Version

4.2

ProjectionVR™

shaderware.com

Student Workbook

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shaderware.com

Student Workbook

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Introduction

This software is used to support radiography education. ProjectionVR™ is a fully featured simulation of radiographic positioning practice. This virtual radiography™ simulator is currently supporting students studies at universities in USA, Canada, Sweden, Poland, Portugal, South Africa, New Zealand, Australia and the UK.

This workbook contains 14 Laboratory sessions that can be used in class or for individual study. It is to be used in conjunction with the Student Guide.

> "The development of virtual radiography has been shown to be a defining moment in how the teaching of diagnostic radiography is conveyed to students"
>
> Student Radiographer, 2009

> "… healthcare professionals… should learn skills in a simulation environment and using other technologies before undertaking them in supervised clinical practice."
>
> Great Britain: Department of Health, 2011

Chapter

1

Introduction to ProjectionVR™

This chapter contains four Labs that develop the students study skills, introduce concepts and terms and start to develop an appreciation of each object, it's size and operation. Students are also made aware of the equipment handling skills they will need.

Lab 1 – ProjectionVR™ syllabus (core)

Aims of Lab

- Familiarise the student with the computer lab environment.
- Introduce the syllabus and learning and teaching strategy.
- Resource the students with materials and a demonstration.

Lab 2 – ProjectionVR™ X-ray room (core)

Aims of Lab

- Familiarise the student with navigation in a computer mediated 'first person' virtual environment.
- Introduce the student to the x-ray room. Describing the equipment and procedures carried out.

Lab 3 – Scenarios, exams and exposure (core)

Aims of Lab

- Introduce the student to the console. Describing the equipment and procedures carried out.
- Introduce basic radiographic terminology

Lab 4 – Receptors, side markers and patient movements

Aims of Lab

- Demonstrate radiographic image formation on a receptor by irradiation from an x-ray tube. Students produce their first radiograph.
- Introduce & use radiographic and anatomic terminology

Lab 1 - learning from a simulator

Outcomes

At the end of the Lab, students will be able to:

1. Record observations and reflections on a provided worksheet from simulated experiences to aid future learning
2. Access ProjectionVR™ (on the provided computers), the student guide and the student workbook.
3. List the aims of the syllabus
4. Clarify expectations with the tutor.

Activities

Distribution of the ProjectionVR™ student guide to each student

Tutor walk through of the student guide while students follow and take notes

Make notes from demonstration of ProjectionVR™ simulator

Notes: (radiography specific, continue overleaf if necessary)

What are the differences between using a simulation for learning and listening to a lecture?

What questions would you like to ask?

Mind map – draw a mind map to represent the radiography room

(Turn page landscape)

Description of the ProjectionVR™ simulation syllabus

This syllabus is for students with no, or very little, experience of radiographic equipment handling; it represents 11 hours of learning time.

Aims of the syllabus

- Provide an authentic experience for the student that utilises experiential learning in a simulated, safe, environment facilitated by an academic radiographer to prepare for clinical practice.

- Expose the students to a faithful virtual radiographic model of geometry and physics; enabling exploration and familiarisation with radiographic constructs such as 'position', 'projection', 'exposure', 'receptor' etc.

- Foster student peer-to-peer collaboration to minimise feelings of isolation and difference, during a time where new unfamiliar language and environment increase student anxiety.

- Provide accurate formative objective feedback from the simulator for learning.

- School students in radiographic procedure in a behaviourist model of learning, by repeating steps until competence demonstrated.

1. **Introduction**	LAB 1 (45 min) **The ProjectionVR™ demonstration and syllabus (core)**
	LAB 2 (45 min) **Navigating the ProjectionVR™ X-ray room (core)**
	LAB 3 (45 min) **Choosing Scenarios, exams and exposure factors (core)**
	LAB 4 (45 min) **Moving receptors, side markers and the patient (core)**
2. **Radiographic technique**	LAB 5 (45 min) **Patient positioning terminology (option)**
	LAB 6a (45 min) **Radiographic projection terminology (option)**
	LAB 6b (45 min) **Radiographic projection terminology (option)**
3. **Radiographic Procedure**	LAB 7 (45 mins) **Radiographic procedural sequence (core)**
	LAB 8 (45 min) **Image criteria terminology & process (core)**
4. **Radiographic Science**	LAB 9 (45 min) **Magnification (core)**
	LAB 10 (45 min) **Distortion one (core)**
	LAB 11 (45 min) **Distortion two (option)**
	LAB 12 (45 min) **DAP, kVp, mAs, grid & SID (core)**
5. **Patient Practice**	LAB 13 (45 min) **Supine abdomen radiography**
	LAB 14 (45 min) **Supine chest radiography**
	LAB 15 (45 min) **Formative assessment**

