Lec :1 ***ORTHODONTICS*** ***Dr.Anas Q. Hamdi***

Definition of ortho :

It is composed of "2" words , ortho which means the correction of irregular things and donto which means in latin teeth .

Therefore the orthodontics means the correction of irregular teeth , but this is a very narrow definition of ortho .

The ortho treatment includes the study of dental facial and general body growth and the information obtained from this study are utilized for the diagnosis of the case and from this diagnosis , the treatment plan can be formed , the better diagnosis gives good treatment plan and good result will be obtained .

Types of occlusions :

The ideal occlusion : is based on the perfect relationship of the teeth with each other and the perfect relation of the teeth to the dental bases (the maxillary and mandibular bones) and there is a normal form and position for individual teeth, and this is very rarely found in nature, therefore the ideal occlusion is a hypothetical concept but it is a key that gives a clue for the normal and malocclusion .

Normal occlusion : is the accepted deviation from the ideal occlusion like a case of CL.1 occlusion with a minor crowding for about 1mm .

Any occlusion which will not interfere with the esthetic demand and / or functional demand of the individual is considered as a normal occlusion .

Malocclusion : It is the unaccepted deviation from the normal , like a crowding more than 2mm or an occlusion associated with a gum recession .

The malocclusion is divided into 3 types :

1- ***Malocclusion of the individual " teeth " .***

2- ***Malocclusion of the dental arch (bone of the arch) .***

3- ***Malocclusion due to the dental base (bone of the skull) .***
This case is either treated by ortho .Or by surgery .

1- ***Malocclusion of the individual tooth "teeth ".***

A-. Inclined tooth. B- displaced tooth . C- Rotated tooth.

D- Transposed tooth . E –Supra occlusion . F- infra occlusion.
G- impaction .

A- ***Inclined tooth : means that the apex of the tooth is within the dental arch but the crown is outside the dental arch either labial or palataly ,the tooth which inclined labial is called proclined tooth and if the tooth inclined palataly ,***

it is called retoclined tooth .

B – Displaced tooth : means that the apex and the crown of the tooth are outside the dental arch .

Dental arch is separated by an imaginary line from skull bone which contains alveolar arch "dental arch " .

C – Rotated tooth : means the tooth is rotated around its long axis in its position the rotation is either a minor rotation which is about 30 -60 degree or about 90 or sometimes a complete rotation 180 .

When the rotation is less than 90, we can correct the case by using a removable orthodontic appliance in a system called couple force system

***The couple force system consist of 2 forces** , one force acts from palatal side " lingual" and the other force from the labial side , and this is done by a Z spring and / or recurved spring .*

If the rotation is 90 or more than 90 we use fixed orthodontic appliance .

D- Infra occlusion : means that a tooth has erupted into the oral cavity but till now . It does not reach to the occlusal level .

E- Transposed tooth : means any tooth which occupies the position of another tooth (the canine takes the position of the lateral or the first premolar takes the place of the canine .

Note : in case of small jaw with congenitally missed lateral incisor we reshape the canine by the cusp .

F – supra occlusion : opposite to infra occlusion which means that a tooth erupted into the oral cavity and passed to the oocclusal level and this happens or occurs when there is easy loss of the deciduous dentition or premature loss of some permanent teeth .

G – Impaction : means a tooth with complete root formation but still embedded in the tissue (soft and hard " mucosa and bone " tissues) .

Malocclusion of the dental arch: *The malocclusion of the dental arch depends on the angle classification for the malocclusion .*

The classification *was done by* ***Dr.Edward Angle*** *in 1899 and considered* ***the permanent first molar*** *as the key for the classification . So he classified the malocclusion into :*

1 -CL .1 malocclusion : *In this classification , the* ***mesiobuccal cusp*** *of the upper permanent first molar occludes with the* ***mesiobuccal groove*** *of the lower permanent first molar posterior .*

2 - Cl.II malocclusion : *The lower first permanent molar occludes at least a ½ cusp width distal to the upper dental arch . This class can be divided into two types :*

1- ***Cl .II.i :*** *means that the upper permanent central incisor is proclined, this will increase the amount of overjet .*

2- ***Cl.II.ii*** *: means the upper permanent incisors are retroclined in another word there is either normal overjet or decreased overjet in addition to the increase in the overbite .*

Cl.III.malocclusion *: the lower first permanent molar occludes at least ½ of the cusp width anteriorly or mesial to the upper dental arch .*

Over jet and over bite *:* ***Overjet*** *: it is the horizontal distance between the palatal surface of the lower anterior teeth . the normal amount of* ***overjet is about 2-4 mm*** *, if it is more than 4mm this means that there is increase in the amount of the overjet , which means the case is Cl. II.i , but if the overjet is 0"****edge to edge****" or* ***reversed "minus",*** *this means* ***the case is Cl.III*** *.*

Overbite *: it is the vertical distance between the incisal edge of the upper central incisor and the lower incisal edge. The* ***normal amount of the overbite is 2-3mm or sometimes the upper incisor must cover only1/3 of the lower incisor*** *. If the overbite is more than normal this means : a deep over bite". Sometimes the lower anterior teeth will hit or traumatize the upper palatal gingival tissue and this is called* ***"traumatic overbite" .***

Aims of orthodontics : 1-Esthetic demand :

The malocclusion causes sever ***disparagement*** *in the appearance of the person in his face either due to the* ***prominent teeth or malrelationship*** *between upper and lower jaw . This malocclusion will produce* ***a psychological problem*** *to the patient usually for* ***teenages*** *, children and also for the parents*

Some children become isolated in the school due to this malocclusion and some of them will not attend school for this reason , so when you correct esthetic , you will correct the ***psychology of the child*** *.*

2-Functional demand :

The functional of teeth are cutting food , phonetics. Cutting the food is done by the incisors and then the mastication is by the molars . ***A patient with Cl .II.i malocclusion*** *can not do the proper cutting of the food due to the increase in the* ***overjet*** *, so if the increased overjet is treated , it will produce a normal cutting of the food .* ***The voice is produce by the vibration of the vocal cords and this vibration will be adjusted and modified by the action of the tongue and the teeth with the lips .***

The presence of normal overjet and overbite with ***absence of any malocclusion*** *of individual tooth and normal lips relation, the voice will be produced normall ,* ***But the presence of incompetent lips*** *or presence of* ***malocclusion teeth*** *, will affect on the speech and this will* ***lead to lisping*** *. (lisping means pronounce "s" and "z" sounds like*

3 -Trauma prevention : There are 2 types of trauma :

*1-****Direct trauma*** *:this is especially in case of prominent upper incisors Cl.II.i malocclusion ,these are more susceptible to the trauma specially in the schools*

during children play or the child may fall down and the most prominent teeth will touch the floor and these teeth will fracture more than the others .

2-Indirect trauma : is produced by premature contact between the upper and lower teeth and due to this premature contact the attrition of the teeth is produced and this will lead to the periodontal problem .

The crowded teeth also cause a periodontal problem because it will act as an 4-Operative demand :

Usually ortho treatment is done for bridge ,because the bridge can not be done or formed on the tilted teeth , so the parallelism between the abutments is very necessary for the bridge work .e.g. if the lower first molar is missed or extracted lower 7 will be rotated forward, so to make the bridge , we must upright the lower 7 and doing the bridge on lower 7 +5 .

area of stagnation of food between these teeth .

Edentulous area: distal to the first molar , we can not increase the arch length by the distalization of the lower 6 to make a bridge of 4 units .

Orthodontic appliances : are devices which produce a passive or active " teeth" movement . if these appliances utilize either the action of muscles or utilize the force of the spring or elastic or screw , we call this appliance as active appliance

In general we can divide orthodontic appliances into 2 types :

1- Passive appliances . 2-Active appliances .

