* Radiology Sheet no. :8  
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We started talking about the actual practicality of taking radiographs, we talked about the most common radiographs that are taken inside the mouth and are called intra-oral radiographs.

as we already know , intra-oral radiographs are two types: peri-apical and bitewing radiographs.

Also, we knew that in the most comprehensive sense, the maximum number of a comprehensive radiographic examination of a patient is called ***full mouth* *series(FMS)*** and their number differ from one country to another and from one institution to another. However, idiomatically the first FMS is **18** intra-oral radiographs;14 out of them are intra-orals and 4 are bitewigs.

\*projections in the intra-oral peri-apical radiographs:

**1. Anterior set** : “ goes for both the maxilla and the mandible, so we have to think about the central projection in the upper and lower jaw and the right and left upper lateral projection and the right and left lower lateral projection”.

***a. central projection*** –focus on the two central incisors and the mid point in between and the contact point between them-.

***b. lateral canine projection***- focus on the contact point between the lateral and the canine so the distal surface of the lateral and the mesial surface of the canine should be opened-.

**2. Posterior set**:

***a. Premolar projection/set*** : include the premolars in the four quadrants. Premolars should be anterior in the posterior segment as much as we can so it is important to see the distal surface of the canine , the first and the second premolars .

We should open the contact between the first and the second premolar , we don’t care about the distal shot of the second PM because it will appear clearly in the MOLAR shot.

***b. molar projection/set.***

\*\* So if we count them we will have 6 anterior set and 8 posterior set and 4 bitewings.

\*bitewing projections: we have 2 projections;*Premolar and molar (similar to the peri-apical).*

Remember that the difference between the peri-apical and the bitewing that the peri-apical focuses **on the apices** so we really need to get the whole apex and 2-3 mm beyond the apex to have a good periapical radiograph , however the bitewing focuses **on both crowns of the maxilla and the mandible** in the same radiograph.

Other than the bitewing projections, we have another variant: **horizontal** **bitewing and vertical bitewing** ;and for the vertical bitewing the film is placed *longitudinally* instead of placing it *horizontally*, so that the longest dimension instead of being mesiodistally will be up and down so we can catch up the crystal bone level for pts who have loss in that level “ such as the periodontal pts”.

* For a good full mouth series we have to :

1. *Know the projections.*
2. *Look for the surfaces , no. of the teeth, amount of the bone and the surrounding structures.*
3. *Look how dark or light things appear “contrast”.*
4. *Check for normal anatomy which is one of the biggest things .*

That’s why geometry is one, image quality is one and mounting is another one ;because you as dentist you have to distinguish whether I’m working on the right or left side.

Some dentists may think that it could be obvious clinically which is the tooth that they are working on, however we have to know that most of the selection criteria in supplementing clinical exam with a radiograph is that we either look for a difficult disease or try to look for the extent of a present disease that do not appear clinically and here comes the importance of the radiographic examination which is a crucial supplement in extracting, drilling or filling the wrong tooth.

**How** we do that practically will be discussed in the next lecture but remember that it is all about **intra-oral anatomy** - the sinus is in the upper jaw however the mental foramen is located in the mandible-, dental anatomy- how many roots or cusps do we have, the shape of the crowns- and clues in the same film that all will be done in the clinic and are very important and crucial things to know .

* how do we mount x-rays?

>>We mount x-ray as if the pt is sitting opposite to you.

So when you take a radiograph you don’t have to think about your right or left side but think about the pt’s position ( pt’s center ) and then determine the pt’s right and left sides.

***So, you mount it as you see it!***

-Regarding to a picture that was discussed:

We can see something very distal , we can see the 6 and 7 and the area of the 8 also we can see the floor of the sinus so it is a molar projection, on the right side and it is maxilla.

Another picture:

It is a lower jaw, showing the left side and the canine so it is not a central projection ( it’s a lateral canine).

\*\* regarding to the right and left sides:

Remember that **the pt is the reference** and you should be able to locate **the midline first** then you have to think that this is a mesial tooth and that is a distal tooth so it lies on the right side to the midline for ex. so we look for the pt’s head and then we locate the midline for the side where the teeth are hidden ( not visible ).

