If the crown and root of the retained primary tooth are in satisfactory condition, the tooth can be reshaped with a tooth-colored filling material to enhance its appearance. These modified primary teeth should also be closely monitored.
- **Extraction:** A retained primary tooth that has fused to the bone is typically treated with extraction (ankylosed). A space maintainer is usually inserted into the empty area until either the underlying permanent tooth erupts or, in cases where no permanent tooth exists, a dental implant can be placed. Extraction is also performed in cases of a retained primary tooth that is misaligned. If crowding or other orthodontic needs are present, extraction and space closure with dental braces are often part of an overall orthodontic plan.

6. Thumb Sucking

Thumb sucking is considered normal in babies and young children. Natural nutritive sucking instinct leads some babies to suck their thumb or fingers during the first few months of life, or even before birth .Babies have a natural urge to suck, which usually decreases after the age of six months as weaning occurs. However, many babies continue to suck their thumbs after this time. Thumb sucking can become a habit in babies and young children who use it to comfort themselves when they feel bored, tired or anxious **(Price and Gwin, 2008).**

The effects of digit sucking are varied and are dependent on a number of factors, including the position of the digit within the mouth and the frequency/duration of the habit. They are summarized as **(Patel *et al*., 2008):**

1) Proclination of maxillary incisors.
2) Retroclination of mandibular incisors.
3) Reduced overbite or anterior open bite (AOB), which is frequently asymmetric.
4) Posterior crossbite due to narrowing of the upper arch.

One of the questions most commonly asked is 'What is the best time to stop child's habit?'. In dental terms, the answer is 'the sooner the better' and ideally before the permanent dentition is established. There are numerous approaches which can be employed to treat chronic thumb sucking. These can be split into three distinct categories **(Gutierrez and Carugno, 2020):**

1) Behavioral – rewarding a child for not exercising the habit.
2) Mechanical – preventing or interrupting the process of thumb sucking.
3) Aversive – generating negative sensations when the habit is exercised, such as bad taste, pain or major discomfort.

7.Investigations

6.1 panoramic radiograph :

It is the standard radiograph used in orthodontic assessment and provides the dentist with an ear-to-ear two-dimensional view of both the upper and lower jaw (as shown in Fig.24) **(Perschbacher, 2012).**

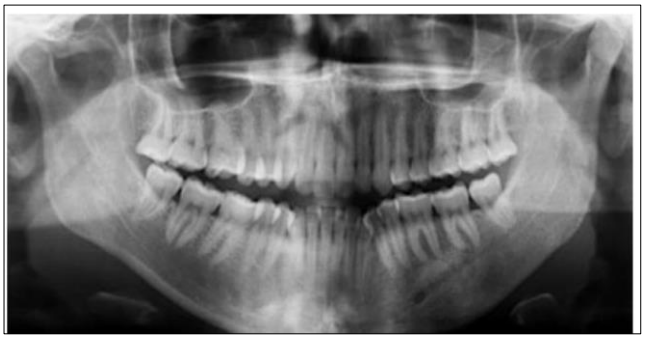

Figure 26: Panoramic radiograph **(Perschbacher,2012).**

6.2 Lateral Cephalogram:

An x-ray taken of the side of the face with very precise positioning so that various measurements can be made to determine the current and future relationship of the top and bottom jaw (maxilla and mandible) and therefore assess the nature of a patient's bite. This is particularly useful to plan any orthodontic treatment that may be necessary (as shown in Fig.25) **(Sharma *et al*., 2008).**

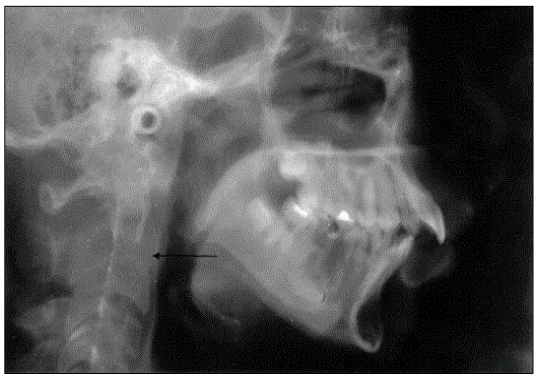

Figure 27: Cephalogram Radiograph **(Sharma *et al*., 2008).**

6.3 Study model :

Study models provide vital information about patient's teeth and occlusion. They are an essential diagnostic aid when planning cosmetic dentistry, oral surgery, and orthodontics (as shown in Fig.26) **(Singh, 2007).**

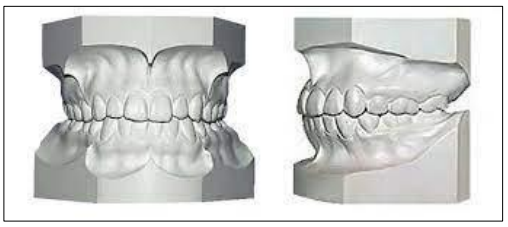

Figure 28: Study model **(Singh, 2007).**

Conclusions:

- Mixed dentition patient mostly seek dental treatment only when acute disturbing symptoms is evident.
- Based on the literature available, we can conclude that the Moyers mixed dentition analysis must be carefully used, since the majority of the articles analyzed showed that the probability of 75% was not as accurate as expected, leading to the need of adapting the probability levels depending on the study population.
- It is possible to identify early development of progressive malocclusion symptoms since the onset of mixed dentition.
- Early treatment of these changes can create a normal occlusal relationship and a balanced neuromuscular environment at an early age which helps the normal growth of the facial skeleton.

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