**pulp therapy for young permanent teeth**

immature permanent teeth are those in which root development and apical closure has not been completed. Are present in children from 6 years until 2-3 years after eruption of 8's. and after apical closure are classified as mature with a continued dentine deposition. when those teeth first erupt, only 2/3 of their roots are formed and they are called immature permanent teeth until the closure of the apex 3 years after eruption.

young permanent teeth are cellular and have a better healing potential than such teeth in adult patients, and this is an advantage. the degree of tooth development will determine what type of teeth treatment is performed. So it is very important to take x-rays to see level of root development.

physiological secondary dentinogenesis represents the apposition of secondary dentine after the completion of crown and root formation and continues at a slower rate throughout the life of the tooth. Even if lets say 10 years old child and lower 6 has apical closure, we maintain vitality as long as we can because dentine continue deposition and roots become thicker and stay stronger.

the secondary dentine formation will continue as long as the pulp-dentine complex is vital. Tertiary dentine formation involve wide range of responses with secretion of tublar and atublar dentine as a result of trauma or stimuls like making a cavity or caries.

**young mature permanent teeth** have closed apices but the canals are wide with thin walls so we try to keep the tooth's vitality as much as we can, so the secondary dentine will keep in deposition even after closure of the apical area, this is important for the long term prognosis of the tooth, so young permanent mature teeth have wide root canals & dentine deposition can prevent the fracture that is a relatively common finding in root treated teeth with wide canals.

**Residual dentine thickness:** it is a term related to large carious lesion in permenant tooth and we need to leave at least 0.25-0.5 mm if dentine thickness lining pulp to have potential for dentine formation. So still possibility of tertiary dentine rather than necrosis. Someone may ask : how to know how much to leave? It comes with experience and with taking x-rays and bear in mind to be more conservative is the best to do.

The aim of all treatment planning for young permanent teeth is to preserve pulp vitality as long as we can, this will provide conditions for continuous root development and continuous physiological dentine deposition which inhances apexogensis.

Dentine deposition can prevent root fracture so always try to maintain vitality.

**the pulp-dentine complex**

The pulp and dentine are closely related and usually looked upon as one unit (pulp-dentine complex) so all procedures performed in the dentine will have an effect on the pulp.

The condition of pulp-dentine complex is the main determinant factor in treatment planning.

pulp exposures in young permanent teeth can result from 3 ways : caries, operative procedures or from traumatic injuries specially in anteriors.

In carious exposures the pulp & the dentine are infected.

In accidental operative exposures only the dentine is infected, the pulp may be vital and sometimes not even inflamed. so in this case we can do a direct pulp capping.

Most happened: in traumatic pulp exposure non of them is infected if the treatment was performed immediately after the injury. so the most important factor here is the time of presenting after the trauma. Dentine not infectednad pulp may remain vital if treated well .. do direct pulp cap (mainly immediately وقع عند باب العياده ودخلتوه)

The most important & the most difficult aspect of pulp therapy is determining the health of the pulp and the stage of inflammation. So for that we have to take the patient’s history, clinical examination, radiographic examination and sometimes to open directly and do pulp evaluation.

**recording the history**

Type of pain is described by the child, and we assess it by vitality tests.

# if there's a response then it indicated that the pulp is vital.

# if continuous spontaneous pain then there's a damage and the pulp is irreversibly inflamed.

# sensitivity to pressure may indicate that the pulp damage has extended to the periodontal ligaments causing extrusion of the tooth from the socket, and it may also result from a high restoration causing a high occlusion.

# food impaction can mimic the symptoms of irreversible pulpitis .

# it happened that a pain because of erupting 6 , pericoronitis or even biting on operculum ..wt to do? Give irrigation and good OH

# teeth with extensive caries and a draining sinus tract or swelling of the soft tissue vestibule indicates a non-vital tooth.

SO a careful extra oral & intraoral examination is needed, and we can check the mobility, tenderness to percussion gently. we can use pulp testing which should be carefully interpreted for 2 reasons the first one is that we are dealing with a young child so whatever we use may give us false positive results most of the time & also premature teeth with wide open apex may not react to stimulation due to incomplete development of the innervation system, then we take radiographs which are essential to the diagnosis but the interpretation of the radiographs of immature teeth can be difficult due to abnormally large & open apex also we have to look at the age of the child & dental age of the child.

The degree of the tooth development & amount of dentine deposition should be **compared** to the contralateral teeth ( especially upper centrals traumatized)and we usually use this in trauma cases to compare the development of the traumatized tooth with the adjacent normally developing one.

 **vital pulp therapy for teeth diagnosed with vital pulp or reversible pulpitis:**

1-protective liner

2-indirect pulp treatment

3- direct pulp capping

4-pulpotomy

**1)protective liner :** mostly in a clean cavity.

is a thinly applied liquid placed on the pulpal surface of a deep cavity preparation, covering exposed dentine tubules,acting as a protective barrier between the restorative material & the pulp.

materials used :- CaOH, GI cements

 the liner must be followed by a well sealed restoration to minimize the bacterial leakage form the restoration- dentine interface.

Indications :- In a tooth with normal pulp when caries is removed for a restoration, a protective liner maybe placed in the deep cavity.

Objectives :- To preserve the tooth vitality, promote pulpal tissue healing & facilitate tertiary dentine formation.