Passive orthodontic appliances : Like space maintainer or retainer or a habit breaker, all appliances keep the teeth in its position without movement .

Active appliances : These appliances cause teeth movement , they include:

1- Removable ortho.appliance . 2-Fixed ortho.appliance. 3-Myofunctional appliance.

Types of orthodontic treatment :

There are 4 types of orthodontic treatment :

1-Preventive orthodontic treatment . 2-Corrective orthodontic treatment .

3-Interceptive orthodontic treatment . 4- Surgical orthodontic treatment .

1-Preventive orthodontic treatment :

It is the action taken to preserve the integrity of what appears to be normal at a specific time and this includes :

1-Early correction of carious lesion especially proximal caries .

2-Early recognition and elimination of oral habit .

3-Using space maintainer in case of early lost of deciduous dentition .

2 – Interceptive orthodontic treatment :

It is the phase of science and art of irregularities and malocclusion employed or added to eliminate potential irregularities in the developing dentofacial complex , these procedures are employed to lessen or eliminate the severity of developing malocclusion due to the hereditary factor (extrinsic or intrinsic). ex : planning serial extraction .

3 – correctence or :

Recognize or diagnosis the existing malocclusion and need for using certain technical procedures to reduce or eliminate the problem and the malocclusion sequel .

1-Surgical orthodontic : This is a type of treatment which depends on both orthodontic treatment and surgery . The orthodontist can only do alignment of

the teeth and to put it in acceptable position then the surgeon will complete the treatment .

Types of orthodontic appliances :

A – Active orthodontic appliances " fixed orthodontic" .
These appliances cann't be removed from the patient mouth by himself because these appliances will be cemented and fixed on the individual teeth .

It is composed from : 1-Bands . 2- brackets . 3- arch wire . 4- auxilleries (power chain , elestics "a ligature " .

The bands mostly are used in the posterior teeth , also can be used on the anterior teeth , but the bracket more favorable to be used on the anterior teeth than the posterior, the band due too bulky , aesthetic and the space needed between the anterior teeth is not enough.

The bands come indifferent size and shape , the anterior band is different from the posterior band. The process of fixation of the band called "banding"(cementation of the band on the teeth) by using orthodontic cement or we can use zinc oxide cement for cementation of the band .

The process of banding includes :

1 – Separation of the teeth (0.5mm) by using separator either elastic or brass wire . After one day we remove this separator and do cementation (after choosing a proper size of the band).

Bracket is used on the anterior also on the posterior teeth (premolars) .

The process of fixation of the bracket on the tooth is called " Direct bonding " .

We use a composite material to fix the bracket on the teeth and this is done by :

1 – Polishing of the teeth . 2 – Rinsing with water .

3 – We do acid etching which means : Adding of acid (orthophosphoric acid) or gel which has a concentration of 35 % on the surface of the teeth for 1-1.5 min ,

then the acid must be washed completely and the surface of the tooth must be dried . 4 – Then apply a bonding agent on the surface .

The bracket must be fixed by using isobased (compost) .The active component of fixed appliance consists of : the arch wire and the Auxiliaries (elastic ligature wire), while the anchorage component consists of : the posterior teeth or sometimes from the anterior teeth to increase the anchorage .

Advantages of fixed appliance :

1 -It can correct of all types of malocclusion because it can get all type of tooth movement which is either : tripping movement , torquing movement , rotational or body movements .

2 – It moves the teeth faster than the removable appliance .

3 – It can be removed from the mouth so , it not need a well cooperative patient.

Disadvantage of the fixed appliance :

1 – Very expensive . 2 – Needs a very good dentist that means a good training dentist or specialist .

3 – If the appliance fractures , we will get unwanted tooth movement because , as we said the appliance gives a fast tooth movement .

4 - It takes more chair time in the dental clinic and this unfavorable for the patient and the dentist .

Removable appliance : *It can be removed and inserted by the patient himself , also can be cleaned , the dentist can activate and adjust*

Activation *: means the production of a potential energy inside active component*

Adjustment *: means the accurate fitness and properties of the retentive component like Adam's clasp , Fitted Labial Arch (F.L.A) and C-clasp .*

Removable appliances consist of : *1 – Stainless steel wire and from this wire we do active and retentive component . 2 – Acrylic base plate .*

Myofuctional appliances :

These types of appliances depend on the action of the muscles on the teeth and jaw .Mainly in our work we use either:

1 – Monoblock : which is an appliance used to treat Cl.II.i when there is an increase in the overjet , overbite and proclination of the upper teeth . it consists of 2 appliances, one on the upper and the other on the lower, joined together to act as one unite or as one block, so it is called mono block . it is used mostly at the age of 12-13 years for the girls and 12-14 years for boys .

2 – Frankel appliance : It is divided mainly into :

1 – Frankel I : used for Cl .I and Cl.II malocclusion .

2 –Frankel III.use for Cl.III malocclusion .

Combination of both removable and fixed appliance :

In some cases when we have only one or 2 malposed tooth , we cann't correct this malposition by using a removable appliance and the patient can not pay for the fixed appliance , we can do a removable appliance and only a bracket or band on the malposed tooth .

Removable orthodontic appliances : It is an orthodontic appliance which can be inserted and removed by the patient himself for cleaning and also be removed by the dentist for activation and adjustment .

Advantages of removable orthodontic appliance :

1- Cheap . 2 – Can treat all the simple orthodontic cases .

3 – Any dentist can work on this appliance .

4 – Because it can be removed by the patient himself, so easily to maintain a good oral hygiene that means a good periodontal teeth .

5 – The force which is used for activation this appliance can be distributed on all the teeth and jaw and can be despited during insertion and removing of appliance so any fault with the activation will not harm the dental structure .

Disadvantages of the removable orthodontic appliance :

1 – By the removable appliance a limited number of teeth that can be moved , additionally a limited number of teeth movements can be done usually by the tipping movement .

Components of the removable appliances :

A-Active component : this is the most important as an essential part of the removable appliance because this part causes the active teeth movement .
The active component includes : 1-Spring : it is attached to the acrylic base plate from one side by a part which called retentive tag , the tag is embedded inside the activation and movement of the tooth . The spring in orthodontic appliance constructed from stainless steel alloy and sometimes from gold or platinum gold . 2-Screw . 3- Elastics . 4- Extension of acrylic base plate .

Stainless steel alloy :

Previously large wire and springs were constructed from gold and sometimes from platinum or Platonized gold , these appliances are very expensive so stainless steel alloy used as alternative alloy .

The stainless steel alloy (composition) is composed of 18% chromium, 8% nickel , a small amount of carbon and the rest of the alloy is iron .

Advantages of the carbon in the alloy :

Carbon reduces the flexibility and gives the stiffness to the wire(so reducing the amount of carbon will produce softer stainless steel alloy and vice versa) the amount of carbon in this alloy does not exceed 0.5%

Advantages of the chrominum :

To give a passive (relentive) layer to prevent the future oxidation of the metal, since chromium oxide contains 2 atoms of chromium and atom of oxygen .

The oxygen layer directed to the outside of the wire and this layer will prevent any additional oxygenation .

Advantages of stainless steel alloy :

1 – Not tarnish and not corroded by the oral fluid .

2 – Allergies are unknown for the stainless steel alloy, that means the alloy is compatible with the oral cavity . 3 – Cheap .

4 – Can be soldered , soldering means the union between 2 material by using a third one , usually the flux is used to reduce the melting point of the soldering material consist of brass with cupper or consist of white gold .

5 – Can be welded , welding mean the union between 2 material of the same type by a third material of the same type .

The Stainless steel alloy can be made or manufactured of different sizes and gets ideal flexibility and rigidity .

Deflection D : It is the distance of change of the free end of the stainless steel wire from the original position to the new position due to given an amount of force . The deflection is equal to the potential energy which is stored inside the spring due to the amount of force activation .

