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slides

handout

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We will talk about cracks and fractured teeth, it's an important subject because it's a common thing.

### Terminology

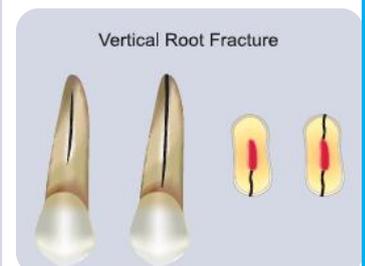
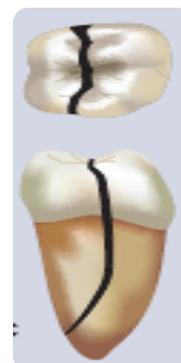
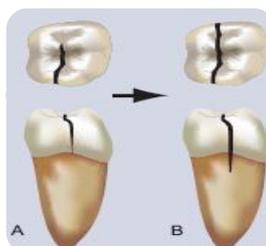
**Cracked tooth syndrome:** this was a term used to describe teeth with cracks but this term is not accurate because a syndrome is multiple of symptoms occurring together characterizing a specific disease, but the crack is not a disease so we can't say cracked tooth syndrome, and it's not a pathological entity it can cause a disease but it's not a disease itself.

Because the diagnosis of a crack is very tricky they try to classify the symptoms and if the patient has certain symptoms all together then we can say that he has crack tooth syndrome.

There were many theories trying to diagnose the crack and most of these theories were based on mechanical approach of diagnosis, and many ways have been suggested for the treatment and they were all based on mechanical aspect also so they treat it as a disease rather than a cause and they didn't consider the pulp status so we shouldn't use this approach.

There is another way to classify cracks in teeth, the AAE they have classified the defects in teeth into 5 categories

- 1- enamel infractions (craze lines)
- 2- fractured cusps
- 3- crack tooth
- 4- split tooth
- 5- vertical root fracture



But as you can see there is a little bit of confusing terminology between them and there is some overlap between them.

The doctor's PHD was about cracks and they came up with these simple 3 categories to classify them rather than 5

- 1- craze lines
- 2- cracks
- 3- fractures



And these defects can progress into each other so craze lines can progress into cracks and cracks can progress into fractures, so craze lines actually are the cracks in enamel.

Cracks can happen in both directions from inside the tooth to the outside and vice versa but mainly in sound teeth it happens from **outside to inside**, from enamel cracks progressing into dentine and then to fractures and this is actually not very common in the population because you need to have a very high occlusal load on the tooth for this to happen or to eat on a hard object because the tooth itself has a protective mechanism for that, the enamel is not uniformed, the dentine property are not uniformed and the dentino-enamel junction works as a protective mechanism as well because there is a mismatch between the mechanical properties between the enamel and the dentine and that will cause the crack to stop at the dentino-enamel junction.

Where as in restored teeth things can happen in a different way because we are doing treatment for the tooth and we can create the crack inside the tooth and it can progress from **inside to outside**.

So craze line are enamel infractions and they are not reaching the dentine and if they reached the dentine we will call them cracks , usually you don't have to do any treatment for craze lines unless in some cases where the patient has pulp symptoms and there is nothing wrong with the tooth except those craze lines we can use some unfilled resin like bonding agent just to seal those craze lines.



This is how craze lines look like, they are most commonly seen on anterior teeth and they are vertical lines, horizontal lines can happen but usually they are caused by a blow but the ones that are created by the occlusal function are vertical lines.

On posterior teeth they can cross the marginal ridge and the can extend on the buccal and the lingual surfaces as well so they are not really horizontal lines we can find them on the occlusal surface where the maximum load exist.

So cracks are defect in teeth where the two fragments are still joint and it affects enamel, dentine and it can extend to cementum if the root is involved or it can extend to the pulp as well and in this case usually the patient will need some sort of treatment because he will have symptoms but not all cracks create symptoms so if there is no symptoms you don't have to treat them.

So cracks can be vertical, horizontal or it can be crack in a cusp in a mesiodistal direction.



