**Physiology of tooth movement and Anchorage(ortho#12).**

\*I used some extra sources and information just to make some points clear . Enjoy ☺

**What do we need for tooth to move:**

\*Force.

\*PDL.

\*Bone.

\*Tooth.

**\*What happen when a continous light force is applied ?**

As we know tooth move in periodontal space by generating **Compression side** and **Tension side** (pressure-tension theory ).

**IN Compression side :**

when such force is applied , blood flow decreased ,periodontal ligment cells and fibers are distorted , a sustained force of at least **4 hours** duration is required to stimulate the production of chemical messengers such as **prostaglandins**, **cyclic AMP** and **cytokines** that induce the differentiation of **osteoclasts** , within few days those osteoclasts migrate to the compression areas and remove bone along the socket this known as **Frontal resorption**.

**IN Tension side :**

The periodontal fibers are stretched and proliferation of fibroblasts and **osteoblasts** , Osteoid is deposited on the tension side by osteoblasts .

\*\*Tooth need 7-14 days with such light force to move .

**\*What happen when a continous heavy force is applied ?**

An excessive continous force may create stress within the ligment space to occlude the blood supply to an area, after 4 hours differentiation of osteoclasts will take a place , within few days osteoclasts begin to appear that will cause **indirect bone resorption undermining resorption**( that mean resorption take deep place from cancellous bone outwards to wards the lamina dura ).

\*\* tooth will need 2-3 days to move with such heavy force, then the rate of tooth movement will be slow ( using heavy force that doesn’t mean accelerate the orthodontic treatment at initial phase it will be rapid but then as a response to undermining resorption it will be much slower ).

**\*Tipping movement :**

The simplest type of tooth movement, single force, used in removable appliances cause movement of tooth around center of resistance, force needed is 35-60 g.

**\*Bodily movement :**

The complete translation of a tooth where all parts of the tooth (crown and roots) are moving , couple force is required , a force of a 70-120g is needed ..

\*Intrustion 10-20g.

\*Extrusion & Rotation 35-60g.

**\*Anchorage :**

Is the resistance of un wanted tooth movement( there will be action and reaction ) . suppose that are using palatal spring ,and you want **to distalise the premolars** **(this is the action)** , **the reaction is the mesial movement of molars** or it may affect the anterior teeth if the base plate is contacting them .

\*if the force that we use to move premolars distally was very low ; the reaction to it will not be sufficient to move molars mesially .and that called Optimum force

Optimum force: the lightest force that produce the maximum response to the orthodontic force.

The force depend on the total root surface area of the tooth ; so to move a single rooted tooth is going to take less force than a multi-rooted tooth.

In removable appliance we do tipping movement so the action is the force applied to the premolar distally ( the optimum force 35-60g) , so if we apply 35 g to move the premolar will it be enough to move the molar mesially as a reaction ? NO, let’s say that the molar needs 60 g of force to tip it mesially , so this is safe.

But if we activated both palatal finger springs to move the two premolars in the same time ,this means that the force will be 60 g so it’s the optimum force to move the molars mesially.

And this is how we calculate the anchorage requirements , we have to think if the force we are using is going to reach the optimum force level to move the anchor teeth or not.

So to minimize anchorage loss is to activate one appliance (move one tooth ) at a time to reduce the resultant force and use a light force (optimum force ).

\*the highest anchorage value is the upper first molar (more roots) , if we add the first molar with the premolars it will be almost equal to the anchorage value of the anterior teeth .

**\*Forms of anchorage :**

**-Intraoral anchorages :**

\*Anchorage obtained from the teeth, it may : intermaxillary or intramaxillary

\*Anchrage obtained from soft tissue.

\*Anchorage obtained from the skeletal.

**Intermaxillary anchorage :**

\*between arches.

\* the most common used is intermaxillary elastics, the elastic run from the upper anterior teeth to the lower posterior teeth they aid in the retraction of upper incisors and reinforce anchorage,HOW?

If you want to distalize the canines and retract the incisors (the action), the reaction is the mesial movement of upper premolars and molars ,the force produced by the elastics will counter act the mesial movement of the premolars amd molars .