General principles for spring design :

1- Wire dimension . 2-Diameter of wire . 3-Direction of teeth movement.

1-Wire dimention : the flexibility of the spring can be increased by increasing the length of the wire and decreasing the diameter of the wire , while the rigidity is opposite to the flexibility .

The required amount of the force in orthodontics can be obtained by increasing the length of the spring and increasing its diameter, and since the space in the oral cavity is very limited , therefore the length can be increased by doing a loop or coil inside the spring .

Advantages of coil : A- Increase the length of the wire .

B -Increase the flexibility . C-Decrease the force .

Also it is used in activation of the spring in some design . The reduction of the diameter of the wire will also produce flexibility and this will lead to do a flexible spring that can cause trauma to the soft tissue , so it is necessary to guard or sleeve the small diameter wire specially 0.5mm wire in case of buccal canine retractor and in case of finger spring . Note : buccal canine retractor and finger spring are classified according to whether they are guarded OR not (simple " without guard " ,modified;' guarded").

1- The diameter of the wire :

A-0.3-0.4 mm used for auxiliaries .

B-0.5 mm used for "Z" spring or recurved "Z" spring and also for guarded finger spring "M.F.S "

C- 0.6>>>> used for simple finger ,spring "S.F.S".

D-0.7 >>>> used for Adams clasp ,Hawley's arch " Robert " retractor and also for Mill's bow .

E- 0.8 – 0.9 >>>> used for labial bow .

F- 1.25 – 1.5 >>> used for face bow .

3 – Direction of teeth movement : By the removable appliance, we gain :

A – Tipping movement .

B – Rotational movement (when the rotation is less than 90 degree) .

C – Mesiodistal movement .

Types of springs according to the teeth movement :

1 – Palatolabially or lingolabially movement : we use

A – "Z" spring : is used on the single tooth especially the anterior .

B – Recurved " Z" spring : movement of more than one tooth also for anterior .

C – " T" spring : is used for the pushing a single posterior tooth .

2 – Mesiodistal movement : means movement either from distal to mesial or mesial to distal. We use finger spring either the simple one or the modified , this spring is placed palataly or lingually .

3 – Distal movement : finger spring in both types or buccal canine retractor .

4 – Distal and palatal movement : modified buccal canine retractor .

5 – labiopalatal (buccopalatal , labiolingual , buccolingual) :

A . Hawely's arch . B .Robert retractor .

C .Mill's bow . D . Another type of wire .

All the time when the case can be treated by either palatal spring or labial " buccal " spring , we prefer using the palatal one due to :

A-Esthetic of the patient . B-Less traumatic to the soft tissue .

C-Do not interfere with the lip function .

D-Not easily distorted during insertion and removal of the appliance

The design of the spring all time must be non traumatizing to the soft tissue so the end of the active arm must not be sharp and traumatic , so we do a very small coil on the end of the active arm especially in the finger spring " both types" and the simple buccal canine retractor

The required amount of force applied in orthodontic treatment for the teeth : A . Anterior teeth 25 gm / cm2 of the root surface " means the part of the root embedded inside the bone " .

B .Canine tooth 30 gm / cm2 . C. Posterior teeth 90 gm /cm2

Components of the removable appliance :

A .Active component . B-Retentive component . 3-Acrylic base plate .

A .active components :

These are the most important as an essential part of the removable appliance because these parts cause the active teeth movement .

The active component includes :

1 – Spring : it is attached to the acrylic base plate from one side by a part which is called retentive tag , the tag is embedded inside the acrylic , and the other side is called active arm , which is used for activation and movement of the tooth .

The spring in orthodontic appliance is constructed from stainless steel alloy and sometime from gold or platinum gold .

2 – Screw : there are different types and sizes of screw , the small ones are used for the movement for a single tooth , while the large screw is used for the movement of a group of teeth and sometimes for the movement of whole dental arch in case of expansion screw .

The disadvantages of screw :

A . very expensive . B .bulky . C . Uncomfortable to the patient .

3 –Elastics : the elastic is store the force of activation for about 45 days , when it is used intraoral , and it can produce a steady amount of force to move the teeth and it is superior from the elastic point of view in comparison with the spring, especially if it is used for the anterior teeth and the larger type of the elastic is used extra orally .

4 – Extension of acrylic base plate .

Components of the removable appliances:

A- Active component . B- Retentive component .

C – Acrylic base plate . D .Anchorage .

B . Retentive component : of the removable appliances

are those parts which retain the appliance inside the oral cavity to the teeth, and this will share the anchorage requirement of the removable appliance additionally , they prevent dislodgment of the appliance :

1 – **Adams's clasp** : the most common part is used as a retentive component , it is a simple clasp very neat and it utilizes a very minimum space in the oral cavity .

Adam's clasp accepts many modifications which are needed in the orthodontic treatment with the removable appliance .

Adam's clasp can be used for any tooth either posterior or anterior upper or lower, **Deciduous or permanent** except in the lower anterior teeth because they are very small in the mesiodistal direction and the clasp will interfere with the action of the lower lip , also the bridge of Adam's clasp is very small and difficult in wire bending .

2 – Fitted labial arch : it is used on the upper permanent anterior teeth and usually done in the centrals but sometime is extends to include the four anterior .

- Sometimes ,we do a small coil on it, to receive the "J" hook of the extra oral traction or sometimes the extra oral anchorage .
- The gauge of the wire of both Adam's clasp and the fitted labial arch is 0.7 mm of wire .

- ***Fitted labial arch acts as auxiliary in the retention of the appliance . The main retention of the appliance can be obtained from Adam's clasp and the acrylic base plate .***

- ***Fitted labial arch consists of two parts :***

A – The labial part . B – Palatal or lingual part .

The labial consists of a U shape, which is located between the two central incisors , it must be 2-3 mm away from the gingival tissue to avoid trauma .The ends of the U shape extend upward then horizontally to form the labial arch is located between the middle and the incisal thirds .

The labial arm must be fitted on the labial surface , to prevent accumulation of food debris or plaque between the wire and the tooth surface , then the wire is directed upward (between the central and the lateral incisors or between the lateral incisors and the canine, if more than one tooth is involved) toward the occlusal surface " incisal edge " then transmitted to the palatal surface , between the two neighboring teeth and also must be fitted on the two surfaces until reaching the end of contact between these neighboring teeth " when reaching the cingulum , then the wire must be elevated about 0.5 mm , to avoid trauma to the soft tissue , and the retentive tag which will keep the wire inside the acrylic base plate must be 0.5 mm away from the gingival tissue for thickness of acrylic .

C – Acrylic base plate : 1- It is considered as a major connector for the entire removal appliance, it provides a base for the attachment of the spring and the retentive components .

2- It is very important to extend the base plate as much as possible to include the emabrasure area between the teeth , in this situation the base plate can distribute the pressure of activation to the anchored teeth and into other teeth .

3-- The base plate must extend on the occlusal surface of the teeth to form posterior bite plate and in this situation only the plate cusps of the posterior teeth " premolar and molar " are covered by the base plate .

4- Sometimes the whole 2nd molar can be covered ,or ½ of the occlusal of the 2nd molar or the 3rd molar can be covered to prevent the longer extension of the acrylic base plate to prevent gag reflex of the patient , also the 2nd and the 3rd molar must be covered to prevent over erosion of the tooth .

5- The posterior plate also can extend anteriorly to form bite plate .
These are two types of anterior bite plate :

A – Straight type . B. Inclined type .

Sometimes, the whole occlusal surface of the teeth can be covered by the posterior bite plate , the 3rd molar must be inclined if it is present .
Advantages of the anterior bite plate :
A – Reduce the increased overbite by preventing the further overgrowth of the lower anterior teeth .
B – It accelerates or facilitates the growth of the posterior teeth While the posterior bite plate is used in the treatment of cross bite , it will open the mouth anteriorly to help in the labial of the teeth in crossbite.