Fractures on the other hand are just like cracks but the two fragments of the tooth are separated or one of the fractured part are totally missing



Fractures are just like cracks they can affect enamel, dentine, cementum or even the pulp and the treatment here varies from restoration up to extraction if there was hopeless prognosis

In cracks and fractures they are either starts from the root and end in the crown or they were already start from the crown and for the coronal ones there must be a high stress point and enough tensile load for them to happen and usually they happen from inside to outside because of sharp edge of a restoration and that's why we do roundation all the time or it can happen from undermined enamel due to caries, and it can happen from outside to inside in sound teeth due to high occlusal load.

Coronal cracks and fractures extend in the mesiodistal direction, this is the most common presentation for them, it doesn't have to cross the whole tooth it can affect only one marginal ridge also it can happen in a buccolingual direction and it can affect one cusp.

These cracks terminates at the CEJ they can finish anywhere **supragingival** , **supracristal** or **subcristal** so it can go straight and then go obliquely or they can go vertically down to the root. Pulp involvement is possible in either or depending on the location of the crack.

Cracks in the root:

They can originate in the root or they can be apical extension of coronal crack (most likely mesiodistal crack on the proximal surface) , here we have high stress concentration site or after root canal treatment (end of metal post ,dentin defect, sharp edge or stick in the canal or ledge that is sharp, and the buccal and lingual extensions are (I don't know the word)

Less likely to create defect with hand filing (circumferential filing and very slight turns) in comparison with rotary.

Reciprocating create less defect by movement clockwise and counter clockwise

Also these cracks can occur in intact teeth as well, as reported in Chinese population in molars that have attrition (sign of bruxism or clenching).

So these cracks can extend toward the periodontium (cementum) , they go in buccolingual direction not as the coronal , so it can affect one surface like the buccal , they can terminate around different levels of the ~~root apical, middle or going all the way~~ towards the crown.



**The most common susceptible tooth** was the mandibular first molars, because of the wedging effect of the maxillary molar in the central fossa .

**The most susceptible cusp** is the nonfunctional cusp and that's because of some anatomical variations such as narrower buccolingual direction, thinner enamel on the cusps since enamel can protect tooth and dentine from load, and steep cusps (lingual cusps are much more steeper so can create more stress and there is lack of support on lateral excursions because they are non functional cusps so nothing is protecting them from the outer surface.

**The most susceptible roots** is the mesial root of mandibular molar, it is related to the shape of the root, more like oval and the canals are oval , mesio buccal root of maxillary molar and the roots of maxillary premolars because of not being circular.

Circular is the best so you can spread the stress uniformly.

**Done by: Mohammad Yousef**

Most susceptible **root** to crack:

- the mesial root of the mandibular molar
- the mesio buccal root of the maxillary molar
- Roots of maxillary premolars

It is mainly due to the shape of the root being oval (circular roots are the best and more resistant to crack formation because they can spread the stress uniformly, any other shape will have a stress concentrating site)

In the **lower arch** the most susceptible tooth is: the mandibular molar

In the **upper arch** it is: the maxillary premolar not the molar because molar has an oblique ridge that protect it

### **Diagnosis**

The general principles in any endodontic examination are:

- Taking history to get a provisional diagnosis
- Examination
- Tests, radiographs, and everything we do upstairs to confirm the diagnosis
- investigations
- assess the tooth and put your treatment plan

### **Typical symptoms of cracks**

Usually patient complain of pain to hot and cold drinks, pain upon biting on either application (when you press on the tooth) or on release and often it is a chronic problem (months or years)

But the symptoms vary considerably because cracks are **not a disease, it is the cause**

The symptoms will be caused by pulpal damage (reversible, irreversible pulpitis, periapical lesions)



\*Hence the diagnosis is for the status of the pulp and the periodontal tissues\*

The symptoms will depend on:

- whether the problem is due to a crack or a fracture
- The extension of them (is there a pulp involvement or not)
- The position (is it in the crown or the root)
- stage of pulp disease by the time the patient present for treatment
- if the tooth is root filled (the pt might not have symptoms)

Diagnosis of pulpal status:

Pulpitis, reversible or irreversible depends on the severity and duration

(Initial sharp pain then dull pain that last (lingering) that the typical symptom of irreversible pulpitis)

Infected canals can be necrotic or pulpless

Periapical status

Previous root filled canals can be infected

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We get the provisional diagnosis by getting full history from the patient

If the patient couldn't sleep from the pain that a sign from irreversible pulpitis

When you examine u will confirm the diagnosis and of course you should be able to identify the cause of the problem it is part of your diagnosis

**Etiology** might be caries, break down of coronal restoration or it can be a crack

Why these are consider as the causes for pulp diseases?