**2)Indirect pulp treatment** :

performed in a tooth with a diagnosis of reversible pulpitis and deep caries that might otherwise need endodontic pulp therapy if the caries is completely removed. (you can leave some on floor only)

so it's important to remove all the carious tissues from the dentinoenamel junction and the lateral walls of the cavity then having a good seal between the tooth & the restorative material preventing micro leakage, remember that we don’t keep caries all around only we keep caries in the area where we are afraid of pulp exposure.

Rational for this treatment based on observation of odontoblasts , can be induced to reduce their secretry activity in response to reduced infection challenge. So if sealed secretry more quickly the tertiary dentine more thus increase the distance from pulp to carious dentine.

It is done by :

 1- the one step excavation :- By excavating as close as possible to the pulp put a protective liner & restore the tooth with permanent filling without the need for second visit.

2- the step wise excavation :- this is done over 2 steps, the first step is the removal of large carious dentinewith a carbide round bur leaving a carious mass over the pulp covering it with GI, then after 3-6 months we will have tertiary dentine so less susceptibility to exposure or irritation to the pulp and we can then remove the remaining caries & place of the definitive restoration . the most critical step here is the placement of a well sealed restoration.

Objectives :- we don’t want to enter to the pulp. changing the cariogenic environment in order to decrease the number of bacteria, close the remaining caries from the biofilm of the cavity and to slow or arrest the caries development.

The decision of Which method to use depends on the case, the patient, the tooth. but most of the time we use the step-wise excavation if we guarantee that he will return after 3-6 months.

**3)Direct pulp capping**

when the tooth has a small carious or mechanical exposure with a normal pulp, so this exposure is capped with MTA or CaOH then we put a permanent sealing restoration .

Objectives :- to maintain the vitality of the tooth, post treatment clinical signs & symptoms of sensitivity, pain or swelling should not be evident, pulp healing & reparative dentine formation should occur.

Mostly in traumatic that has inflammatory response .

**4)Partial pulpotomy : carious or traumatic exposure :**

Carious : we isolated, irrigated but bleeding can not be stopped in few mins : so inflammation is deep in tissues and we need to remove inflamed pulp .

In the past we removed all the inflamed pulp up to cervical and cleaned the pulp champer but today we depend on clinical judgment and remove only the apparent inflamed part.

Indications :- In young permanent tooth for carious pulp exposure in which the pulp bleeding is controlled with several minutes, the tooth must be vital with the diagnosis of normal pulp or reversible pulpitis.

The technique :- the tissue beneath the exposure is removed for a depth of 1 mm to 3 mm so you have to remove until you feel that you have a healthy pulp. The best way to remove the coronal pulp tissue is by using a high speed diamond bur.

So you have to try to remove all the caries before proceeding into the pulpotomy, pulpal bleeding must be controlled by irrigation by sodium hypochlorite or chlorohexidine then it is covered with CaOH or MTA.

 the CaOH has been demonstrated to have a long term success. We use the non-setting CaOH first then another layer of the sitting CaOH liner then the filling or MTA which is better for the patient.

 CaOH has a high ph that promote anti bacterial effect. But the problem is that it is soluble and may dissolve and leave a space.

MTA results in more predictable dentine bridging & pulp health, it has a long term sealing ability & stimulates a high quality & greater amount of reparative dentine, so MTA must be 1.5 mm thick should cover the exposure & surrounding dentine followed by a layer of light cure resin modified GI.

The restoration that seals the tooth from micro leakage is essential for the success of the treatment & establishes environment that will prevent any further future bacterial contamination.

🡪 🡪 For traumatic exposure 🡨 🡨

The upper anteriors are the most affected, they may have complicated fractures involving the pulp, so it is indicated in immature incisors with vital pulp that includes complicated crown fracture.

the smaller the size of the pulp exposure, the better the prognosis “ 1-2 mm” better prognosis also there is a very important factor which is the time when the patient presented, these two factors are very important for the prognosis of the tooth.

The inflamed pulp tissue beneath the exposure is removed to a depth 1 to 3 mm to reach the deeper healthy pulpal tissue.

Removal is carried out by high speed diamond bur with copious irrigation,

Pulpal bleeding is controlled using sodium hypochlorite or chlorohexidine &the site is then covered with CaOH or MTA again then we seal by a layer of resin modified GI & then restore the tooth.

 We have to re-evaluate in one month & then once every 3 months for the first year to monitor the vitality & root development.

 We use white rather than gray MTA esp. in the anterior teeth to decrease the chance of discoloration.

 The remaining pulp should be vital after partial pulpotomy with no adverse clinical signs & symptoms like sensitivity, pain or swelling.

 There should be no radiographic signs of internal or external resorption, abnormal canal calcification or periapical radiolucency, continued root development for teeth with immature roots & apexogenesis (it is a root formation and it is a histological term used to describe the continued physiological formation of the roots apex, formation of the apex in vital young permanent teeth can be accomplished by implementing the appropriate pulp vitality.

 The objective of apexogenesis is sustaining a viable hertwig's root sheath to allow a continuing development of the root length for a more favorable root crown ratio, and maintaining pulpal vitality to all the remaining odontoblasts to produce thicker roots to decrease the fracture possibility, promoting normal root closure to have a natural apical constriction for root canal fillings if needed, generating dentinal bridges inside the pulp.

Good luck:)