Note that the anchorage will have effect on lower teeth will do mesial movement and procline the lower anterior teeth so you should find a way to resist this movement(the proclination of lower anterior teeth) if you don’t want it.

**Intramaxillary anchorage :**

\*within the arch anchorage is provided by the teeth in the same arch when a tooth is being moved in one arch anchorage is gained by all the non moving teeth in the arch so increasing the number of teeth that provide anchorage will produce less unwanted movement of the other teeth.

**\*reciprocal anchorage** : when two equally sized teeth or groups of teeth are to be moved in equal but opposite directions used for closure of midline diastema .

**\*stationary anchorage** :if tilting is prevented by certain measures ,force will evenly distributed along the whole root surface(bodily movement) thus mininmizing unwandented movement.

Bodily movement needs more force than tipping movement, so the anchorage will be more.

When the action is distalisation of the posterior teeth, then the reaction is on anterior teeth in order to prevent the anterior from moving, the bite plane (type of stationary anchorage) change the movement from tipping to bodily .

**\*Drugs affecting response to orthodontic movement :**

2 types of drugs will depress the response to movement is : Bisphosphonates used in the treatment of osteoporosis , NSAID and Cortiocosteroids they are PGs inhibitors.

\*corticosteroids : inhibit the formation of arachidonic acids ; reduce PGs synthesis.

\*NSAIDs: inhibit the conversion of arachidonic acida to PGs .

**Effect of orthodontic treatment :**

**\*Pain and mobility :**

Moderate pain and mobility is normal , at first 2-7 days the patient is warned about the possibility of having pain .

Sudden and excessive pain : due to increase of force .

Management :

\*discontinue the treatment & leave it some days.

Source of pain from ischemic PDL areas sometimes.

**\*effect on pulp:**

Very rare to have loss of vitality but it may happen when we have heavy force cut the blood supply to the apices of teeth as a result of undermining resorption , also the teeth subjected to trauma .

\***root resorption :**

If there’s heavy force, long orthodontic treatment and move the tooth toward cortical bone ( the movement should be toward the cancellous bone ) , all of that increase the possibility of root resorption.

The maxillary incisors followed by mandibular incisors then maxillary 1st molars the most common teeth subjected to root resorption during orthodontic treatment .

Categories of root resorption : mild (slight), moderate ( if quadrant of root is subjected to resorption ) and severe ( more than quadrant ).

Study followed 139 patients who had orthodontic treatment and subjected to root resorption for 10-15 years ,after that 121 of patients had stable teeth and 18 patients show some mobility in their teeth. So the conclusion was if the length of root is less than 10 mm the more tooth subjected to mobility in long term.

\*0.5mm alveolar bone loss is consider mild but in orthodontic treatment may cause defects in bone that unrestorable.

\*as a rule if you move the tooth in healthy periodentium there will be no affect on bone level. So you should first treat you’r patient from perio diseases if he has it.

**\*Skeletal or growth modification :**

Here we apply heavy force to modify the rate or the direction of growth , like if we have pt with class III here you can prevent the mandible from growth forward or accelerate the forward growth of maxilla.

In maxilla you should use 350-450 g of force each side with a duration of 12-14 hours a day during night time where growth hormones affect more.

If you want to accelerate the forward growth of maxilla should be done before age of 10, also if you want to split the mid- palatine suture you should do it early before closure of suture before age of 14.

**Spider Screw** : appliance has skeletal affect used to split the mid- palatine suture.

**Face mask appliance** : used to pull the maxilla forward should be used before age of 10 , it made of elastics hooked onto patient braces this create forward pulling force to pull the upper jaw forward, is not that successful in mandible it just redirect the growth but we use it with classIII patient because most of them have small maxilla rather than large mandible.

Skeletal appliances the most successful way use during growth spurt , girls 8-12 , boys 10-15 years of old.

**CONCLUSION :**

Always use sustained single light force in orthodontic treatment,the orthodontic movement depend on : force,duration and distrubtion of force .

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