PULP THERAPY OF PRIMARY TEETH –sheet 1

Pulp therapy of primary teeth includes: indirect pulp capping, direct pulp capping, pulpotomy, pulpectomy.

Aims of pulp therapy of primary teeth: to maintain integrity and health of primary teeth and their supporting tissues.

\* The difference in primary teeth is that you have the option to take them out, because they will exfoliate at some point and will be replaced by permanent teeth, so you have to make a decision either to treat or extract based on the patient, dental history, dental status and medical status.

So in primary teeth you have the option to take it out or treat it based on several factors.

* + But in general we prefer to treat and maintain the primary teeth they are important in :
1. Digestion and assimilation of food.
2. Maintaining a space for permanent teeth to erupt (so the best space maintainer is the primary tooth itself) , so we don't like to take them out before their natural time of exfoliation because space maintainers have many disadvantages like caries and food accumulation.
3. Helping the patient to get the best occlusion.

4- Prevention of infection, if we treated the tooth before it gets infected that will prevent pain and taking medications.

\*Infection may cause resorption of primary tooth and it may affect also permanent teeth.

\*Sometimes we prefer to take them out, for example if we have an infected primary molar with local infection, it will affect the underlying premolar especially in early stage of development, and then development of turner tooth may occur. In this case you have 2 options either to take it out or treat that tooth, but if we have a resorbed root we prefer to take it out.

How to know when to extract primary teeth or not? We have to do proper treatment planning.

**Treatment plan:**

Any treatment plan should be based on a thorough history, examination and appropriate investigations. It should take in consideration patient's medical, dental and social status.

* Any planned treatment should include consideration of :
1. The patient's medical history
2. the value of each involved tooth in relation to the child's overall development (for example , we always prefer to keep E's as much as we can but D's sometimes we prefer to take them out)
3. alternatives to pulp treatment
4. Restorability of the tooth.

**Medical factor**:

When you take the medical history it gives you the direction of treatment, if we have:

* 1. Patients at risk of extraction for severe disorders like hemophilia, every effort should be made to preserve the tooth and prevent extraction, any patient with bleeding disorders we prefer pulpectomy rather than extraction.
	2. Immune-compromised child who suffer from primary disease or treated by chemo-therapy or transplantation, we go for extraction rather than pulpectomy to prevent the risk of residual infection.

 3. Patients with congenital heart disease, we go for extraction.

 4. Patients with diabetes that have a high susceptibility to infection, we go for extraction.

 So we always prefer to maintain the primary tooth, but when we have a risk of infection we have to extract it.

* **Dental factor:**

 We have a number here which is 3 in the guidelines of society of American pediatric dentistry 2006 (minimal number of extensively carious primary molars teeth that require pulp therapy to go for treatment ) when the patient have more than 3 carious teeth the patient may not cooperate with us .

\*Dental factors guide us to either take the tooth out or leave it:

1-general oral condition of the patient

if the patient has less than 3 of extensively carious primary molars that require pulp therapy , you can treat them all (the patient can tolerate up to 3 pulpotomies , if more than 3 they go for extraction) we try to preserve E's and extract D's .

\*It’s not a rule, but in general when you find a patient with 8 carious molars, it is very difficult to do pulpotomy for this 8 molars

* 1. If we have hypodontia (most probably missing of lower second premolar) we have to treat the tooth and preserve it as much as possible.
	2. Tooth itself might guide you to what you should do, if the tooth is not erupted we prefer to keep it and do pulp treatment rather than take it out.

\*The worse type of extraction when the permanent first molar is erupting (not erupted yet) so we should treat the primary tooth to prevent mesial migration of the permanent first molar).

* 1. If the tooth is not restorable (badly destructed) we go for extraction.
	2. If we have internal root resorption on x-ray in primary teeth, we go for extraction.
	3. large number of extensive caries involving pulp (more than 3) , we go for extraction
	4. If the roots of primary tooth are resorbed (about 2/3 of the root is resorbed) and it's symptomatic, and it is near exfoliation, we go for extraction rather than try to keep it there.
	5. Balancing extraction , if we extract first primary molar on right side and the primary molar on the left side needs pulp therapy

\*we can put a space maintainer on the right side and do the pulp therapy for the left side primary molar.

\* Or extract the left first primary molar out to maintain balance.

And that depends on the case.

 We do this balancing extraction in C's & D’s, but don't do it in E's.

* 1. Extensive pathology of acute facial swelling that necessitates emergency admission like cellulites, it should be extracted.
* **Social factor:**

 If the patient is:

* + - 1. Regular attender.
			2. Good compliance.
			3. Positive parental attitude .