Because they are pathway for bacterial penetration

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=So a patient came with a pain on biting

The differential diagnosis might be:

- a crack
- apical periodontitis from infected/necrotic canals
- lateral periodontitis it can be caused by a crack if it effect the root, fracture or periodontal disease

So by doing our examination, visual, tactile, soft tissue, cold test electrical test, periapical test, periodontal probing we can confirm the diagnosis

### Examination of a crack

The same old examinations plus

Tactile sensation, use a probe ~~to pass it on the surface and feel a catch~~



Magnification microscopes, loops can be used alone or can be used in combination

It is preferred if you do probing for all the teeth, it doesn't need to be done only for cracks, you need to examine the periodontal tissues around the tooth

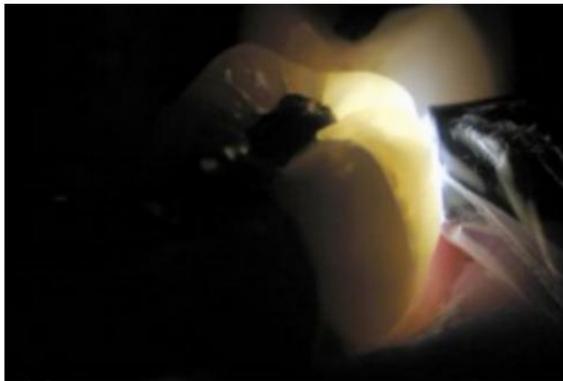
So you walk the probe and might find isolated periodontal defect , deep narrow pockets and usually they are associated with a crack or a sinus tract ( it doesn't have to be a fistula or a drainage sinus it can present itself as a deep pocket but there will be pus discharge form it)

The deep pocket location will depend on the crack location/extent of the crack; if it is buccal it will be buccally if it is mesiodistal then mesiodistal and so on

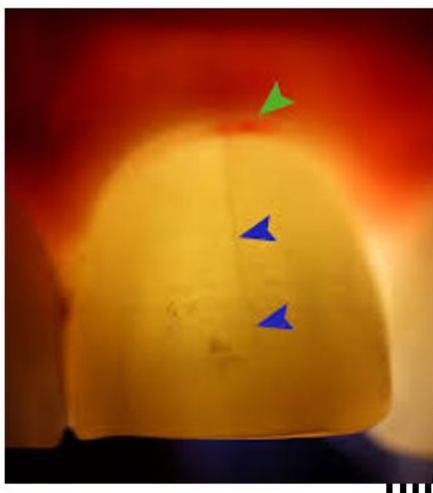
Another important tool to use is the **fibro optic light**,

You have to remove any other light sources in the clinic for a better contrast and it will be even better to use a magnification loops with it

You light the tooth, you will get an area that is shinning and area that is dull and between them a line, that is a crack



What about this picture?



I can see a line but both sides of the tooth are shinning, **it is craze line**

It involve only enamel

So a crack will block the light if it involves dentine

Another tool to use **only** when suspecting a crack it doesn't have to be done for every tooth

It is the test for biting pain



We have a tooth slooth and fracfinder



They are plastic instruments which have pointy parts on one side that you place toward each cusp and the flat surface of it will be on the opposing teeth

We ask the patient to bite and we look for pain on application, release or both

Other from these two instruments

We can use anything like slow speed bur head, suction, cotton rolls, wooden wedge

Sometimes some patients will not have any pain although they have a crack why?