Anchorage requirement of removable appliance :

The anchorage :

It is the resistance to the active components, because the active component will produce a force to move the teeth and this force will be equalized by the teeth which are clasped by an Adam's clasp or by an Adam's clasp in addition to fitted labial arch . Every tooth in anchorage should receive a force which is not more than 0.1 N , because this force will not move the tooth .

Types of Anchorage :

1 – Reciprocal anchorage : means the movement of two teeth , equal in size , one against the other , e.g : the movement of the two upper central incisors to close the central disthema.

2 – Simple anchorage : is the movement of a small tooth against a large one , e.g : the movement of lateral against the molar .

3 – Stationary anchorage : it is mostly used in the fixed appliance and usually obtained by using palatal bar which will join molar band " the left one to the right " , however the stationary anchorage can be used in the removable appliance in case of combination of the fixed and removable appliance .

4 – Inter maxillary anchorage : means the movement of tooth or group of teeth in one arch against a tooth or a group of teeth in the opposite arch , in other words the movement of the lateral incisor situated in the maxillary arch against the lateral segment of the lower arch . usually the intermaxillary anchorage is of a great advantage in using the anterior plate and myofunctional appliance .

5 – Interamaxillary anchorage:

Means traction of the strong tooth against a group of teeth , e.g : the canine against the molar and premolar .

***6 – Extra oral anchorage** : means an anchorage situated outside the oral cavity by using a head cap or neck strap .*

Types of wire bending:

*1 – **Z – spring** : it is a palate – labial or lingo – labial movement spring , the gauge of the wire is 0.5 mm of stainless steel wire .*

***The Z- spring is composed of 3 parts** :*

A – Active arm . B – Two active coils . C – Retentive tag .

***The active arm** : It is that part of the spring which gives the movement of the tooth . The length of this active arm must be equal to the mesio – distal width of the tooth .*

In the end of this active arm , there is a small coil to prevent tissue trauma .The position of the active arm must be behind the cingulum , near the gingival 1/3 and must be perpendicular on the long axis of the tooth .

***B – The two active coils** : from these two coils , we do the activation of the wire by opening either one or both coils*

1 – " 2-3 " in diameter . 2 – The two coils locate at the same level .

3 – The direction of the 1^{st} coil must be opposite to the direction of the 2^{nd} coil .

4 – The two coils must be away from the gingival tissue about " 1-2 mm" to avoid trauma to the gingival tissue .

The function of the coils :

For activation and Increase the length of the wire ; so it increases the flexibility of the wire .

***C – The retentive tag** : it is that part of the wire which is zig zag in shape and it will end with a very small cutting 0.5mm perpendicular on the gingival tissue for thickness of acrylic .*

Uses of Z- spring : ***1 – Z- spring moves only one tooth . it can be used on all upper and lower anterior teeth ; it is used in correction of palatally or lingual positioned teeth .***

2 – In case of cross bite , we have to use a posterior bite plate with the Z- spring to open the bite anteriorly .

3 – Also the Z- spring is used to correct the rotated tooth when the rotation is less than 90 degree in combination with the Hawley's arch in a system " " coupled force system " .

Couple force system : it is a system which uses two forces applied on the same tooth , one from the palatal or lingual side and other is from the labial .

2 . Recurved spring or recurved Z – spring :

Recurved spring consists of two z- springs joined together at the active arm .Gauge of the wire is 0.5 mm of stainless steel wire .

Action of the recurved spring is similar to the z –spring by pushing the anterior teeth more than one tooth from the palate or lingual side toward the labial surface in case of cross bite or palatally positioned teeth . Also it can correct the slight rotation with the using of couple force system .

The components of the recurved Z- spring :

A – Active arm . b- Four active coils . c – Two retentive tags .

The position of the active arm must be located toward the gingival margin behind the cingulum and it must be perpendicular on the long axis of the tooth .

The 1st two active coils must be opposite in direction of the wire bending to the other two active coils .

Note : the properties of the coil and retentive tag are similar to that of the z-spring .

activation of the wire : by opening the four coils .

The amount of activation : the active arm must pass the incisal edge of the anterior teeth .

3 . Finger spring:

There are two types of finger spring " simple and modified : finger spring :

A – Simple Finger Spring : it is used for mesiodistal movement of the tooth , it is used on all teeth anterior and posterior except the molars , it is used when the tooth is within the dental arch .

This spring is more comfortable than the buccal spring , e.g : if we have an upper canine mesially positioned , we prefer using finger spring which will not interfere with the soft tissue and the dislodgment of the finger spring is lesser than the buccal spring. The gauge of the wire is 0.6 of stainless steel wire .

Components of the simple finger springs :

A – Active arm . b – Active coil . c – Retentive tag .

Active arm : used for movement of the tooth either mesially or distally . It extends from the active coil palatally and extends upward till it reaches the contact between the two neighboring teeth and extends upward in complete contact with the surface of the tooth to prevent accumulation of food debris or plaque , then extends labially , also a good contact between the wire and the tooth surface similar to the C- clasp . The end must not traumatic and this is done by a small coil which is called a non traumatic coil .

The extension of the wire must extend ½ mesiodistal width of the tooth .

2 – Active coil : 1-Size of the coil is 3-4 mm . 2-Position of the coil must be between the two teeth because, we want to move one of them against the other. 3- Direction of the coil is opposite to the direction of the tooth movement ,activation of the wire by opening the coil .

The active arm must pass ½ the mesiodistal width of the tooth .

The position of the wire from the coil to the active arm must be away from the soft tissue about 1 -2 mm to avoid trauma to the soft tissue .

3 – Retentive tag : it is the end of the wire ,which is embedded inside the acrylic , it is a zigzag in shape and perpendicular on the tissue surface and that part is 0.5 mm in length for thickness of the acrylic .

B . Modified finger spring :

It is also called guarded finger spring because it has a guard to protect the palatal tissue from trauma by the active arm .

The components of the modified finger spring :

1-Active arm : similar to the simple finger in all its characteristic .

2-Active coil : this is also similar in position , size and direction to the simple finger spring .

3-The only difference is the end of the coil which is joined with the retentive tag .

It is directed upward and the retentive tag will start to form a horizontal (U) shape and this will extend toward the 1st tooth near the extracted area , and also again the retentive tag will end with 0.5 mm perpendicular on the palatal tissue for thickness of acrylic .

The only part that is embedded in acrylic is the (U) shape and the end of the retentive tag .

Buccal springs :

1 – Simple buccal canine retractor (B.C.R):

From its name it is used for the canine only . It moves the tooth from the mesial side toward the distal side when the tooth is within the dental arch .

The platal spring , as we said . is more favorable than the buccal spring because:

1– Esthetically is more acceptable .

2 – Less traumatic to the soft tissue than buccal canine retractor

3 – The buccal spring is easily dislodged than the platal spring because the platal will be covered by acrylic base plate .

The components of the B.C.R :

1 – Active arm . 2 – Active coil . 3 – Retentive tag .

1 -The active arm : extends from the active coil and upward until reaches the contact area between the lateral incisor and the canine . The active arm ends with a very small coil which is non traumatic coil must be perpendicular on the imaginary horizontal line that extends on the surface of the lateral and canine , the position of the coil is in the interdental area .

2 – The active coil :

Size of the coil is 3-4 mm , the position is 1-2 mm away from the soft tissue or vestibular sulcus and about 1mm away from the gingival tissue , and the activation of the wire is by closing the coil .The amount of the closing is called "activation " .

The active arm must pass ½ the mesiodistal width of the tooth or the tip of the tooth (tip of the canine) .

