Describe basic principles involved in panoramic radiography.
- Describe the proper techniques for preparing and positioning the patient to produce optimal images.
- Identify and correct common panoramic errors.
- Apply a systematic approach to image evaluation and interpretation.
- Improve the quality of panoramic images taken in the office.

**Top 5 Panoramic Errors**

<table>
<thead>
<tr>
<th>Technical Errors</th>
<th>Percent</th>
<th>Caused Unacceptable Image</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tongue Space</td>
<td>71.6</td>
<td>AP Position</td>
<td>54.1</td>
</tr>
<tr>
<td>AP Position</td>
<td>58.8</td>
<td>Low Density</td>
<td>40.2</td>
</tr>
<tr>
<td>R/L Not Identified</td>
<td>35.4</td>
<td>Poor Contrast</td>
<td>37.9</td>
</tr>
<tr>
<td>Vertical Position</td>
<td>31.3</td>
<td>Horizontal Position</td>
<td>24.0</td>
</tr>
<tr>
<td>Horizontal Position</td>
<td>28.0</td>
<td>Vertical Position</td>
<td>21.9</td>
</tr>
</tbody>
</table>

*Rushton et al., 1999*

1/3 of all panoramic images are diagnostically unacceptable.
**Patient Preparation**

- Explain procedure to the patient
- Ask patient to remove head and neck metallic objects
  - Earrings, necklaces, facial jewelry, tongue studs
  - Hairpins, barrettes
  - Intraoral prostheses
  - Glasses, hearing aids
- Place panoramic lead apron
  - Position high in front, low in back
  - DO NOT USE THYROID COLLAR
- Select exposure factors per patient size and stature

**Sample Exposure Guide**

<table>
<thead>
<tr>
<th>Patient size</th>
<th>kVp</th>
<th>mA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child ≤ 6 years</td>
<td>60</td>
<td>4</td>
</tr>
<tr>
<td>Child 7-12 years</td>
<td>62</td>
<td>5</td>
</tr>
<tr>
<td>Adult female, small male</td>
<td>64</td>
<td>6</td>
</tr>
<tr>
<td>Adult male</td>
<td>68</td>
<td>7</td>
</tr>
<tr>
<td>Large adult male</td>
<td>70</td>
<td>9</td>
</tr>
</tbody>
</table>

**Other factors**

| Obese, large boned, bone density differences | Increase kVp | Increase mA |
| Frail, small boned, edentulous | Decrease kVp | Decrease mA |

**Patient Positioning**

- Patient sits or stands with straight spine
- Stand-up type – grasp handlebars & step forward
- Front teeth bite end to end in bitepiece groove
- Clinician aligns the head
  - Midsagittal perpendicular to floor
  - Occlusal or Frankfort plane parallel to floor
  - Anteroposterior plane aligned with specific landmark

**Patient Positioning Errors**

- Slumped spinal column
- Horizontal or midsagittal plane
  - Tilted or rotated
- Vertical or occlusal plane
  - Chin up or down
  - Anteroposterior
    - Too far forward or too far back

**Pre-exposure Instructions**

- Patient Instructions
  - To eliminate air-spaces artifacts:
    - Swallow and press your tongue against the room of your mouth
    - Close you lips around bitepiece
    - Close your eyes
    - Remain completely still

**Slumped Spine**

- Slumped Spine - creates a pyramid or column-shaped radiopacity in midline
- Correction – instruct the patient to sit or stand tall
- Make sure chin rest is placed just below the patient's chin so the patient does not have to slump down.
**Midsagittal Error**

- Rotated
  - Side turned toward receptor is narrow, side toward x-ray source is widened
  - Severe overlapping of teeth
  - Correction – Center midsagittal plane & align perpendicular to floor

**Anteroposterior Plane Error**

- AP too far forward
  - Anterior teeth are blurred and narrowed
  - Severe overlapping of teeth especially premolars
  - Spine superimposed over ramus
  - Correction
    - Move patient toward x-ray source
    - Teeth end to end
    - Align landmark