This test is **not reliable** because it depends on the direction of the force in relation to crack position,

the force must induce some fluid movement within the dentine in order for the patient to feel pain

Another examination is to use radiograph

Fractures are the easiest to detect (you can see separated parts)

You can also take multiple views to see the separation



Cracks you won't see you see with a crack **tooth** like:

-Widening of PDL space

-adjacent bone loss

-radiolucency in the furcation area (the crack might be extended to the pulp floor)

any separation However what can are the **changes around the**



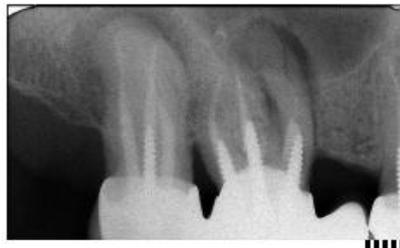
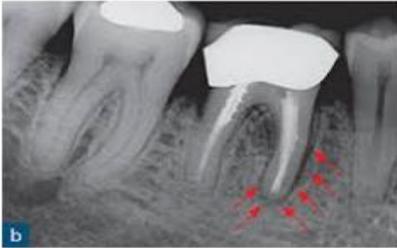
-Horizontal, mesial, distal bone loss

- J-radiolucency when you have a vertical fracture or?? In the root

-Fracture lines or spaces along the root canals fillings

-dislodgment of retrograde fillings

(If you are doing surgery and you got a retrograde filling dislodge you will suspect having a fracture in the root or a crack)



ALL these tests were done before we remove the restoration

Do you think restoration will hinder your vision of a crack?

=YES, it will

Remove ALL restorations to allow a thorough visual inspection to identify the position and extent of the crack/ fracture even if we see a crack before removing we need to check again after removing , you can Use fiber optic light or magnification

We can apply some stains such as methylene blue , you can do it on the outer surface, dentine or root in surgery

Doctor doesn't recommend it especially if you are working in an aesthetic zone it can cause permanent staining and it takes time , some people leave it under the filling and then in next visit they check it again .

Here it has been used to surgical assessment

### ◆ **Surgical assessment**



"It is a way to confirm a diagnosis of a vertical root fracture or a crack

If we don't have any other diagnostic tools we can raise a flap and see the crack

You might read that you have to wedge?? To check if it is a crack or a fracture

Doctor doesn't recommend that because doing that mean you will extend the crack or fracture further ( I'm not sure about this part and it is not mention in the slides >.< )

### **Management**

First , what is the significant about a crack ?

From a Mechanical aspect:

- it is a weak point ( a stress concentration site ) it might lead to Potential cause of tooth loss later on
- It allows flexing of the tooth
- Cause fluid shift and there will be pain

Hence they thought of splinting the crack with orthodontic bands , crowns , onlays because they thought of it as a mechanical problem thinking it won't progress if they did that

But it is a biological problem

### **Biological aspects**

Possible pathway for bacterial/ toxins penetration into the root canal system of teeth

Potential cause for pulp and periapical disease

If you leave it there, you will have unfavorable outcome

You also have to think about dentine, it is permeable

There are dentine tubules so even if your crack isn't extended to the pulp it can still affect it

Because dentine is permeable to bacteria toxins

And that why Cracks should be removed

By Shahad waheed ( second part is done >.< )



Last exam good luck everyone

-What is the significant about the cracks? We diagnosis that there's a cracks what does that mean??

-know we will talk about mechanical aspect so it's a weak bond that will be progress to the fracture and lead to potential causes for the teeth loss in the future (extraction)

-its stress concentration area that allow flexing the tooth, shifting the fluid and cause the pain

-so it's important to splint the cracks using the orthodontics band since it consider mechanical problem.



—-from the biological aspect its consider a potential pathway to bacteria and toxin that penetrate the root canal system and lead to the disease.

-Dentine permeability is also taken into consideration.

- the dentine has dentine tubules so even if the crack is not extended toward the pulp it still has an effect on the pulp because the dentine is permeable to bacterial toxin even the bacterial cells are too small but still has effect on the pulp.

- So I think about it as biological aspect and that's why the cracks should be removed, don't leave them on the teeth so usually you need to remove them.

- There are 2 studies was done on the patient that has reversible pulpitis because of the cracks , one of the study removed the crack put temporary filling and follow it then put the crown (onlay) while the other ones put directly the crown so what is the differences between them?