***3 – The retentive tag** : it extends from the other side of the coil upward in a smooth curvature until it reach the contact area between the 4th and the 5th teeth at the occlusal surface between the teeth . it must be well adapted to prevent the interference with the occlusion of the opposite jaw , and extends palataly downwards ending in L shape for retention of the wire in the acrylic .*

Notes :

- *The retentive tag must be away from the midline .*
- *The gauge of the wire is 0.7 mm of stainless steel wire .*
- *Sometimes , some modifications can be done on this wire using gauge of wire 0.5 and must be sleeved with a small tube to give more flexibility , and the wire either is embedded in the acrylic or soldered with Adam's clasp .*

2 – Modification buccal canine retractor :

This wire is used for the canine when the tooth is buccaly malposed and mesially angulated .

It has two movements, mesially and palatally at the same time .

The gauge of the wire is 0.7 mm . The component of the wire is the same as the simple buccal canine except in the active arm as the active arm in the MBCR end with a U shaped bending that extend between the two neighboring teeth " the lateral and the canine" perpendicular on the imaginary horizontal line that extends on the labial surface of the teeth and in the undercut area , then the other side of the U loop end with a C shape which extend on the labial surface on the canine at the junction between the middle 1/3 and the gingival 1/3 of the tooth.

It must be very well adapted on the labial surface of the tooth to prevent accumulation of food .

3 – Hawley Arch :

It is used labially for multiple teeth movements , the movement from labial side toward palatal side , it is used in many types of movements :

A – To correct slight increase in the amount of the overjet when the overjet is more 4 mm and less than 7 mm .

B – It is used in the " couple force system " when there is a slight rotation less than 90 degree , in combination with the z- spring or recurved spring .

C-Used as a retainer , so it is called " Hawley retainer " for retention of the teeth after the end of the orthodontic treatment to keep the retention for about 3- 6 months according to the difficulty of the case , here the wire isn't active but as a passive wire . The gauge of the wire is 0.7 mm of stainless steel wire .

The components of the Hawly's arch :

It is composed of the labial arch which extend from the distal side of the lateral incisor to the distal side of the 2nd lateral incisor " from left to right " .

This labial arch is located at the junction between the incisal 1/3 and middle 1/3 of the tooth then this labial arch continuous with 2 U loops ,from these 2 U loops we can do the activation by squeezing " closing " these 2 "U " loops.

The Hawly's arch when it is active ,it must be passing the incisal edge then these 2 "U" loops end with a retentive tag which either done similar to the retentive tag of the buccal canine retractor or it may be soldered with Adam's clasp .

Note : When we have 2 appliances are similar in all components (Adam's clasp , Hawley arch , Acrylic base plate), we can know that this appliance either active or retentive appliance from the shape of the acrylic base behind the upper or the lower anterior teeth ,if the acrylic is zigzag in shape" interdenal acrylic" inserted between the anterior teeth, that means that the appliance is a Retainer but if the acrylic has been cut or trimmed or curved in shape that means it is an Active appliance .

Robert Retractor : This is another type of labial bow " arch " or spring , it is composed of two buccal canine retractor joined together by a labial arch .

The position and extention of the labial arch similar to the "H.A" the gauge of the wire is 0.7 mm .

The only difference between the H.A and R.R is in the action of the wire .

R.R used to decrease the increase in the amount of the overjet more than 6mm by activation of RR via closing the coils .

The amount of activation is 1-2 mm behind the anterior teeth and also trimming of the acrylic is 2-3mm behind the anterior teeth .

Note : R.R also can be done with 0.5 mm with a sleeved which is a protective tube .

Adam's Clasp : ***It is the major retentive clasp in orthodontic appliance, it can be used on all teeth in oral cavity " molars ,premolars , uppers and lowers" and on the upper anterior teeth . It cann't be used on the lower anterior teeth because :***

1- ***It is bulky . 2-Interfere with action of the lips .***

2- ***Lower anterior teeth are very small in the mesiodistal dimension and they are weak .***

The gauge of the wire is 0.7mm of stainless steel wire .

- ***It can be used on a single tooth or on two teeth e.g. either on molar alone or on the molar and the premolars and this is called (major A.C) .***
- ***Also we can do some modification on the A.C . e.g. we can do one A.C . on the molar and half A.C. on the premolar and this half A.C. is soldered on the 1st A.C. or we can solder a tube on the bridge of the A.C . for extra oral traction (EOT) .***
- ***Also we can solder a small coil to receive an elastic .***

Parts of Adam's clasp : ***1 – Bridge of Adam's clasp : it is a horizontal bridge located on the buccal surface of the tooth .The width of the bridge extend from two imaginary lines or the width or the length of the bridge similar or equal to the line which extends horizontally between two perpendicular lines that extends from the tip of the cusp downward to the gingival tissue.***

The bridge must be 45 degree with the long axis of the tooth .

The end of the bridge extend downward to form two U loops end in the undercut area then the end of the loop must be half length of the other arm

The U loops must be 45 degree with the bridge then another bend has been done to extend toward the occlusal surface and the retentive tag will be started " similar to the tag of buccal canine retractor" .

The only difference in the A.C is that the distal retentive tag must be bend mesially to decrease the extention of the acrylic base plate posterioly, to be more comfortable to the patient and to prevent the gagging reflex to him .

Retention : ***Retention means the stability of the appliance inside the oral cavity or retention of the teeth .*** ***There are three types of Retentions :***

1 – Retention of the wire in acrylic base plate and this is done by doing a bend like zigzag or L- shaped bend in the retentive tag of the wire .

2 – Retention of the appliance inside oral cavity and this is done by :

A – Adam's clasp . B – Fitted labial arch . C – C- clasp . D – Acrylic base plate.

3 – Retention of the teeth inside the oral cavity into its final position after the end of the orthodontic treatment and this is done by using Hawley Retainer (which means a passive appliance inserted in mouth without activation to keep the teeth in its place after orthodontic treatment .

1-The duration of wearing the retainer is different according to the difficulty of the case and it is about 3- 6 months .

2-The rotation and expansion need more time for retention ,

3- Sometimes in case of rotation , we put permanent retention like a small piece of wire can be put palatally with a layer of composite .

4- The Hawley retainer consists of Hawley arch , Adam's clasp and Acrylic base plate

Note : The wearing of the orthodontic appliance (active or passive) must be worn all the day (24 hours) and it is only removed after eating for brushing of the teeth and the appliance except the myofunctional appliance that must be worn 14 – 16 hours daily .

Etiology Of Malocclusion : ***Malocclusion means*** ***any abnormality in the form and position of the jaw , teeth or both of them ._There are two factors which affect the occlusion :_1 – Genetic factors . 2 – Environmental factors .***

1 – Gentic factors : Replace the major factor that affects on the occlusion of the individuals , so there is a difference either due to the difference in the ethnic group or to the pathological condition or trauma such as in mongoloid races (the length of the alveolar bone is less than the length of the basal bone , this case is called " Mesognathic "). While in the negroid races is greater and is called " Prognathic" or it is called " Bimaxillary proclination " that means the upper and lower jaws are proclined forward . However , as previously mentioned there is much individual variation within the same ethnic group possibly as a result of population mixture and racial variation can only be described in very broad term .
Genetic factor and inherited factors that affect on the jaw and dentition in general can be classified into 2 major factors :

A – General factors : affected on the individual can also classified according to the part that will be affected :

1 – Skeletal factors : these factors include the dental base in relation to the cranial base and these could be varied from person to person according to the position of the jaws ,size and the shape of the jaws .

2– Soft tissue factors : which include the muscles of the face and the muscles of the mastication that have : 1-Direct relation to the skeletal factors , they are either have effect on the skeletal factors or skeletal factors affect on them .
2-Abnormality of orofacial muscles .