**Occlusal Plane Error**

- Chin up
  - Upper teeth, nasal structures and condyles are blurred and widened; condyles may be cut off sides of image
  - Hard palate superimposed over maxillary teeth apices
  - Occlusal plane flat or frowned, maxillary incisors elongated
  - Correction - Lower chin down so occlusal plane is parallel to floor

**Anteroposterior Plane Error**

- AP too far backward
  - Anterior teeth are blurred and widened
  - Excessive ghosting of ramus and spine
  - Image may be larger than receptor
  - Correction
    - Move patient toward cassette
    - Teeth end to end
    - Align landmark

**Occlusal Plane Error**

- Chin down
  - Lower teeth are widened and foreshortened
  - Hyoid bone superimposed over mandible
  - Condyles cut off top of image
  - Occlusal plane has grin appearance
  - Correction - Raise chin up so occlusal plane is parallel to floor

**Patient Preparation Errors**

- Metallic objects left in place producing radiopaque artifacts.
- Lead apron placed high on back of neck
- Tongue not pressed against palate
- Patient movement during exposure
**Patient Preparation Errors**

- Metallic artifacts – failure to ask patient to remove objects in head and neck region
  - **Correction** – instruct the patient to remove glasses, jewelry, prostheses

- Metallic artifacts – improper lead apron placement low in front, high in back
  - **Correction** – place the lead apron high in front and low in back

- Tongue – palatoglossal air space created when tongue not in position
  - **Correction** – give patient pre-exposure instructions; press tongue against roof of the mouth

- Movement – patient incapable of remaining still or not instructed to do so
  - **Correction** – give patient pre-exposure instructions, make sure patient is able to cooperate

- Over exposure – high density “dark” image
- Underexposure – low density “light” image
- Incomplete exposure – exposure cycle cut short
- Cassette resistance – cassette contacts patient’s shoulder(s) during exposure
Neck and Shoulder Strategies

- Instruct patient to lower right shoulder down when the receptor approaches the sight side
- Bend right knee to lower right shoulder
- Instruct patient to hold the hand grips underhanded
- Instruct patient to cross hands and hold the hand grips underhanded
- Instruct patient to hold with left hand and dangle right arm down
- Seat patient in chair and dangle arms on each side

Panoramic Interpretation

- Anatomic assessment – several features can be used to determine anatomic accuracy including:
  - Condyles are on image - usually upper outer, at same level
  - Palate and ghost images of palate should be above the apices of the maxillary teeth, running through the lower portion of the maxillary sinus
  - Ramus width should be very similar on both left and right sides

Panoramic Errors

- Many errors can be produced on panoramic images.
- Most can be avoided by:
  - Proper patient preparation and instruction
  - Accurate patient positioning
  - Selection of kV and mA based on patient size

Panoramic Interpretation

- Features of the Dentition - visual features of the dentition can be used to assess whether the teeth, particularly the anterior teeth are positioned correctly within the focal trough:
  - No or slight upward curve of teeth
  - No tooth size discrepancy on left or right side
  - Anterior teeth in focus (see pulp canal clearly)
  - Anterior teeth shape “normal”
    - Not too narrow or too wide
    - Premolars will always overlap due to inherent x-ray beam projection to the arch of the teeth in this region

Panoramic Interpretation

- Adequate exposure – adequate density and contrast to recognize anatomic features.
  - Density - ideal density should be such that structures are not obstructed by areas of darkness i.e. areas of “burn out” or areas that are too light i.e. areas of “white out”
  - Mandibular parasymphyseal area
  - Maxilla near the apices of the maxillary teeth
  - Excessive or inadequate density can lead to failure to detect features such as unerupted and impacted teeth or even pathology

Getting the Most Information Out of Your Image
Adequate exposure – adequate density and contrast to recognize anatomic features.