We go for pulp treatment (pulpotomy or pulpectomy) and we know they'll comeback for review.

If the patient is:

1. Irregular attender.
2. Poor compliance.
3. Unfavorable parental attitude.

 The patient won't come back so we go for extraction

* **Diagnosis :**

 Clinical diagnosis is derived from:

1. Comprehensive medical history.
2. Review of past and present dental history and treatment including current symptoms and chief complain.
3. Evaluation of the area associated with chief complaint by questioning the child and parents, we start with the child but also we need to ask parents because their description is clearer than the child's description.

 Ask about location, intensity, duration, stimulus, relief and spontaneity of the pain.

We talk to the child to obtain a rapport but you have to talk to the parents to get the state of the pain.

1. Extra oral examination as well as intra oral examination soft and hard tissues.
2. Radiographs, most of time if you suspect pulpal involvement you would go for apical x-ray rather than bitewing x-ray.

 Clinical test such as: palpation, percussion and mobility.

**Taking history:**

* + Taking a good history is important; you talk to the child first, and then get more details from parents.
	+ If they are coming in pain, you need to take a good history of pain, it will guide you towards what you to do for the involved tooth..
		1. History and characteristic of pain are important in determining whether the tooth pulp is treatable or not and this will affect the prognosis of the tooth.
		2. selection of appropriate treatment for the tooth is essential in its long time prognosis

Ex. if the tooth required pulpectomy and we do a pulpotomy, we might get rid of the immediate symptoms (the pain will relief for a certain period of time, but actually it’s not the appropriate treatment in this case) so mostly after a month, the patient will come back with a failure of pulpotomy, abscess will develop and u will end by pulpectomy which was the appropriate treatment from the beginning.

* + 1. Presence or absence of history of pain is not as reliable as in permanent teeth.
		2. Degeneration of primary pulp even to the point of abscess formation without the child recording pain is very common.

 **It's hard to explain .. why?! :**

* Children interpret pain differently than adults.
* Children may be distracted by their high level of activity, and they go complaining to their parents from the pain too late .
* Children have been shown to be poor historians when reporting the severity of the pain.
* Children aren’t good at describing subjective symptoms of pain and if the dentist ask the child a leading question, false positive and false negative results may occur.

most of the time, children try to guess and let u hear what u want to hear , and it might be false negative or false positive , So we don’t always depend on their description and we should ask the parents about the symptoms that the child had suffered from .

 **History of pain :**

* toothache at meals or immediately after, may not indicate extensive pulpal pathology , It could be due to food accumulation in a carious lesion (pressure) or due to chemical irritation of food over a carious lesion , so if it is only associated with meal time most probably there will be no extensive pulpal pathology.
* Momentary pain which disappears on removal of stimulus i.e. following thermal stimulation indicates that pathology is limited to the pulp chamber.

If pathology is limited to the pulp chamber we can do vital pulp therapy: indirect pulp therapy, direct pulp therapy, pulpotomy. If the pathology is extended to the radicular area we go for pulpectomy or extraction.

* Reversible pulpitis is a provoked pain by thermal, chemical and mechanical irritants and once the causative irritants are removed, the pain theoretically ceases.
* teeth exhibiting provoked pain (not spontaneous) of short duration (doesn't last for long time) , relived with over the counter analgesics , or by brushing or upon the removal of the stimulus and without signs & symptoms of irreversible pulpitis , have clinical diagnosis of reversible pulpitis and are candidate for vital pulp therapy (indirect pulp treatment , direct pup cap or vital pulpotomy).
* teeth diagnosis with a normal pulp, requiring pulp therapy or with reversible pulpitis should be treated with vital pulp procedures (indirect pulp therapy , direct pulp cap ,pulpotomy ).
* A (spontaneous pain) sever toothache at night and the child can't sleep , indicate extensive degeneration in the pulp and the pathology extends to the radicular area (so it's irreversible pulpitis) , so we go for pulpectomy or extraction.
* spontaneous toothache of more than momentary duration occurring at any time means that pulpal disease has progressed too far for treatment with a pulpotomy ( pulpectomy or extraction ).
* Spontaneous or irreversible pulpitis is a constant or throbbing pain without stimulation and may last a long time even after the causative irritants are removed.
* Spontaneous or irreversible pulpitis is associated with extensive degenerative changes extending in the root canal if pulpotomy is not indicated.
* So in general if the child can't sleep at night , we don't go for pulpotomy , we go either for (pulpectomy or extraction).