3-Interference in soft tissue function such as breathing or swallowing .

3– Dental factors : which include the tooth size and the size of the jaws .If the tooth in normal in size and large jaw ,this will lead to general spacing and if the normal jaw with large size teeth ,this will lead to crowding and the vice versa .

B – Local factors : include : ***1 – Extra teeth (supernumerary) .***

2– Missing teeth (congenital missing teeth) : this will lead to decrease in the number of the teeth such as canine and the 3rd molars .

3 – Early loss of deciduous teeth .

4– Delay in the shedding of the deciduous teeth .

5-Abnormal eruption behavior of the teeth such as canine and the third molars .

6 - Abnormality in the shape, size or the teeth such as hypodontia which is either complete " whole tooth is missing " or partial part of the tooth is missed .

7 – High and large labial frenum attachment and this will cause the central disthema .

Factors affecting occlusal development :

A – The major factors :

1 – Skeletal factors ***: Any pathological condition affecting growth the jaw is likely to have a marked effect on the occlusion of the teeth , inherited and acquired congenital malformation .***

The division of the jaw into basal and alveolar component is artificial ; as both obviously belong to the same bone .

The jaws relationship can be considerd under 3 headings :

A- Jaws in relation to the cranial base .

B- Jaws in relation to each other .

C- Alveolar bone in relation to the basal bone .

A- Jaws in relation to the cranial base :

The jaws are part of the total structure of the head and it is possible for each jaw to vary in its positional relationship to other structure of the head , this variation present in three plans(sagital , lateral and vertical) , but it is usually greatest in sagital and vertical , each jaw varies in its relationship to the cranial base .

B – Jaws in relationship to each other :

The relationship of the jaws to each other may also vary in three plans of spaces ; any variation may affect the occlusion of the teeth :

The anterioposterior positional relationship of the basal parts of the upper and lower jaws to each other with the teeth in occlusion is called skeletal relationship. ***Sometimes is called dental base relationship or skeletal pattern .***

Skeletal relationship classified into :

1 – Skeletal class 1 : in which the jaws are their ideal anterio posterior relationship in occlusion .

2 – Skeletal class 2 :in which the lower jaw in occlusion is positioned further back in relation to the upper jaw than skeletal class .1 .

3 – Skeletal cl.3 : in which the lower jaw in occlusion is positioned further forward than in skeletal cl.1 .

Variations of skeletal relationship may be either:

1 – Variation I size of the jaws .

2 – Variation in position of the jaws to the cranial base .

The relative size of the jaws in lateral dimension also has an effect on the occlusion of the teeth , if one jaw is wider than the other , the occlusion of the teeth is affected causing a buccal cross bite .

If the upper jaw is wider than the lower jaw , this will cause either unilateral or bilateral cross bite .

The vertical relationship of the upper and lower jaws also affect the occlusion ., the effect is most clearly seen with the shape of the lower jaw at the gonial angle , the high gonial angle produces a longer vertical dimension of the face , and in severe cases an anterior open bite , conversely , the mandible width a low gonial angle tend to produce a shorter vertical dimension of the face .

C -<u>Alveolar bone in relation to the basal bone :</u>

Although the alveolar bone is supported by the basal bone , the relationship between the upper and lower alveolar bones is not necessarily the same as that between the upper and lower basal bones .

The alveolar bone supports the teeth , and therefore matches tooth position rather than basal bone position. Nevertheless , the basal bone provides the base and the alveolar bone relationship and hence the tooth relationships may only differ from the basal relationships within a limited range .

The reason for the possibility of the difference between basal and alveolar relationships is the tooth position is not governed entirely by jaw position , other factors may cause the teeth to be tilted a way from their correct inclinations during eruption , alveolar bone grows to support the tilted teeth and , therefore may slightly different in position from the basal bone .

Skeletal relationships should be assessed either by clinical assessment or by radiological cephalometic X-ray .

Continue factors affecting occlusal development .

2 – Muscle factors (soft tissue factors) :

This is the second groups of the general factors that affect on the occlusion and final position of the jaw and teeth .

The muscles which mostly affect on the jaws and teeth are :

1 – Muscles of the lips . 2 – Muscles of the cheek .

3 – Muscles of the tongue and mastication .

Note : any variation in the origin and insertion of these muscles will cause malocclusion and affect the function of the teeth .

1 – Muscles of the lips :

The lips consist of several muscles which form a single unite , they play their part of occlusion development by a virtues of their size , form and function .

The form and function of the lips can be considered in two planes :
A- Vertical planes . B – Sagital planes .

A – Vertical planes of the lips :

B – Sagital planes of the lips :

The sagital relationship of the lips is almost entirely determined

by the relationship of the basal bone of the jaw to which lips attached .
1 -The lower lip tends to be further backward than the upper lip which increases of the skeletal cl.2 relationship , and further forward in case of skeletal cl .3 relationship, this is not only increase the difficulty of the eruption path of the upper incisors , such modification may alter the primary effect of the skeletal relationship on the occlusal relationship of the teeth , either increasing or decreasing the effect of the skeletal discrepancy for , e.g : in skeletal cl.2

relationship , the lower lip may function completely or partially behind the upper incisors .

2-If mild skeletal cl.2 , the lower lip will increase proclination of the teeth . if it is severe skeletal cl.2 and lower lip doesn't cause any effect on the teeth .

3-In case of strong and long lip this will lead to increase the action of the lower lip on the upper anterior teeth , especially the central incisor , because the central incisor erupts before the lateral incisor and this will lead to retroclination of the upper central incisor and cause dental cl.2 division 2 .

4-Sometimes , there is skeletal cl.2 , but the occlusion and the eruption of the teeth affected by the action of the muscles , which cause either dental cl.2 or cl.3 .

The function of the lips also affects on the final position of the teeth , the lower lip plays more role than the upper lip , both in function , movement and in governing the final position of the incisors , in normal function during swallowing and speech , it may exert pressure which cause retroclination of the lower incisor teeth .

The lip line : ***The lip line means*** *the level at which the lips meet together in normal function and the ideal level of the lip line is at the center of the crowns of the upper anterior teeth , so the lower lip will function behind the upper incisor will cause proclination of them*

If the lip line is high .e.g : the upper lip is shorter than lower lip , and this will cause retroclination of the upper central incisor and this cause cl.2 ii dentally , because the lower lip will act on the upper anterior teeth . In severe sk,cl.2 there is no lip line , i.e : the lips are incompetence .

2 – The muscles of the tongue :

The tongue also plays a great in the final position of the teeth and dental classification , and the action of the tongue on the occlusion by three parts :

A – Size of the tongue . B - function of the tongue .

C – Resting position of the tongue .

A – Size of the tongue :

It is the most important factor , the normal size of the tongue that the tongue will fill the space surrounded by the lower teeth in the lower jaw at resting position , or the normal size of the tongue when the outer border of the tongue attaches to the lingual surface of the lower teeth , at rest position .

When the tongue size increases , either the outer border of the tongue covers the occlusal surface of the posterior teeth causing posterior open bite , e,g : the upper posterior teeth not contact the lower posterior teeth , or when there is protruded tongue , e.g : the anterior part of the tongue is located between the upper and lower anterior teeth and this will cause anterior open bite .

Sometimes when we have a small tongue , this will lead not to fill the space of the upper jaw during swallowing and will lead to decrease the size of the maxilla ,because the pressure of the lips and muscles of the cheeks will be more than the pressure of the tongue inside the oral cavity and this will lead to small upper jaw , which will cause posterior cross bit , e.g : the upper posterior located in the center of the lower posterior teeth .

B – The function of the tongue :

1 – Speech : the studies show that the speech doesn't have an effect on the occlusion , but the malocclusion affects the speech

2 – Swallowing : the tongue helps in the swallowing process , there are 2 types of swallowing .

