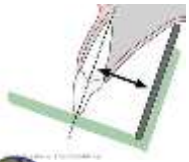
Differences Between 2D & 3D Imaging & Making the Most of 2D

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Image Acquisition





- Intra Orals – Bitewings & Paralleling Periapicals
- Image Receptor – Parallel to long axis of the tooth (& as close to tooth as possible)
- X-Ray beam at 90 degrees to receptor & tooth
- Rectangular Collimation
- Film holder & beam aiming device
- Minimise geometric distortion & superimposition & reduce scatter

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Panoramic

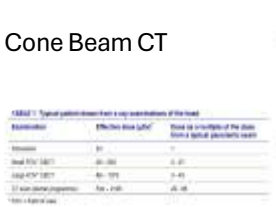


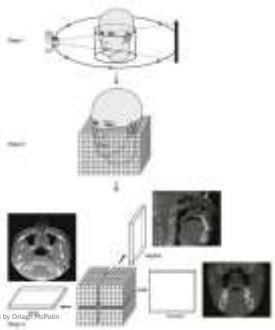


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Cone Beam CT





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Spatial Resolution

2D image pixels

3D image voxels

Isotropic – all three dimensions equal

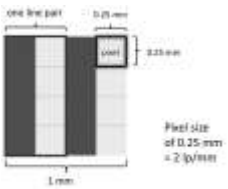


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Spatial Resolution

- Smallest detectable feature size
- lp/mm



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Spatial Resolution of CBCT

Lower than that of IO Radiography (film or digital)

Imaging Modality	Spatial Resolution (lp/mm)
Intra Oral Film	10-20
Intra Oral Digital Radiography	7 – 25
CBCT	2

- Means of increasing SR for CBCT → Smaller Voxel Size
- Smaller voxel size → Increased Dose (Increased Scatter, Noise & Scan Time)
- Important to strike a balance!

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Contrast Resolution

- Smallest detectable difference in attenuation coefficient (radiodensity)
- The ability of an imaging system to distinguish between structures that have only a small difference in density/x-ray attenuation
- Allows visualisation of subtle differences

- Relatively poor in CBCT c.f. Plain Film (PA > CBCT)
- Due to Scatter & Noise (related to the increased dose)

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Viewing Strategy

- **Systematic approach required!**
- Identify artefacts
- Review normal anatomical features / anatomical variants
- Examine Teeth (apical & periodontal tissues) URQ → ULQ →LLQ → LRQ
- Other structures (Mandibular Body/Ramus on DPT, IAC, Max Sinus and Antral Floor, Nasal Cavity)

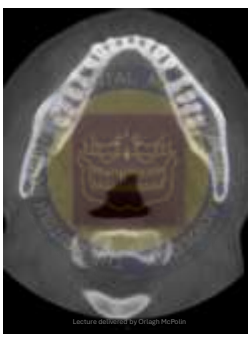
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R



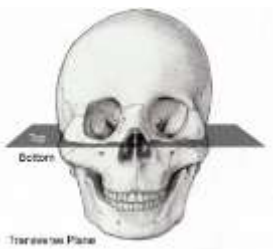
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Axial





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Coronal





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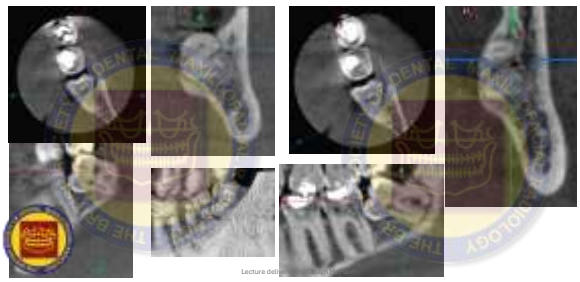
Sagittal





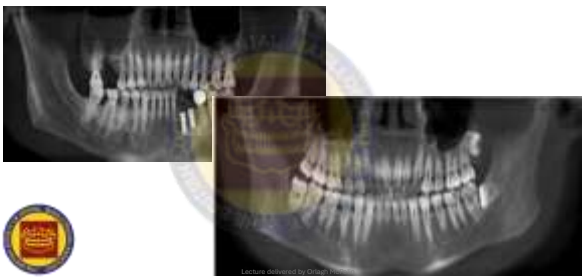
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Multiplanar Reconstruction