- Both are done on reversible pulpitis but one study has the number of the teeth require endo treatment is very high the symptom will be continuous until it became irreversible pulpitis, while the study that removes the cracks only had 6% compared to first one that had 21%.

- This is the only evidence show that is better and more protectable to remove the cracks.

- If the cracks reach to the root but not deep, no periodontal involument, you can remove it as possible, put restoration and follow up.

- Usually you need to put the tooth in the investigation,we remove all caries ,all restoration all cracks ,and that will allow full assessment of the teeth and I can see if the pulp involve or not,check the remaining tooth structures, because it's important to check it before finish your treatment to know if the tooth was restorable or not, what is the type of restoration should be used, all these information must be known before you finish the RCT treatment ,that's why you will know your long term prognosis will give the indications about prognosis for treatment as well .

- so by this you can able to tell the pt if his teeth was good and can spent long period of the time , or can put crown , bridges or used as abutment .

- It's important to investigate and as part of it after remove the caries ,cracks ,the crack help you to assess the restorability because leaving that crack is actually defect.

- so prognosis will depend on the position of the crack for example the Dr show the pictures that has a crack on the crown its can be supragingival ,equaingingival ,subcrystal you can do crown lengthening for it ,it could be fine it's give me a good prognosis .

- it could be fair if really subcrystal and very deep that is dental problem.

- other example is fair bcz its verticals crack even remove it but still there's microcrack that can still split the tooth so it's less prognosis since anything in the root is poor or hopeless.

- So it depend on the position of the cracks what ether is terminate, obliquely or vertical which is consider fair.

- fair is still good while hopeless ,poor consider problem .

- and it's also depend on the extend of the crakes if its involve the pulp ,so if its on the pulp roof really its need the endo treatment.

- other one it might be poor due reach the pulp floor , its communicating with the canal so it shouldn't be treated it need the extraction due direct forward for bacteria to the pulp [poor prognosis].



— So the management would be depend if the tooth is vital,irreversible,reversible or necrosis which mean need an Eudo treatment.

- We start with the vital teeth , remove the restoration ,decide if the crack was coronal then you remove it and put restoration , but if the defect was on the root we go for the extraction because already it will be vertical root fracture.

- Then put the liner (CAOH),and temporary restoration, we need to put the protective temporary restoration because we doing the temporary treatment restoration to relieve the pt pain &protect the tooth from farther fractures.

- This is similar to what you do in the vital pulp therapy,you don't put the restoration directly , you put proper temporary restoration and return the pt after 2,3 months, do checking for pulp by doing pulp sensibility &radiograph...so if all things is good then you put the permanent restoration so it's the same principle.

- So now just we do GI+SSC,which is important to use SSC.

- RCT is indicated 1- if you have pupal perciapical disease previously,or at the beginning or during the follow up so if the pt return with the pain you will open the access for him.

- 2-Pulp involvement, crack that reach to the half of the teeth in the pulp chamber.

- 3-Amount of teeth remaining is minimum and you need some sort of intra coronal retention then we might need to do elective endo treatment as post for example then we put definitive restoration,

- For definitive restoration, it should have cusp coverage ,we can't use any onlay ,amalgam just normal amalgam ,they have to have overlay or cusp protective or overlay&crowns.

- The Dr. is prefer overlay which is more conservation and don't need more preparation.

- The main idea is to have cusp protection .

- Sometimes altered procedure might needed like orthodontics...if have subgingival fracture for example.

- The extraction is indicated if there's radicular cracks or fracture that indicated hopeless prognosis or if there's coronal crack with peridonal pulp involvement.

- What ether involvement the root or pulp chamfer these are consider poor prognosis that need to be extraction.

- Or after remove everything ,remaining insufficient teeth structure for any type of restoration ,so it's not restorable go for extraction.

- The other option may be applicable on multirooted teeth which is hemisection(root section) which mean if there's vertical Root fracture on the MB aspect so I will take this part from the root instead of the whole teeth and it has own indication.

- As temporary restoration you can use (ketac silver ) which is GI cement, resin modified &ketac and the Drs prefer it due presence of the silver so easily can see and removed because of colour contrast,but if you use any tooth coloured it could be hardest to remove.