- Contrast - assessed by determining if the interface between the enamel and the dentine can be seen, usually in the molar region.
- Particularly important in areas where there are multiple overlapping structures
- Inadequate contrast can lead to failure to detect features such as unerupted and impacted teeth

Basic Structures
Air-spaces
Ghosted Structures

Panoramic Anatomy

Air-spaces

RL Air Spaces Are Imaged
- Nasopharyngeal - airway of the pharynx and nasal cavity located above the soft and hard palate
- Oropharyngeal - airway of the pharynx and oral cavity located below the soft palate
- Palatoglossal - space between the dorsum of the tongue and hard palate

Single real image - some midline structures are projected in the midline and occur as a single image
- Structures tend to be located anterior to the machine’s center of rotation and the receptor
- Examples include the central incisors, incisive foramen, nasal septum, nasal soft tissue, lingual foramen, and genial tubercles
Double Real Images
- Double real images - some structures are projected bilaterally.
  - Structures tend to be located in a diamond-shaped region that corresponds to the patient’s midline from the middle of the image to the most posterior extent of the radiograph.
  - Object intercepted twice by the x-ray beam and produces two images of the same object.

Ghost Images
- Characteristics
  - Same general shape as original but does not produce a mirror image
  - Appears on the opposite side of the radiograph compared to the original
  - Appears in a higher position than the original
  - Appears magnified and unsharp (blurred) than the original.

Double Real Images
- Characteristics
  1. One image is the mirror image of the other.
  2. Both are real images.
  3. Each image will have the same proportions.
  4. Each image will have the same location on the opposite side.
- Some examples include hard and soft palate, pharyngeal airway spaces, hyoid bone and cervical spine.

Ghost Images
- Characteristics
  - Same general shape as original but does not produce a mirror image
  - Appears on the opposite side of the radiograph compared to the original
  - Appears in a higher position than the original
  - Appears magnified and unsharp (blurred) than the original.

Ghost Images
- Structures or objects that are located posterior to (behind) the center of rotation and the x-ray source tend to be ghosted onto the contra-lateral side of the image.
- Some examples include earrings, ramus, inferior border of mandible, chin rest, R/L markers on some machines.

Unusual Anatomy
Examples of Pathology
Panoramic Interpretation
Asymmetrical Condyles

Cemento-osseous Dysplasia
- Periapical cemental dysplasia
- Focal cemento-osseous dysplasia
- Florid osseous dysplasia

Bifid Mandibular Canal

Fibrous Dysplasia

Pericoronar Radiolucencies

Neurofibroma
Possible Calcifications

- Rhinoliths
- Antroliths
- Calcified stylomandibular ligament
- Calcified stylohyoid ligament
- Submandibular sialoliths
- Tonsiliths
- Pheboliths
- Calcified lymph node
- Calcified carotid arteries

Procedure

- Identify specific structures first before ascribing an abnormal diagnosis to a cervical radiopacity:
  - Hyoid bone
  - Epiglottis
  - Soft tissue of the tongue
  - Soft palate
  - Auricle

Carotid Calcifications

- Site – bifurcation of the common carotid artery into the internal and external arteries
- Location on image
  - Inferior right and left corners of the image
  - Found near the level of the C3 and C4
  - Near posterior aspect of the hyoid bone
  - 1.5-2.5 cm inferoposterior to the angle of the mandible
- May appear nodular or as 2 radiopaque bands representing calcifications within artery
Carotid Calcifications

Applications

- Implant
- TMJ
- Pathology
- Trauma
- Growth and Development
- Airway Assessment
- Pre-surgical Planning/Post Surgical Assessment

ACCURACY

<table>
<thead>
<tr>
<th></th>
<th>Average Distortion</th>
<th>Maximum Distortion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panoramic</td>
<td>3.0 mm</td>
<td>7.5 mm</td>
</tr>
<tr>
<td>Periapical</td>
<td>1.9 mm</td>
<td>5.5 mm</td>
</tr>
<tr>
<td>CT scan</td>
<td>0.2 mm</td>
<td>0.5 mm</td>
</tr>
</tbody>
</table>

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Risk vs. Benefit

- Photons Don’t Care
- What do you need to see?
  - Volume
- How well do you need to see it?
  - Resolution

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Photons Don’t Care
What do you need to see?
  Volume
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