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Psuedo Panoramic Views



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Superimposition

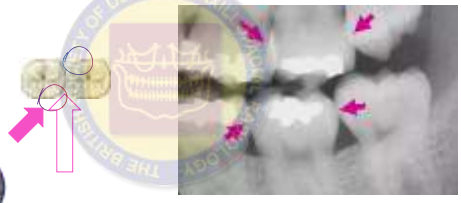
- Overlapping shadows of different parts of an object or a separate object
- Limits information, particularly related to location and shape of a lesion / object

- No information about the depth

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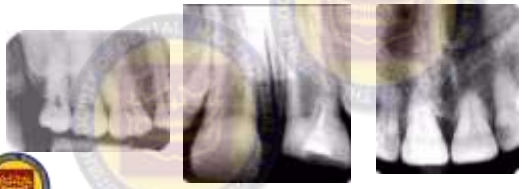
Superimposition



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2D Limitations



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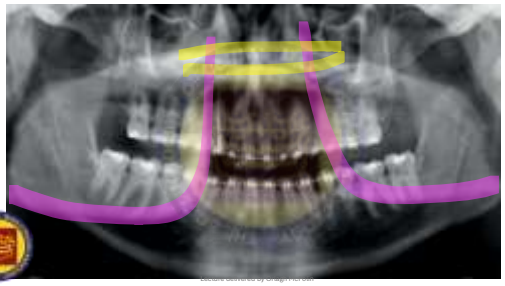
DPT Limitations

- **Structures outside the focal trough may not be evident**
- Variable magnification
- Not geometrically accurate
- **Ghost Shadows**

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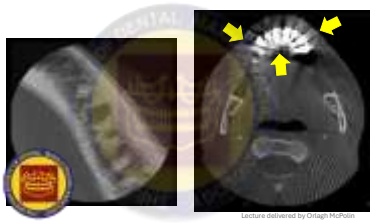
Ghost Shadows



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CBCT Limitations

- Limited soft tissue differentiation
- Artefacts – metal streak artefact, movement



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3D Advantages

- **Bone** Anatomy – width, volume, profile, undercut
- **Bone reaction** – expansion, fenestration, periosteal reaction, resorption
- Relationship to **adjacent anatomy** – IDC, Mental Foramen, Sinus Floor, Nasopalatine Canal, Lingual Canal
- **Teeth** – root morphology, fractures, resorption, root canal anatomy, periapical changes
- Cysts, Tumours etc.

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2D	3D
Superimposition	**No Superimposition**
Quick	**Shows Exact Position**
Easy Comparison	**1:1 Scale**
High Spatial Resolution	**Limitless Manipulation**
Can be straightforward to interpret	**Difficult to Interpret**
Distortion	**Multiple Images**
Artefacts	**Artefacts: Metal, Movement**
Low Dose	**Higher Dose**

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Question	2D	3D
Caries?	Yes	Possibly!
Root #?	Possibly!	Possibly!
Peri-implant bone loss?	Yes	No
Impacted tooth?	Yes	Yes
Resorption?	Possibly!	Yes
Accessory root canal?	No	Yes
Cyst/Tumour/Lesion?	Yes	Yes
Bone #?	Yes	Yes
nal involvement?	Yes	Yes
nship to 3rd Molar?	To an extent…	Yes

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SEDENTEXCT

Clinical Application	CBCT Guidance
Caries Detection	Not justified
Periodontal Bone Imaging	Only in complex cases
Endodontics and Periapical Pathosis Detection	Only in posterior teeth cases where 2D imaging is non-diagnostic or equivocal
Fractures of Teeth	Justified where conventional radiographs are non-diagnostic
Impacted Teeth for Resorption Assessment	Justified where conventional radiographs are non-diagnostic
Third Molars	Justified where conventional imaging suggests a close relationship with neurovascular canal

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Making the Most of 2D Imaging

- Artefact Reduction
- Improved Geometrical Accuracy (Root length RCT, Panoramics and focal trough)
- Minimise Superimposition of Adjacent Structures
- Maximise Contrast Resolution
- Reproducible Images (facilitate comparison over time)

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Failure in patient preparation



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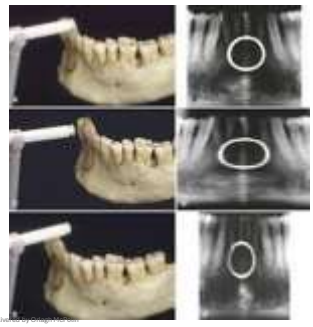


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The Bite Block





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Essentials of Dental Radiography and Radiology; Whaites & Drage; 5th Edition & Pocket Dentistry Online

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Positioning



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Positioning



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Positioning



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Normal or Abnormal?

