**Procedural errors in root canal treatment**

**Sheet #5**

Procedural error is any mistake that occur at any point of root canal treatment procedure

Classification of procedural errors : access cavity related , instrumentation related , obturation related

**\*\*So lets start with the first one ; access cavity related :**

1. **Treating the wrong tooth** : it happens due to 2 reasons ; either due to misdiagnosis or due to inattention . so make sure to make the right diagnosis and try to remember the tooth that you are going to treat it or what it looks like

If you treat the wrong tooth you must continue the endo and be honest with the pt and tell him what have you done

1. **Missed canals** :

 a- MB2 in the upper molars are the most canals to be missed (studies showed that the MB2 is almost always present in the 1st molars “96%” )

 b- another canal in distal root of the mandibular molar ( its called radix intomalaris)

 c- second canal in the lower anterior teeth (its very easy to be missed , because our access from the lingual side , so you will always find the buccal canal and miss the lingual . so if the pulp chamber look suspicious or you suspected another canal ; look lingually )

d- second canal in the lower premolars

e- third canal in the upper pm

how to prevent this ? by preparing adequate access cavity with complete deroofing and always expect there will be an extra canal , use magnification loops , and always check the periapical xrays or if you were really disparate go for CBCT

* This pt was referred to the dr with acute apical abscess , the mesial root has massive hypercementosis around it so this was really tricky ! because if the dr extracted that tooth there will be a high risk of osteonecrosis , so RCT must be done and it must be a successful one . the dr took CBCT to be able to see all the canals
1. **Damage to existing restorations** : its very common these days , example : the Hollywood smile (veneers) and porcelain crowns . to prevent this >> always use water coolant and use diamond bur ,don’t use heavy force and be careful to the clamp
2. **Crown fracture** : we all know that the root canal treated tooth is more susceptible to fracture , for 2 reasons >> first because the tooth has lost significant tooth structure and second the proprioception is reduced . so you always restore the tooth after RCT is done and reduce the occlusion on it
3. **Perforations** : its communication between inside and outside the tooth in the oral cavity and the pdl . So before you start , know how much you need to drill to avoid perforation ; if you drilled enough and you still couldn’t find anything stop and ask for help or take xray because maybe you are in the wrong direction and you must change the angulation.
* Reasons of perforation :

 a- iatrogenic (the most common cause) :

 1- calcified canals (you must take an xray

 2- overzealous instrumentation at the root curvature (strip perforation )

 3- inappropriate post space preparation

b- pathologically : example ; caries ,root resorption

* the prognosis of perforation : if perforation happened and you were working under **aseptic** conditions and you sealed the tooth perfectly then there wont be any problem, but if there was **infection** or you didn’t seal the tooth properly the prognosis is poor !
* so the prognosis depends on :

-time ( if I perforate and immediately restored the tooth the prognosis will be better than if I sent the pt home then restore the tooth after a week)

-size

-location ( perforation in the **middle** of the root has the **best** prognosis , if you go more apically it will be more difficult to seal and if you go more coronally there will be communication with oral cavity with higher chance for infection )

-adequacy of seal

* to confirm perforation :
* the first sign is bleeding (sudden and exaggerate bleeding)
* the pt complains of NaOCl in his mouth
* angeled xray with a radiopaque instrument in the suspected canal , ex put a file
* use apex locator , there will be no circuit
* use microscope
* use perio probe to locate a narrow isolated pocket which is a consequence of perforation
* management of perforation :
* always prevent
* if you perforate always try to find the right path of the canals and seal the perforation with MTA (biocompatible material) or you can seal with GI or IRM or even amalgam
* surgical approach > raise a flap and put MTA then do RCT
* ortho extrusion > if the perforation is out of the crestal bone level
* intentional re- implantation > took the tooth out and do the procedure out the mouth then re implant it ( the dr showed a case were the tooth was taken out then the root was resected and MTA was placed , be careful not to break the tooth while you are taking it out!)

**\*\* instrumentation related errors :**

1. **ledge** : it happens if you start with a large non flexible not pre curved file , so it will stuck inside creating this ledge , and if you continue pushing you will perforate . so if you create a ledge you will lose you working length . you must regain access to the canal ; bring a small file and pre curve it , its very difficult to by pass a ledge especially in molars , but if you succeeded in by passing it don’t pull the file out until you **smoothen** the wall to be able to find the right path again .
2. **zipping(transportation)** : it happens when you use NiTi file ; since it have a shape memory property which will be a disadvantage here . what happen is when the canal is curved the NiTi file try to straighten up due to its shape memory so it will cut more from the outer wall of the canal and will not stay in the canal centrally , this will cause zipping. The narrower part will not be at the apex so there wont be an apical seal, and there will be an over enlargement in the canal , so the canal will take an hourglass appearance (the canal will be wide coronally then gets narrower and then will be wide apically) ,.
3. **apical perforations** : if you did a ledge and insisted to reach the working length then you will end up with a perforation ! . perforation will lead to destruction of cementum and the periodontal ligament and as a consequence this will compromise the RCT
4. **strip perforations** : due to overzealous instrumentation . as we know the inner side of the curved root is called a **danger zone** , if we instrument the canal equally at the mesial and the distal walls we will end up with strip perforation . **Marwan abu Rass** created the anti curvature technique to avoid this perforation ; by filing against the curved wall