Lab 2 –ProjectionVR™ room (Core)

Outcomes

At the end of the Lab, students will be able to:

5. Run ProjectionVR™ and manipulate their viewpoint in the radiographic room
6. Select from the available simulation scenarios
7. Correctly name objects in the radiography room.
8. Use of 'locks' and 'detents' to move a virtual x-ray tube gantry, table and Bucky
9. Name and use a virtual light beam diaphragm to collimate an x-ray beam

Activity:

a) Work individually or in pairs to read chapters 1 and 2 of the student guide at your own pace and try out the software controls mentioned.

Notes: (radiography specific, continue overleaf if necessary)   What questions would you like to ask?

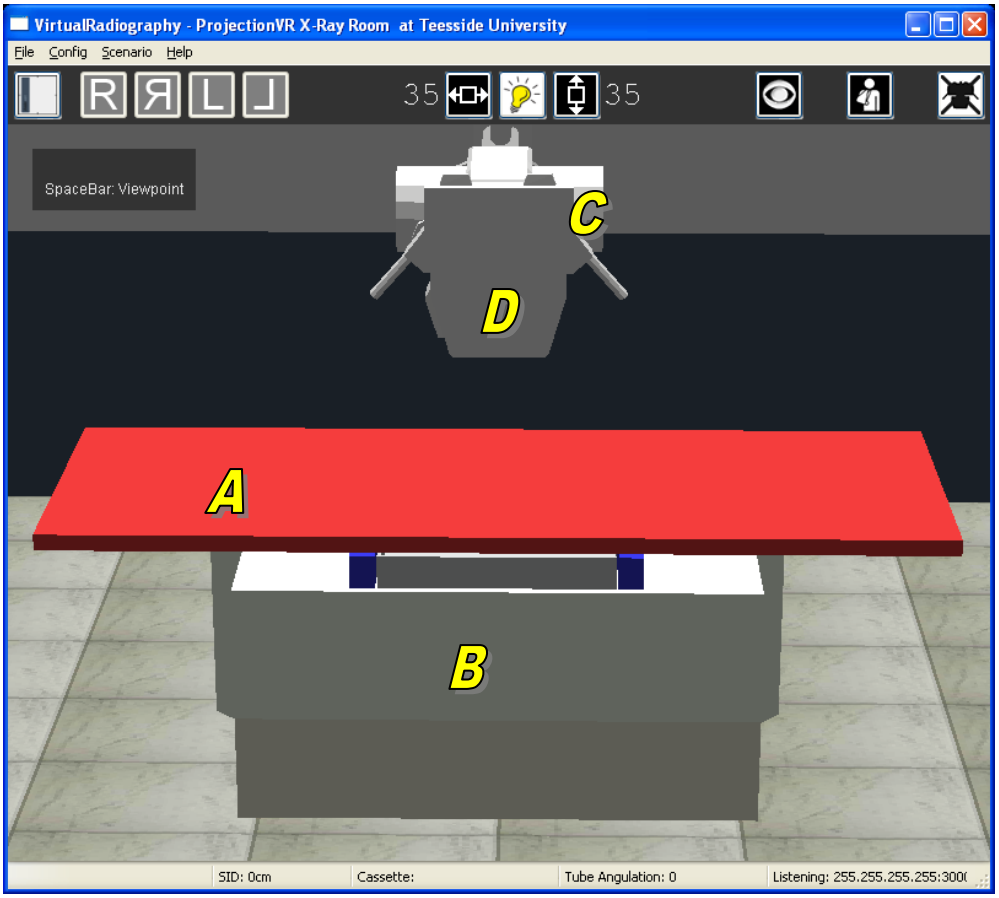
b) Review the pictures on the next page. What are the following objects?