\*\*\*pulpotomy is not indicated when we have a history of irreversible pulpitis >>question in the exam.

 **Clinical examination :**

* Ccareful intraoral and extra- oral examination is essential in arriving to the correct diagnosis.
* Cellulitis due to an infected primary tooth indicates that this tooth is non-vital, most of the time we will go for extraction.

If we see an abscess or draining fistula it's either a pulpectomy or extraction because irreversible damage to the pulp occurs.

How can we tell if the abscess is from E or D? By vitality test, x-ray or using the probe very gently to check for mobility, try not to use percussion…mobility is another indication of severely diseased pulp.

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* An access of fistula in primary molar presents in interradicular area .
* Fistula clinically will present at the junction of attached gingiva and the alveolar bone, Options of treatment in that case are either pulpectomy or extraction , not vital pulp therapy depending on patient and the tooth itself .
* Pulpal inflammation in primary molars precedes its exposure.
* most primary molars where caries had involved more than half of the intercuspal distance, manifested pulp inflammation involving the entire pulp horn, but rarely the root canals tissue and it's the ideal indication of vital pulp therapy.(pulpotomy)

\*in the past they rely on a rule that said (if you see a broken marginal ridge, go for pulpotomy) , most of the time in D's that could be the case , because in the broken marginal ridges at least the pulp horn adjacent to the carious area will be affected and extensive inflammation in the pulp may occur even if u do a regular filling it will fail.

Nowadays, the approach has been improved toward indirect pulp therapy rather than pulpotomy.

Usually in class 2 especially in D's when they are extensive , it will require more invasive treatment .

E's if we have occlusal caries , usually the choice will be indirect pulp therapy

* Inflammation of the pulp in primary molars develops at early stage of proximal carious attacks, and by most of the proximal caries, is manifested clinically the pulp inflammation is quite advanced.
* Abnormal tooth mobility is another clinical signs that may indicate a severely diseased pulp.
* When such a tooth is evaluated for the mobility, manipulation may cause the child to feel pain, so be gentle (to check for mobility use the probe very gently)
* Sometimes pain is absent even with advanced mobility, this means that the pulp is in more advanced and chronic degenerative condition
* Pathological mobility must be distinguished from normal mobility in primary teeth near exfoliation, we start by comparing with the contralateral tooth, most of the time they have equal level of mobility we have to take an x-ray.
* Sensitivity to percussion or pressure is a clinical symptom; suggest an inflammation that has progressed to involve the periodontal ligaments.
* Care should be taking in interpreting the results, as the children give a lot of false positive (they are very sensitive).
* In children, do a gentle percussion with the tip of finger and not with mirror handle.

We don't use electric pulp test in primary molars because it leads to false positive results.

**Radiographic examination :**

* Preoperative radiographs are a must before pulp therapy.
* It provides important information that will affect the diagnosis and treatment modalities.
* So we don't go ahead for any treatment before taking x-rays
* most of time we need periapical x-rays
* Periapical radiograph provide necessary details for the tooth and the surrounding structures.
* Interradicular radiolucency and resorption are indications for extraction.
* Bitewing radiographs may also be requested
* But always you get a better details and underlying successor with periapical radiograph to decide if pulp therapy is necessary or not.
* A radiograph may be misleading (the radiograph is taken too early) if it doesn't show the inter-radicular radiolucency but the patient is complaining from symptoms of irreversible pulpitis (severe pain and mobility), that because it doesn’t develop sufficiently to be shown in radiograph.
* faulty radiograph is more in upper arch due to the superimposition of the permanent successor, the appearance of inter-radicular area may be masked in that case and you have to take a supplemental radiograph with another angulation to show details more clearly.
* In general radiograph interpretation is more difficult in children than in adults.
* The roots of primary teeth undergoing even normal physiological resorption often present a misleading picture or one suggestive of pathological change.
* The proximity of the carious lesion to the pulp can't always be accurately determined from the radiograph. What often appears to be an intact barrier of secondary dentin protecting the pulp may be actually a perforated mass, irregular calcified and carious materials , so we try to treat the tooth because the pulp near that area may develop extensive inflammation
* Internal resorption (which is an incidental finding), usually indicates chronic inflammation and the activity of giant cells causing resorption of the dentin.
* Internal resorption creates few symptoms and usually detected as an incidental finding in radiographic examination and should be considered as a form of irreversible pulpitis; usually we extract the tooth and place space maintainer in such cases.