A – Tooth part adaptive swallowing : *means that the tongue come between the posterior teeth and this will cause posterior open bite , so during swallowing we need to put the tongue between the teeth posterioly .*

B – Teeth together adaptive swallowing *: when the posterior teeth (upper and lower) contact each other during swallowing and the tongue protruded forward and this will cause either anterior open bite or proclination of the teeth or deep maxillary palate .*

3 – Breathing : *during breathing , the tongue helps in maintaining a good anterior oral seal to get a normal nasal breathing . When there is a sharp lip , the tongue becomes forward with the lips to get a good anterior oral seal and causes anterior open bite , whenever there is a nasal obstruction and there is a malocclusion , we have to correct the nasal airway before correction of the malocclusion .*

C – Resting position of the tongue :

Normally , the tongue fills the lower jaw in ideal form , sometimes in case of a large tongue or small tongue ; this will lead either to cross or open bite either anteriorly or posteriorly.

Sometimes , the tongue is very large and this will lead to fill the lower jaw covering the occlusal surface and also fill the upper jaw and this will lead to increase the size of maxilla and cause scissor bite , e.g : the platal surface of the upper posterior teeth occluded or contact with buccal surface of the lower posterior teeth and this is difficult to treat it by orthodontic treatment , only we can correct the case by surgical and orthodontic treatment and this face is called lion's face .

***Tongue thrust** : tongue thrust also affects on the occlusion :*

There are two types of tongue thrust which affect on the occlusion and the position of the teeth .

1 – Habitual tongue thrust . 2 – Endogenous tongue thrust .

1 – Habitual tongue thrust :

It is a habit acquired by the child or even in some adult person , they either push the tongue between two teeth and cause displacement or spacing between the teeth or the patient pushes the tongue and thrust anteriorly or pushes it forward and causes anterioly open –bite .

We can stop the habit by putting a habit – breaking which called " tongue – guard " to prevent the forward movement " position " of the tongue and also we can stop the habit by exercise to the muscles of the tongue .

***2 – Endogenous tongue thrush** :*

In some subjects , the swallowing activity is combined " associated " by anterior thrusting of the tongue which appear a basic neuromuscular mechanism , this means : it is directly related to the nervous system ,so it is called " endogenous tongue thrust " it is associated with lisping during speech and this affects also the vertical development of the anterior segment and this will cause anterior open bite and incomplete over bite .

***The endogenous tongue thrust is fortunately uncommon** , it appears only in 3.1% , the correction of the teeth and the position of the teeth will not alter the tongue in activity and the relapse of the treatment will occur again .*

The occluasl development of speech :

They don't know whether the speech is affected on the occlusion or the occlusion is affected on the speech , we see a very nice alignment or setting of the teeth with a defect in the speech or we see crowding or malocclusion or

instanding teeth and there is normal speech , but in some cases there is one or two instanding tooth and this will interfere with the action of the tongue in speech , so alignment of this or these malposed tooth will solve the problem .

Bad oral habits (Thumb , finger , dummy and comforter) :

Thumb and finger , in addition to dummy and comforter sucking , all these habits lead to anterior open bite or posterior cross bite due to construction and decrease in the size of upper dental arch due to increase in the outer muscle force of the lip and cheek .This habit should be stopped between 3 to 4 years old , it means before eruption of the permanent dentition , if the habit is continuous after eruption of the permanent dentition , we have to stop the habit before orthodontic treatment by using Habit Breaker .

Neutral (balance) zone :

This means that the teeth after complete eruption , they are located under equal force , which is gained by muscles outside and inside the oral cavity , in addition to air pressure . Rcduction of the oral muscles to produce any activity associated with the habit , this will lead to interference with the balance zone .

Reductionorer – adaptation of the oral muscles must be done before orthodontic treatment and the force must be done before orthodontic treatment because the relapse (failure) of the treatment will occur .

In previous lectures , we have mentioned :

1 – Skeletal factor . 2 – Muscle factor .

3 – Tooth size and arch size relation ship.(dental factor) .

There are three effects of excessive (large) dentition in normal jaw are present:

1 – Overlapping and displacement of the teeth .

2 – Impaction of the teeth .

3 – Mesial movement of the teeth .

1 – Overlapping and displacement of the teeth :

In case of overlapping , the dental arch is too small for dentition , the teeth erupting into the arch tend to become displace by the teeth already in the arch and this particularly affect the last teeth to erupt in any groups like the lateral incisor , 2nd premolar, canine , 3rd molars .

In incisalor region , the teeth tend to overlap each other and the case is called " imbrications " that means all the teeth in same direction and this will interfere with the artificial cleaning of the teeth and usually the treatment is difficult .

2 – Impaction of the teeth:

It occurs due to completely blocked of the space by erupting of the other teeth due to crowding and also affected the last tooth erupted in the dental arch like canine , 2nd premolar , in addition to 3rd molar .

3 –Mesial movement of the teeth :

There are two types of mesial movements :

1 – Normal physiological mesial movement , or mesial migration which is always occurs as a part of normal growth .

2 –Mesial movement : which occurs in case of early extraction or exfoliation or losses of primary or some permanent dentition and this occurs due to the crowding .

Sometimes we have a normal size of dentition with large jaw or normal size jaw with small size of dentition and this lead to generalized space in the upper and lower jaws and this affects on the esthetic of the patient , in addition to the health of the gum or the health of the dentition according to the amount of the spacing .

Local factors :

1-Supernumerary teeth : it occurs mostly in the premaxilla than in any part of jaw , they appear to be inherited factor, it means there is no environment factor with responsible for their appearance .

The supernumerary teeth which occur with cleft lip and palate are mostly as of fragmentation of dental lamia during cleft formation and this can't consider as a normal case .

The prevalence of supernumerary teeth is about 1% of a large number of dental patients . the supernumerary teeth can occur in primary and permanent dentition , but mostly in permanent dentition has a marked effect on occlusion .

The supernumerary teeth are classified into :

1-Supplemental . 2- Conical . 3- Tuberculated .

1-Supplemental supernumerary teeth : this is similar to the normal teeth I both shape and form in addition to the size .

They appear as additional teeth , especially in the upper lateral incisor on permanent dentition and as central incisor in deciduous dentition .

It is less common to find an extra premolar or molar except in African race and the Asia population .

The effect of supplement teeth on the occlusion is to decrease the width of the alveolar dental arch and increase crowding of dental arch ; it is difficult to differentiate between the supplemental tooth and the normal one , so the supplemental tooth is not necessary to be the one must be removed for relief and crowding .

2-Conical supernumerary teeth : the typical conical supernumerary teeth occur in the premaxilla near the midline and is called mesodense , it may occur as a single tooth or in pairs ,it means two conical mesodense , the conical

supernumerary teeth have a certain specification which are different from tuberculated teeth . The conical tooth appears to be developed in early development of the jaw , its root formation begins at least as early as that of the permanent upper central incisor , and sometimes earlier ,mostly eruption occurs during childhood before eruption of the permanent dentition and cause malposition of adjacent central incisor , it must be located between the upper central incisor because of these charactreristic features it has been regarded that is arising from dental lamina as an extra tooth in the permanent dentition .

The occlusal effect or problem is caused by conical central supernumerary teeth , they cause localized mal –alignment and they cause flaring of the permanent upper central incisor and sometimes the central incisor may be retarded or in large jaw will lead to cause a large central disthema.

3-Tuberculated supernumerary teeth : from their names , they are like tuberculated in shape , that means the tooth has a small cusps , they erupt in young people after eruption of the permanent dentition , so the effect of the tuberculated supernumerary teeth may cause displacement of the teeth in addition to the crowding , so the supernumerary teeth must be removed and occlusion must be corrected by the appliance .