A …… E ……

B …… F ……

C …… G ……

D …… H ……


VirtualRadiography - ProjectionVR X-Ray Room at Teesside University
File Config Scenario Help
35
35
SpaceBar: Viewpoint
C
D
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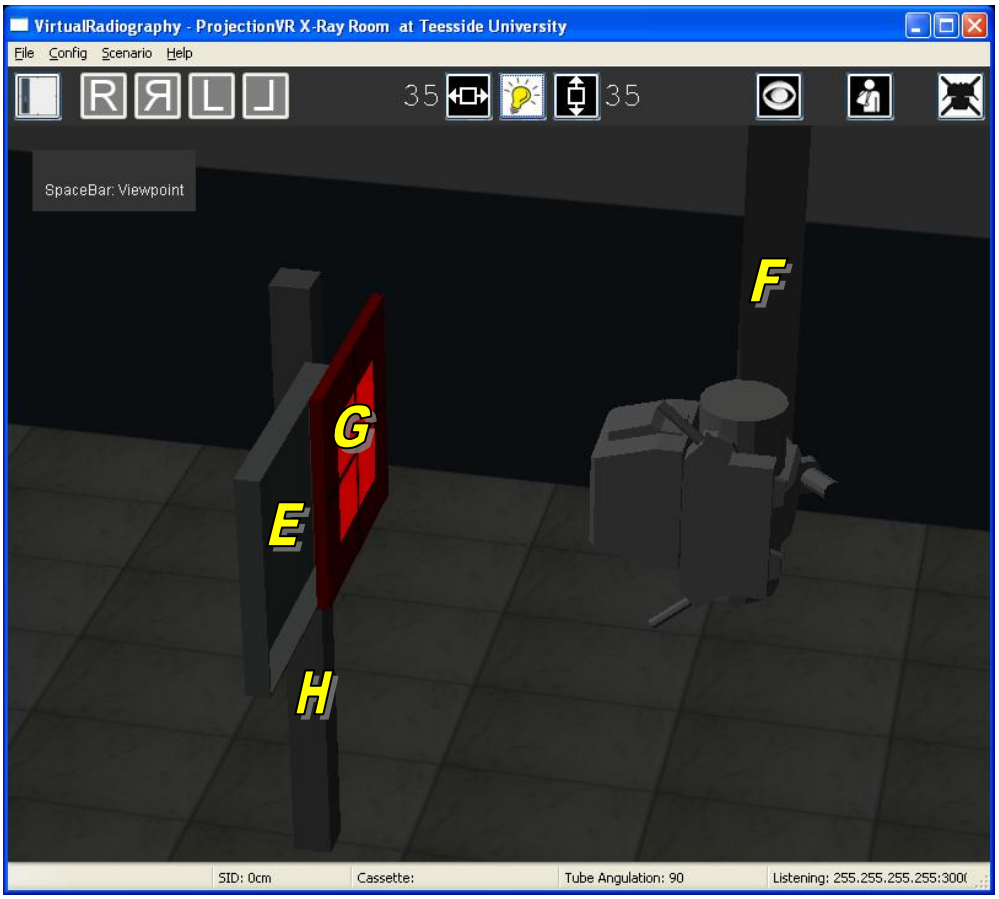
SID: 0cm
Cassette:
Tube Angulation: 0
Listening: 255.255.255.255:300(


VirtualRadiography - ProjectionVR X-Ray Room at Teesside University
File Config Scenario Help
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35
SpaceBar: Viewpoint
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SID: 0cm
Cassette:
Tube Angulation: 90
Listening: 255.255.255.255:300(

Lab 3 – Scenarios, examinations and exposure factors (Core)

Outcomes

At the end of the Lab, students will be able to:

10. List receptor sizes and select a receptor from this list
11. Alter focus, mAs and kVp values from defaults
12. Make a test exposure

Activity:

a) **Work individually or in pairs to read chapter 3 of the student guide at your own pace and try out the software controls mentioned.**

b) **Test Exposure**

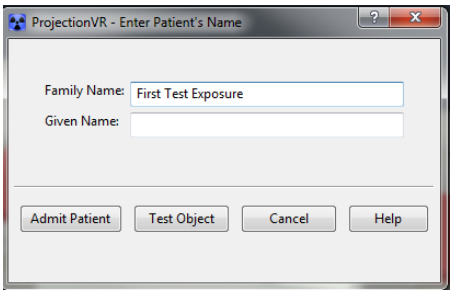
i) Open ProjectionVR™ x-ray room and console (logging in using your college unique ID if required)

ii) On the console, select the 'Examination Tab' - Select 'Quality Assurance' as the exam, 'QA TEST XR' as the study 'NO PATIENT' and 'QA TEST' as the projection.

iii) In the room, select 'trolley' from the 'scenario picker', then, 'erect', and finally 'recumbent'

iv) Select the largest receptor size. Place it on the table top.

v) Book in (admit) the test object by selecting the 'patient' icon  and typing 'FIRST TEST EXPOSURE' in the family name field. Select 'Test Object'



vi) Raise the table to working height; check the SID is 100cm (40in)

vii) Collimate to well within the receptor boundaries using the LBD

viii) Select the 'expose' tab on the console. Change the Tube Voltage to 50,000 Volts (50kV) and the Tube Charge to 10 milliAmpere x seconds (mAs)

ix) Hover the mouse pointer over the 'expose' button. When 'prep-ready' is declared, left click on the expose button and release to initiate the exposure.

x) Select the Tech Data tab. Review the resultant radiograph and exposure details.