**Therefore the dentist needs to correct the comprehensive information based on medical history , dental history , history of pain , Radiographic findings , clinical examination , pulp test deliver the successful pulp therapy ,but we always have failure rate .**

**No total reliable method to determine the histopathologic status of the pulp that has 100%** **certainty.**

Now we'll talk about different modalities of vital pulp therapy for primary teeth diagnosed with normal pulp or reversible pulpitis: ( not irreversible pulpitis)

Before we start we have to know that we should work under rubber dam otherwise we have to put suction and cotton rolls on both buccal and lingual sides of the tooth because it'll affect the prognosis of the treatment to minimize the contamination at the treatment site.

 Options of management:

* Protective liner
* Indirect pulp treatment
* Direct pulp cap
* Pulpotomy

**1- Protective liner**

A protective liner is a thinly-applied liquid placed on the pulpal

Surface of a deep cavity preparation, covering exposed dentine

Tubules, to act as a protective barrier between the restorative

Material or cement and the pulp.

When you feel that you have deep cavity you can use the protective liner, you remove all the caries then you end up very close to the pulp so you put the protective liner, examples of protective liners:

1-Calcium hydroxide

1. Dentine bonding agent
2. Glass ionomer
* Placement of a thin protective liner is at the discretion of the

Clinician (each one should know if he\she needs to put the protective liner or not )

* In a tooth with a normal pulp, when all caries are removed for a

Restoration, a protective liner may be placed in the deep areas of the

Preparation then we put the filling material.

Objectives of the protective liner:

* To preserve the tooth’s vitality, promote pulp tissue healing and

Tertiary dentine formation, and minimize bacterial micro-leakage

* Ideally adverse post-treatment clinical signs or symptoms such as

.Sensitivity, pain, or swelling should not occur

**-indirect pulp treatment**

Indirect pulp treatment is a procedure performed in a tooth with a

deep carious lesion approximating the pulp but without signs or

symptoms of pulp degeneration (the patient has deep caries but he is not complaining of signs and symptoms of pulp condition, he feels pain at meal times and when drinking cold water but this pain is alleviated by brushing in this case we go for indirect pulp capping).

The pulp is judged by clinical and radiographic criteria to be vital

and able to heal from the carious insult.

The idea from using indirect pulp capping is:

To arrest the carious process and provide conditions that help the\* formation of reactionary dentine beneath the stained dentine and remineralization of the remaining carious dentine To promote pulpal healing and preserve the vitality of pulp tissue.

\*indirect pulp capping has a high success rate. sometimes when we do pulpotomy for a tooth, we save this tooth but resorption is accelerated, so we end up losing this tooth sooner.as a result, we try to keep this tooth vital to keep it longer by indirect pulp capping.

Procedure:

1-Removal of all caries at the enamel-dentine junction (all walls are clean) then we remove the caries lying directly over the pulp region and this removal is judicious, which means that we judge to remove or not to avoid pulp exposure, then we remove caries until we feel that we are so close to the pulp and exposure might happen then we stop. So the caries surrounding the pulp is left in place to avoid pulp exposure ..

2-Placement of appropriate lining material to promote healing and repair .

3-Definitive restoration to achieve optimum external coronal seal

(ideally a stainless steel crown, it is the best to achieve coronal seal)

Examples of lining materials

* + Dentine bonding agent
	+ Resin modified glass ionomer
	+ Calcium hydroxide
	+ Zinc oxide/eugenol

Glass ionomer cement

* The use of glass ionomer cements or reinforced zinc

Oxide/eugenol restorative materials has the additional advantage

Of inhibitory activity against cariogenic bacteria.

* there are 2 techniques to do indirect pulp treatment:

**1- ART** (Atraumatic restorative technique): it is a technique of removing tooth decay with hand instruments, and restoring the cavity with adhesive restorative material, most of the time we use glass ionomer .

Atraumatic/alternative restorative technique (ART) has been

endorsed by the World Health Organization as a means of

restoring and preventing caries in populations with little access

to traditional dental care (used in community dentistry, outside the clinics) Because circumstances do not allow for follow-up care, ART mistakenly

has been interpreted as a definitive restoration.

**2- ITR** interim therapeutic restorations utilizes similar techniques but has different therapeutic goals.(used in clinics).

ITR may be used to restore and prevent carious lesions in very

young patients, uncooperative patients, or patients with special

health care needs,(when you have patient with multiple carious teeth it’s helpful to excavate caries and to put glass ionomer (ITR) but this is just temporizing to relieve symptoms, to decrease bacteria … then we go for definitive restorations) or when traditional cavity preparation and

or placement of traditional dental restorations are not feasible

and need to be postponed.