Remember that when you deal with films , they will be located on a bench and you have to look back and forth to locate them in a correct position and to figure out the correct anatomy so it is not a simple task.

According to pictures that were discussed:

1. It is a lower lateral canine projection on the right side.
2. This is a bitewing, you see three molars and it is a left one.
3. This is a molarprojection, I see the third molar then it is a molar projection and it is a mandible since we can see the external oblique line.
4. This is a premolar although the distal surface of the canine doesn’t appear because it is not a good one but we don’t see any of the third molar so definitely it is a premolar projection.
5. It is a molar of that same side (related to pic no.4).
6. This is a maxilla since we can see the floor of the nose, we can see also the PM, the canine and the lateral so it is a lateral canine .
7. These two are central incisors, they are wide and even wider than the lateral incisors, so they are maxillary CI ( as we already knew that the wide CI are located in the upper jaw while the small ones are located in the lower jaw ).
8. This is a lateral canine projection.
9. This is a molar shot, showing of the sinus, the lateral pterygoid plate and the hamulus.
10. PM projection.
11. MOLAR projection.
12. Bitewing.
13. PM bitewing.
14. A couple of PMs.

**So**, always try to think about general anatomy and dental anatomy because that always come in handing, you don’t really need to look inside the pt’s mouth and see where is the amalgam or is it located in the upper or lower jaw or on the right or left, actually this is unscientific and clumsy unless there is a mixing up in between pictures of different pts.

* In order to determine the right and left side of the film accurately you should notice the dot located on the film, so while checking the taken radiograph this dot should be directed toward you for many different reasons, first of all this dot corresponds with the white color that should be placed against the teeth , additionally the lead foil which prevents scattering and protects the film should be directed away from you (away from the dot ) ; you can’t image through the lead foil since it tends to attenuate the photons needed to take the image.
* PARALLEL TECHNIQUE :

Remember that last time we talked about the holders , and we said that the ones that are used in JUH are color coded and each side (whether anterior or posterior) has its own type and components and we need to have things always done at the same time and all these go back to this concept which is the PARALLEL TECHNIQUE.

What does this technique means? And why it is so important while taking image intra-orally?

This technique has ***3 things*** that should be known:

1. *The film should be placed in the mouth parallel to the long axis of the tooth.*
2. *The central rays should be directed 90 degrees (perpendicular) on the film and indirectly on the long axis of the tooth since they are parallel to each other.*
3. *In order to achieve that we need a film holder since nobody is good enough in placing the film parallel to the tooth ( for ex. Anterior teeth have a palatobuccal inclination and if you place the film 90 degree to the palate that will not be parallel to the long axis of* *the tooth at all).*

***So in order to be parallel, you have to use the right holder to the right geometry.***

* There are few things that are important during taking radiograph:

1. *Object to film distance*: the distance between the object (tooth) and the film.
2. *Source to film distance*: the distance between the actual tube from where the central rays goes out and the film.

Those two are a major contributor of magnification (how much magnification do you get really depends on those distances).

So for good magnification, we need the smallest Object to film distance however to achieve parallelism you really need to go with high distance (similar to the focal spot concept) therefore the Object to film distance can’t be zero and the film is still parallel to the tooth, so what we do is that we compromise that and increase the object to film distance and then we compensate for that by increasing the source to film distance to ensure how parallel the rays are.