1. **apical blockage** : if you work shorter than the working length then every time you get in and out with the file debris will be packed at the apical part and if you didn’t do a patency filing blockage will happen at the apex . so always make sure you are reaching the full WL and recapitulate and irrigate and do patency filing always . the dr mentioned a study that have been done on old patients and measured the outcome of the RCT , they tried to determine the prognostic factors that will determine the outcome of RCT ; they found that factor #3 is achieving patency at the apex . however , other people are against patency filing because they think that it will aid in pushing the debris out to the periapical area then he pt could have acute apical abscess after the RCT !
2. **instrument separation** : broken instrument by itself inst a problem , the only problem with the broken instrument is that it will prevent you from cleaning the canal completely . so if your canal was completely cleaned and the file was broken its not a big deal . but if the canal was infected and you broke a file then there will be a problem .

\* so there are 2 causes of instrument breakage :

- cyclic fatigue: due to using old files

- torsional fatigue : by twisting the file in two different dimensions , we can control torsional fatigue .

\* Factors to consider if a file fractured :

-the most important factor is the preoperative state of the tooth (if vital its okay, but if it was infected or there was apical rediolucency then I should worry)

- at which stage the file broke > if you break it after cleaning and irrigation then its better than if you broke it at the first step of cleaning

-at which part of the root it broke > if beyond the curvature then retrieving the instrument will be very difficult

-length of the root / its curvature / proximity to vital structures

-type of instrument : s.s instruments are easier to be taken out of the canal because if you did a trough around the ss file to take it out it will stay centralized so easier to be pulled out , but the NiTi file is very fragile and has a shape memory , so everytime you try to pull it pull by ultrasonic tip it wont stay stable and you will damage the file

\* To separate the instrument :

* retrieval by using special forceps with narrow peaks , ultrasonic tips , hollow tube that troughs around the file to create a space and then stick something in to get a grip on the file to pull it out
* bypassing : if the canal is oval in shape then you can enter file 8 or 10 beside the broken file with good lubrication and go beyond it , then increase the size of files gradually and do a **good apical and coronal seal**
* fill the canal and wait to see what will happen ( we only do this if the tooth was vital preoperatively )
* surgical > apicectomy , root amputation , hemisectioen , extraction

the dr showed two cases one is example of retrieval of the instrument and the other is bypassing it .

the dr showed another case that was referred to him , the previous dentist wanted to do RCT for a 4 there was no rubberdam ,there was peripical lesion , and a broken file in the canal . dr Maaita mentioned that the root was very thin mesio distally but wider bucco lingually , so he tried to bypass the instrument but he couldn’t , so he chose to do surgery and fill the whole canal with MTA , then after a week he did apicectomy and every thing was good .

So how to reduce the incidence of instrument separation ?

* asses the complexity of the case
* do straight line access
* copious irrigation
* preflaring the coronal canal
* achieve glide path
* single use of instruments
* WL radiograph (it shows you the complexity of the case)
* Follow instruction
* Clean the flutes of file
* Do patency filing
* Avoid apical pressure

**\*\*Obturation related mishape :**

1- **over extended root filling** > if the tooth is near vital structure like ID nerve and you over fill the canal then you will get paresthesia

2- **under extended root filling** > if I do cleaning and shaping to the right full WL and obturate a little shorter then its oaky , but if the cleaning and shaping was already short and you left vital pulp tissue then its okay but if you left infected pulp tissue then it would be a problem.

3- **miscellaneous errors** >>

* NaOCl accidents : its extremely toxic , if you push it beneath the apex it’s a disaster , although its our favourite irrigant since it dissolve organic tissue . if it was extruded out the canal the pt will have ecchymosis and swelling immediately with burning sensation . if it happens; dilute it immediately with normal saline , reassure yourself and the pt , give pain killers (although its not an evidence based) , give Ab (if followed by infection ) and antihistamine , ice packs for the swelling ,and if its really serious hospitalize the pt .

To prevent this accident >> place the needle passively , use side vented needle (however the dr prefer to use the open ended needle) , don’t apply pressure only use your index finger , the needle must be moving during irrigation , use lower concentration (0.5%)

* Tissue emphysema : it’s a collection of air in subcutaneous area, it happens due to blowing air with an air syringe to dry the canal (this will lead to transmitting the infection to the periapical area ) . to prevent it use paper points , but if it happened reassure the pt. This situation could be self limiting but you can give antibiotics to prevent cellulitis
* Instrument aspiration : the dr showed a picture of a file in the intestine and after a period of time the pt died! He showed another picture of a clamp swallowed by a pt this was happened in JUH , it got stuck in the esophagus . **so always always use a rubberdam .**

Some people like to put a clamp before rubber sheet , be careful you must tie the clamp with floss , the dr showed a pic in the slides of the right way to tie the clamp (you must tie both ends of the clamp to be able to pull it out if it fractured into pieces )

If the pt swallowed instrument you must take chest xray immediately .

#Refer to the slides to see the pictures

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GOOD LUCK =D