Additionally, ITR may be used for step-wise excavation in children with multiple open carious lesions prior to definitive restoration of the teeth (the patient is cooperative but has multiple open caries then ITR is useful here).

Also ITR may be used in erupting molars when isolation conditions are not optimal for a definitive restoration ( if there is partially erupted 6 with poor oral hygiene or patients with MIH so we excavate and put glass ionomer until the full eruption of the molar) or in patients with active lesions prior to

treatment performed under general anesthesia.

The use of ITR has been shown to reduce the levels of cariogenic oral

bacteria (eg, mutans streptococci, lactobacilli) in the oral cavity

immediately following its placement. However, this level may

return to pretreatment counts over a period of six months after

ITR placement if no other treatment is provided.

It's mostly successful in class 1 caries on E,s more than D,s.

How do you do it?

The ITR procedure involves removal of caries using hand instrument(excavator)

or rotary instruments with caution not to expose the pulp.

Leakage of the restoration can be minimized with maximum

caries removal from the periphery of the lesion. Following

preparation, the tooth is restored with an adhesive restorative

material such as glass ionomer or resin-modified glass ionomer

cement.

ITR has the greatest success when applied to single

surface or small two surface restorations (in small cavities and in E,s more than D,s especially if there is already broken marginal ridge) .

Inadequate cavity preparation with subsequent lack of retention and insufficient bulk can lead to failure. Follow-up care with topical fluorides and oral hygiene instruction may improve the treatment

outcome in high caries-risk dental populations, especially when

glass ionomers (which have fluoride releasing and recharging

properties) are used.

Some authors have recommended that indirect pulp treatment can be

undertaken as a two-stage procedure.

Initial caries removal is achieved without the use of local

anesthetic and a reinforced zinc oxide eugenol or glass ionomer

cement restoration is placed (preferably GI cement)

 After 1–3 months further caries removal is carried out under local

Anesthetic.

No precise method has been developed to determine how much

caries to remove; it is reliant on good clinical judgment(some dentists recall the patient after 3 months, they give local anesthesia and they remove the GI and clean the caries then they put the final restoration (ideally stainless steel crown) )→this is the two stage procedure .

Other investigators have reported a higher success rate when

indirect pulp treatment is performed as a single visit procedure (they remove caries as much as they can from the walls and the pulpal floor and then they put GI filling and stainless steel crown and that’s it ) → one stage procedure, so no need to go in another time to avoid pulp exposure.

We do it most of the time as one step, no inclusive evidence to do it as one or two steps.

Randomized control trial study: partially caries removal is an effective technique in primary molars and partially removal caries is a reliable minimally invasive approach in primary teeth.

Treatment took place under rubber dam and decayed dentine being removed completely from the lateral walls of cavity. Pulpal walls receive partial or total caries removal. Teeth were restored with calcium hydroxide and composite.

Results: partial caries removal is a reliable minimally invasive approach in primary teeth and the retention of caries dentine doesn’t interfere with pulp vitality. Partial caries removal has the same success rate as the total caries removal and it has a lower incidence of pulp exposure and it has a lower operative time.

Current literature indicates that there is inconclusive evidence that it is necessary to reenter the tooth to remove the residual caries.

Several studies have reported success rates (an absence of

Symptoms or pathology) of over 90% at 3 years follow-up.

Success appears to be greater in second primary molars than first

primary molars.

Indirect pulp capping has been shown to have a higher success imp:

Rate than pulpotomy in long term studies .It also allows for a normal exfoliation time ( one of the disadvantages of the pulpotomized tooth is the resorption even if there is no symptoms then we might lose the tooth early on and then you need a space maintainer.

Therefore, indirect pulp treatment is preferable to a pulpotomy

when the pulp is normal or has a diagnosis of reversible pulpitis

The success of the technique appears to be highly dependent on

achieving a good external coronal seal, which will effectively cut

off the nutritional supply for any remaining dentinal bacteria and

will prevent further bacterial micro-leakage (it's very important to seal it using Stainless steel crown).

It has been shown that failure is 7.7 times more likely in a tooth

restored with an amalgam than one restored with a preformed

metal crown.

Adhesive restorations have also been shown to provide optimum

protection from marginal leakage in pulpotomised primary molars (if we couldn’t put stainless steelcrown or if the tooth is about to exfoliate we can put adhesive restorations like composite) .