Unusual Finding → Variant of Normal? Artefactual? Pathological?

Recognise the absence or alteration of normal anatomy to detect pathology

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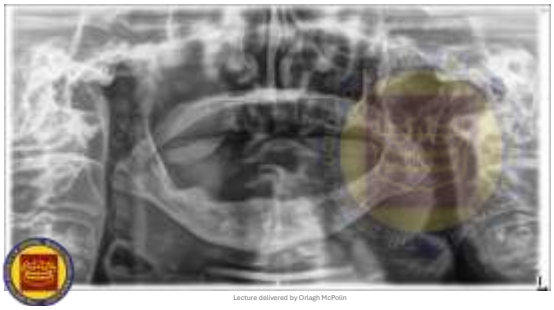
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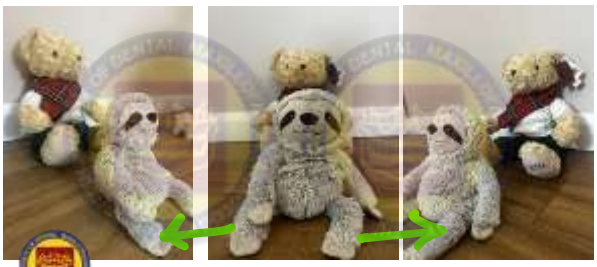
Parallax

- **Assesses depth and localises objects using Plain Radiographs**
- Impacted teeth, foreign bodies

- **Orthodontics** – will the tooth interfere with alignment?
- **Oral Surgery / OMFS** – is it better approached buccally or palatally for exposure or extraction?
- **Endodontics** – MB2 Localisation

An apparent change in the position of an object, caused by a real change in the position of the observer.

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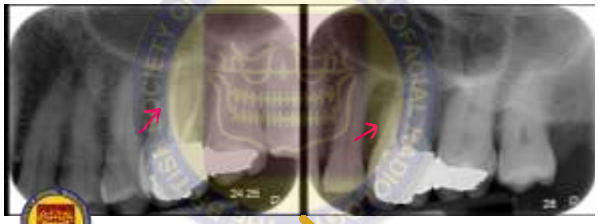
Parallax – how it works

- 2 views at an angle to each other
- Vertical Shift – periapical and oblique occlusal
- Horizontal Shift – 2 periapicals at different horizontal angulations
- **Object further away moves in the same direction as the x – ray source**
- Clarks Buccal Object Rule – **SLOB** i.e. same lingual, opposite buccal

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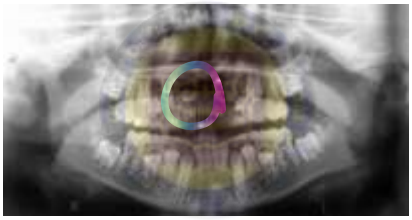
Horizontal Parallax



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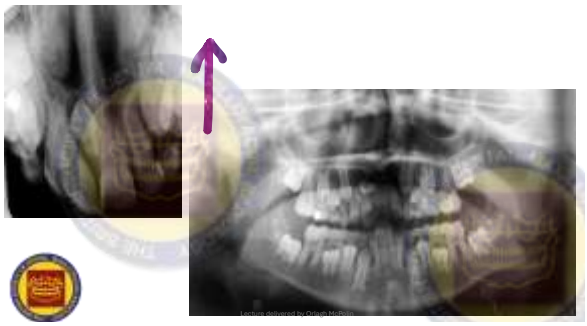
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Vertical Parallax



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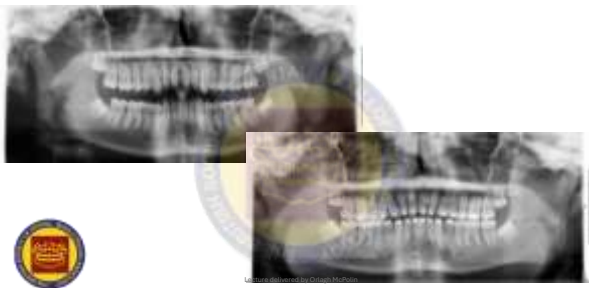
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Comparison Over Time



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Conclusions

- CBCT addresses some limitations of 2D imaging e.g. Superimposition
- Should be reserved for specific cases (i.e. when 2D imaging fails to answer the clinical question)
- High-Quality radiographs improve diagnostic yield
- Knowing "normal" helps recognise "abnormal" enhancing interpretation and differential diagnosis

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