We may think that this doesn’t really make sense however it make more sense if we are taking **a chest x-ray** where the pt stands *in a big room* and the source is located *far away from the pt* so here the distance is measured in **meters** and you can play with the distance and decrease it as much as you can, however the task is much more difficult in taking **an intra-oral radiograph** since the distance between the film when it’s stuck against the tooth or away from it in a correct angulation is about *3-4* **millimeters**.(and this 3-4 millimeters needed to get the right angle almost doesn’t make a difference )

**So always try to be as parallel as you can** !

\*\*summary regarding the technique:

Upon taking an intra-oral radiograph it would be easy to play with the source of the x-ray , at the same time you can play with the holder to determine the object to film distance where you can push the holder underneath the tongue or beyond a mandibular tori but still you are getting a good image as long as you are parallel. so whatever the distance is since you are taking it intra-orally we consider it small in comparison to the biggest theme of things and it is always better to have a reproducibly magnified image rather than a distorted one due to the lack of parallelism since there is a fixed percentage of magnification that is known to everyone and we have to put that into our measurements. That’s why when we take the WL in an endodontic x-ray you can’t just measure and take the measurement as 1:1, instead we put a file and then take the image due to the presence of magnification that we all know about and how to deal with unlike distortion that is much more complicated.

\*\* In general we use in clinics the most sophisticated types of holders.

-Now, all what you need to do is to maintain the parallelism as much as you can although it won’t be 100% . For ex; if a pt has a very shallow palate and we can’t achieve the parallelism unless you bend the holder and then place a cotton roll , then do it.

-Some pts may have torus in their palate that can affect the depth of the palate, then you can place the film beyond the torus to avoid the pt’s discomfort, the bending of the film or the distortion of the image, and by doing this the torus will appear on the film without affecting the parallelism and the tooth will be parallel to the film. The same goes to mandibular torus.

-Now according to the way of placement , as we all knew everything related to teeth should go according to the path of insertion and removal we don’t throw things inside the pt’s mouth ;instead there is a tongue, cheeks, insertion of the masseter muscle and the buccinator muscle and you have to manipulate gently with all of these soft tissues to make sure that everything inside the pt’s mouth is inserted passively otherwise upon placing the film in the pt’s mouth and after going out to take the x-ray, you will find that the film is in place and the holder is in another place because when you put the film intra-orally and you think that it is passively positioned , the patient will push it away and the film is no more parallel if he is not comfort with its placement .

\* Another method that could be done is “**without using a holder**” in some cases such as: when the pt’s mouth is small or he has a gag reflux or you are in a hurry or certain anatomical landmark that if we use a holder will be tough or a dentist that work in remote countries or helping refugees for example and doesn’t have all up to date tools, here we don’t use the parallel technique instead we have another one that is called the ***BISECTING TECHNIQUE.***

\*BISECTING TECHNIQUE:

- It goes back to *Pythagoras* and *identical triangles*.

- here we have *two right-angled triangles*, and in order to be identical they should share a common side and have an equal angle. So how can this relate to dentistry and radiograph?

Here we have two triangles. Now, the first side is the film, the second side is the long axis of the tooth and the common shared side is an imaginary line bisecting the angle between the long axis of the tooth and the long axis of the film that’s why we call it bisecting technique.

So, they are trying to create those two right-angled triangles with a common shared side and an equal angle and then relate it to this technique by the following:

1. *The two equal angles are related to the bisecting technique where the bisecting line passes through them and divides them into two equal angles.*
2. *The right angle is determined by the central rays that falls on the bisecting line at 90 degree.*

***So,*** people who use this technique are very professional and have a good imagination to think exactly about the line that pass through the angle between the tooth and the film and divides it into two equal half and after that they place the central beam 90 degree on it.

-the benefits from this technique is that by creating the two identical triangles the side of the long axis of the tooth will be equal to the side of the long axis of the film ( image ) and by doing that we avoid any distortion in the image and we will have the correct and the closest dimension of the tooth.(as if the dimensions of the actual tooth and the image is almost the same without any obvious distortion )

The film is placed intra-orally by using either a simple holder or by asking the pt to hold it using his fingers .

So this technique requires some knowledge in anatomy and experience as well but still it is a great, valuable and supplemental technique. However, as long as you have a luxury of using a holder, then the holder is more reproducible, it makes more sense, it is much easier and allow you to get better image quality.

When we are doing the bisecting technique ,**we don’t use a holder** that used to tell us how steepy we are or how tilted we are to the right or to the left. So if we are not using a holder then we have to think about:

1. **Horizontal angulation**: if i’m placing a film parallel to the PM, from where should the rays come? Is it from the back, from down or straight …? And how this can affect the image?