- Its stronger material, less sensitive to moisture during the setting and later on ,less brittle

- SS band used to retain the temporary restoration and prevent fracture or cracks.

- Actually ,the Dr use these interim materials for all the teeth all the time.



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- Always if you don't have a lot of remaining tooth structure try to do the coronal seals.
  - Its need enough thickness of TF for good coronal seal& adaptation.
  - So you use small wet cotton pallet, adapt it and close all the space since any space lead to coronal leakage.
  - Sometimes we use (ketac silver ) to build up the missing wall because the TF that used doesn't protect the teeth from fractures, while the ketac silver it will do chemical bonding with the tooth structure and prevent fracture as protection measurement.
  - Its easy to do ,the Drs always use in her cases in endo.
  - The flow charts stander loop technique ,it just tells you how should deal with cracks.
  - its for only reversible and irreversible pulpitis.
  - so we have to remove restoration if the root involves

we need to go for extraction, but if the pulp exposed by caries or cracks you might need to do RCT depending on caries.

- Caries can treat by vital pulp therapy, but cracks need to open endo ,post needed or elective endo, reassessment in days&weeks if theres resolve to the problem then do review and restoration.
- Tooth fractures in root filled teeth :
- When we do RCT we try not to put the teeth under the risk for root fracture, there's 3 predisposing factors for vital teeth which is occlusion ,anatomy.....
- The idea is that the root filled teeth has an extra risk factors, these are bonds that are caused by improper treatment so in root filled teeth we have factors related to the pulp tissue loss which is reduction of proper perception ,decrease of moistures, dehydration that would be partial , the effect of enzymes and host enzyme this will be contribute to the increase the risk.
- Host enzymes and bacterial enzymes can effect on dentine prosperities and fracture risk.
- Factors related to root canal treatment itself:
  - remaining of tooth structures mainly at the cervical area , so don't do extensive coronaly preparation ,extensive access cavity mainly in the cervical area or using for example GP size 6 in order to widen the orifice which is lead to loss of cervical dentine that works as protective tissue against fracture.
  - Since the cervical area consider the higher stress area in the teeth so be careful once you do the access cavity or preparation and avoid excessive tapered canal that has loss of the cervical dentine mainly the inner dentine that contain a lot of moisture and a lot of properties (which is resilient) while the outer dentine is more brittle that's why more inner dentine we remove the less likely prognosis.
- Temporization:
  - This is a protective measures used SS band and GI
  - mechanical properties of dentine can be affected by irrigation, intra canal medicament as well, defect in the dentine canal wall due mechanical preparation by file ,root canal filling specially by using lateral condensation or even the vertical that could be create the defect by any stress, also iatrogenic excessive vertical forces during root canal filling as once use a lot of forces so you hear the sound as (tick).
  - Factors related to restored of dental treatment teeth that would be loss of coronal &radicular root structure mainly the marginal ridges.



— — Once the tooth has 4 remaining wall this is the best prognosis, the stiffness of the tooth decrease once loss the one marginal ridge by 46%, if we go MD toward 2 marginal ridge and involve them the stiffness will be decrease to 63, so its important to do cusp protection once loss of the marginal ridge to prevent flexure causing cracks.

- As more coronaly remaining wall, decrease the risk of coronal fracture and decrease the risk of root fracture due no flexure result.

- Ferrule effect, result due stress distribution inside the tooth, post retained restoration either fiber post or metallic.

- Ferrule effect is important for coronal cusp coverage and using teeth as abutemet will be increase extra load

- .

- Factors that related to occlusion : its overlap between vital or root filled that both are exposed to the risk of bite force, anatomic position if (ant, ,post tooth) ,parafunction, malocusion all these lead to extra load ,anatomy ,physiology of the tooth for examples: tight tooth that found mainly in the mandibular molar, oblique ridge on the upper molar which decrease the risk ,shape of the root, shape of crown, aging (increase a sclerosis in dentine), root development ,young teeth ( has thin root ,risk of the fracture is very high because of no enough tooth structure).

**Done by: Islam Al-Shobaki**