Congenital missing teeth : it means absence of one or more of the permanent teeth , it mostly affected the upper lateral incisor , then the lower 2nd premolar and the wisdom tooth .

In case of missing lateral incisor ,this will lead a space anteriorly ,and in case of a small jaw the canine erupts in place of the lateral incisor and there is on spacing . If the 2nd premolar was absent either there is spacing between the lower 4 and 9 or the deciduous E remains without shedding of the tooth is healthy ot if the deciduous teeth have been lost early , there is no space because the lower molar will migrate or move forward to close the space .

The 3rd molar does'nt have an effect on the occlusion if it is congenitally missing.

Hypodontia :

There are two types :

A-Partial hypodontia : means missing on or part of tooth like the mesial part or cusp and tooth becomes smaller in size and this will lead to affect the esthetic and may cause spacing .

B-Complete hypodontia : this is called Anadontia , it is mostly hereditary factor .

Treatment of the hypodontia :

If the dental arch well aligned , we do a building of the tooth either composite or by crown .

If there is a partial loss of total tooth that means only one tooth absent ,we can do either partial denture or fixed bridge , 6% of European population have Hypodontia while 5-9 % in Arab population .

Partial hypodontia may affect the jaw or the teeth in three aspects :

1-Form of the tooth . 2- Position of the tooth .
3- Growth and development of the jaw .

Hypodontia mainly appear as inherited factor mostly appear in same familiar groups and associated with general abnormality , such as hair spar or it is associated with hypodontia of the fingers or nails (blue or brown spots) the hypodontia affects the tooth shape and the position of the adjacent and this depends on the amount of the tooth loss or number of the teeth that have been missed .

4-High labial frenum attachment :

Normally ,the labial frenum (at birth) located at the crest of the alveolar process then this frenum located between the two primary deciduous teeth during

development of the alveolar process ,the frenum becomes low in position , in some patients the labial frenum is very dense or thick connective tissue that can'nt be drown below so this dense connective tissue will remain in its position between the two upper permanent centrals and this will lead a space between the teeth and this space is called " central median disthema " the disthema in the upper jaw is more common than the lower jaw .

Factors which make the disthema :

1-Hypodontia .
2 – Un erupted conical supernumerary tooth .

3-Proclination of the upper anterior teeth ,either due to the skeletal factor or due to the habit like thumb sucking .

4-Due to the disproportion between dental arch size and teeth size .

5-High labial frenum attachment .

Always before doing any type of orthodontic treatment , you have to do good diagnosis to know the main causative factor that causes the problem , in case of high labial frenum , we can elevate the upper lip and see if the there is any blenching (whitening) of the frenum that means the labial frenum is the main cause , also we can take X-ray to be sure from the causative factor ,

5 – Abnormal eruption behavior :

Any tooth in the oral cavity or in the jaw before eruption in the X-ray as abnormal position then during development of the jaw and the tooth will correct itself again and appear in its normal position but sometimes there are factors that affect on the tooth and prevent it from its normal position such as trauma which mostly affects the children especially at the age 4-6 years .

The trauma mostly affects the upper anterior teeth , any trauma to the primary incisor will transmit to the permanent teeth which are in eruption at the beginning only the tooth crown and 1/3 of the root has been formed during trauma .

The formation and development of the permanent traumatized will be affected , the development of the root will continue and the change its direction leading to dilacerations of the tooth (the tooth root) and this dilacerations will lead to impaction or un eruption of the traumatized permanent tooth .

During diagnosis ,you have to take a good history from the patient and the parents of the child of any previous trauma in addition to that you have to take X-ray to see the position of the tooth and the shape of the root , if the tooth is dilacerated , the treatment is very difficult because in some cases the tooth will be (v) in shape or the crown may be directed upward , so the tooth must be removed and the treatment is done according the case .

The 2nd tooth that appears in the oral cavity which is affected by the development is the canine , this is due to several factors :

1. ***Long path of eruption because the canine crown is located at the base of the skull near the floor of the orbit .***
2. ***Angulation of the canine (the canine mostly erupted at 75 degree of angulation , mesially angulated) .***
3. ***The canine is the last tooth erupts in the oral cavity , except the 3rd molar .***
4. ***Early loss of primary dentition this will lead to shortening the space available for the canine eruption .***
5. ***Delay in the shedding of the primary canine will lead to the eruption of the canine away from its position (malposed canine) .***
6. ***When the canine from the beginning is located in abnormal position or sometimes associated with a cyst) .***

Diagnosis of malposed canine :

A-Clinical diagnosis which includes :

1-Visual examination :

This is done by elevation of the upper lip and looking if there is any swelling or elevation in the buccal or palatal mocosa .

If there is any swelling in the buccal mucosa that means the canine erupted in the normal position ,also we can see the crown of the lateral incisor if its direction distally that means its eruption in the right path because the canine during the normal eruption will hit the root of the lateral incisor and push it forward and the crown of the lateral incisor will be directed distally .

In some cases even the root of the central incisor is pushed forward which is leading a space between the incisors and this space is called **AUGLY DUGLY STAGE** which is a normal physiological spacing located between the anterior teeth and this space will disappear after complete eruption of the canine sometimes we call it **VLIND ERUPTION** .

2-Palpation :

This is done by touching the primary canine to see if there is any mobility in the tooth , this mobility means that the canine had hit the root of the primary tooth that will cause root resorption of the primary canine and the crown will be mobile.

Also we can do palpation from the buccal side of the jaw to see if there is any shadow of the crown in the palatal side of the jaw ,we can see a swelling but we can n't palpate the area because we have a dense bone ,so the canine will be away from the mucosa.

3-X-ray :

There are different types of it :

A-Periapical X-ray : ***we should take good angulation and position of the tooth to enable us to see if there is any trauma to the root or lateral incisor .***

B-Occlusal X-ray : ***to see the depth and the position of the tooth wither buccally or palatally .***

C-Cephalometric X-ray ***: this is very good X-ray because we can obtain the following :***

1-Measure the height of the tooth from occlusion .

2-The angulation of the tooth .

3-It reveals the relationship between the tooth and another adjacent teeth like the lateral incisor and the 1st premolar .

4-It is used to study the growth and development of the face and the jaw in addition to know whether the problem is due to local factor or skeletal .

D-Panoramic X-ray : ***This shows the angulation of the tooth and the relation of the canine with erupted and un erupted teeth .***

Treatment of the malposed teeth :

1-Correction of the tooth either by using a removable appliance if the tooth is measily angulated or in cross , or fixed appliance , if the tooth is distally angulated or vertical in position or partially erupted or impacted by using fixed orthodontic appliance with surgical exposure (this treatment is done after creation of a good space in the canine region) .

2-Correction of the tooth by fixed appliance with surgical exposure by adding bracket or cleft on the un erupted tooth .

3-Removal of the tooth and this is last choice for treatment and we have a good contact between the lateral incisor and the 1st premolar and the premolar must be in a good condition , in case no caries or filling , and the canine is impossible to be corrected by orthodontic treatment or by surgery .

4-We can also leave the tooth in its position if the malposed tooth away or very high in its position and the process of the removing of this cause damage to the surrounding vital tissues , so the patient is observed every 6 months .

Factors controlling the treatment :

1-General health of the patient .
2- The position of the un erupted tooth .

3-The space available for correction of the tooth .
4- Early loss of deciduous teeth.
5 – The condition and position of the neighboring teeth and also for malposed teeth .

If the deciduous tooth has been lost earlier than its time of shedding , this will cause many problems as the following :

1-Effect on the psychology of the child and parents because it affects the esthetic of the child .

2-There is an effect on the function of the jaw , chewing and speech .

3-It has an effect on the position and the relationship between the upper and the lower jaw , this will lead to forward postural position of the mandible .

4-It will lead to over eruption of the opposing teeth or tooth .