-Remember that you have to go 90 degree to the contact point between the teeth so that we can see an open contact with 2 separate surfaces otherwise there will be an overlap between the teeth and no need for the image anymore since it will be useless.

* If you remember regarding to teeth setting , we have ‘A’ LINE which passes through the distal side of the canine all along the PMs AND ‘B’ LINE which passes through the 2nd premolar all along the buccal cusps of the 1st and 2nd molars , then we’ll have a nice curve where the molars tug in which means that the U shaped curve moves inward, therefore the 90 degree on the PMs differs from the 90 degree on the molars so if you are taking image for PMs then it would be 90 degree however for molars then you have to do a shift to obtain the 90 degree so you have to respect the anatomy, the ‘B’ line, the ‘A’ line and go through the arch.

1. ***Vertical angulation***: another important thing is whether I’m coming from a very high point or from a shallow point.

\_ if I’m coming from a high point then the teeth will be shorter than normal and here we may get confused with some diseases that shorten the teeth so we have to distinguish whether this tooth is a real short one or i did this shortening by getting too high. On the other hand, if I go shallow then the teeth will be taller.

Few things that help the image’s tough/hard areas:

A third molar is always a challenge, however for a nicely erupted tooth it is a considered as a normal molar similar to other molars. The problem comes with the partially or fully impacted tooth(which contributes for 90% of third molars ) so if you get a mesially impacted tooth, you can easily shot the crown however the apex will be really distal and upon trying to shot things far that much you’ll stop at a certain point because your pt is a human being, he has glossopharyngeal and vagus nerves that contribute in gag reflux. *So how could we solve this problem?*

You ask the pt for some help, you tell him that you are trying to capture an image for a third molar and you may need some help from him then you place the film covered with the holder in his mouth and ask him to push it backward as much as he can . Another useful method is to forget about the horizontal angulation concept but how ?

We have already taken a molar projection with an open contact so now we have no problem in closing it in order to get the apex of the tooth so what I do that I come distally to capture the tip in the image however the image will not be that much pretty because it is not for caries determination.

-**Endodontics** have their own holders , the holder has **a hollow** called a **basket** which gives a space and allow the holder to fit passively and bite on the whole tooth that you are working on since we don’t want the pt to bite on a file because the file may go beyond the apex or it may fracture and lost in the apical part.

\*slop technique:

*How can we know that this is a buccal or palatal root ?*

>>When we take a radiograph, it is a 2D image therefore the roots will be superimposed and you can’t tell which is the buccal one or which is the palatal one especially if they were of a same length. So , What we actually do is we take two radiographs at different angles for ex. We take a lateral canine projection then a PM projection or central projection depending on what we are trying to see then I ask myself two questions:

I place picture no.1 versus picture no.2 and ask: ***1. picture no.2 is it more mesial or distal to picture no.1.***

***2.The object that I’m trying to localize, is it going mesial or distal in picture no.2.***

If the answer of the two question **is the same** ( for ex, mesial-mesial ) then we are talking about **a lingual/palatal object** but if the image and the object goes **in different ways** then we are talking about **a buccal object**. That goes with lesions, impacted teeth, canals …

* According to a picture that was discussed:

We took two radiographs for an impacted canine ( object of interest ), one is central projection ( the original one-refrence ) and the other is a lateral canine projection ( additional one ) then we check if the second image itself goes mesial or distal to the original one ( here in this case it goes distal ) then we check for the object of interest ( canine ) if it goes mesial or distal in the second picture ( it also goes distal since in the second picture we can only see the distal side of the root however in the first picture the whole root can be seen all the way to the midline ) then we say that the object of interest is located lingually or palatally.

* Remember that such thing can’t be done statistically without taking images, you have to take two images in different angulation since it is all about shadowing.
* Children don’t have enough mouth opening so techniqually you can go with modifications. Ex; a picture that look like an occlusal radiograph but actually it is taken by no.2 film.