Lab 4 – Receptors, side markers and patients (Core)

Outcomes

At the end of the Lab, students will be able to:

13. Place a receptor ON an erect Bucky
14. Annotate a receptor with a correctly oriented side marker
15. Select from the available examinations
16. Admit the patient and move them into position
17. Collimate to a given anatomical area

Activity:

a) **Work individually or in pairs to read chapter 4 of the student guide at your own pace and try out the software controls mentioned.**

b) **Shoulder examination**

i) On the console, select the 'Examination Tab' - Select 'Upper Extremity' as the region, 'Shoulder XR Rt' as the study 'erect' as patient orientation, and 'AP Neutral Rotation' as the projection.

ii) In the room, select 'erect' as the 'scenario'

iii) Select a 24 x 30cm (12 x 10in) receptor, and place it on the erect Bucky surface. Rotate it to landscape orientation.

iv) Select the 'R' side-marker and place it on the receptor to appear on the lateral aspect of the patient. Rotate it to be legible

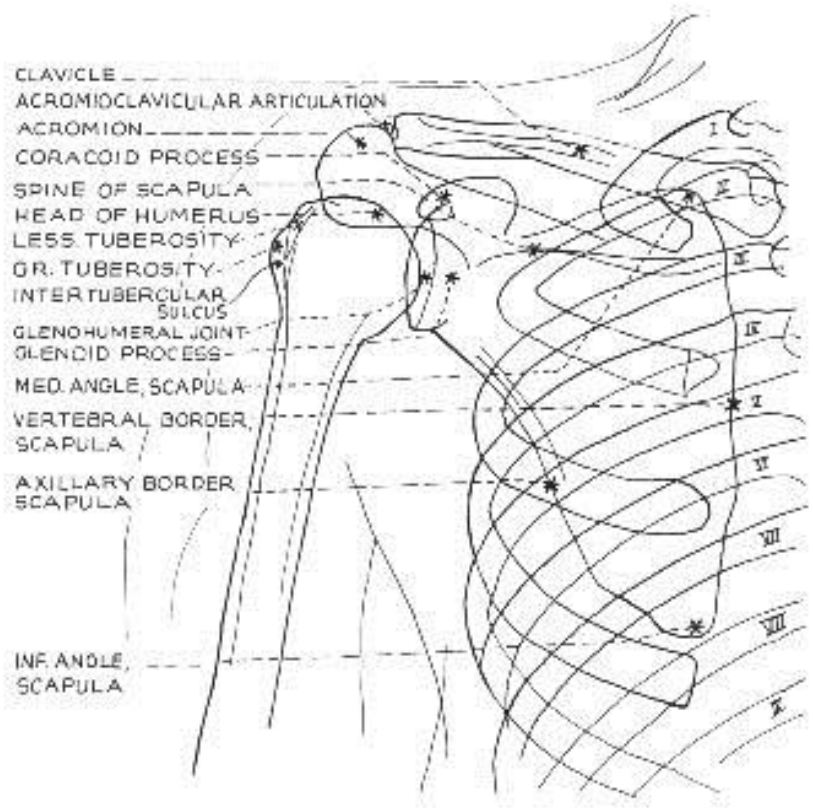
v) Check the SID and as necessary move the x-ray tube to 100cm (40in)

vi) Collimate to just within the receptor boundaries using the LBD

vii) Admit the patient into the x-ray room 

viii) Position patient, receptor, chest stand and tube to include right shoulder region as shown in the diagram overleaf.

ix) check tube voltage is 62kV and tube charge is 8mAs; expose the patient and review the result.



Meschan, I. 1951 *An Atlas of Normal Radiographic Anatomy* Saunders, London

c) **Review image**

i) Select the Image Processing Tab and rotate the radiograph to match the reference image above.

Make notes:

What questions would you like to ask?

d) **Questions**

Give the largest and smallest selectable receptor sizes; are these standards? Which have more choice CR or DR systems?

Define 'exposure factors'. List some:

What does the light beam diaphragm (LBD) control and what should the maximum setting depend on?

Define 'landscape' orientation

What are the rules for receptor orientation?

e) **There are no further examinations in this attendance, discharge the patient**

Chapter

2

Radiographic Technique

This chapter contains two Labs that discuss radiographic positioning and projection, introducing terms and concepts..

Lab 5 – Patient positioning terminology

Aims of Lab

- Discuss patient positioning in isolation
- Practice simple 'out of Bucky' examinations

Lab 6 - Radiographic projection terminology

Aims of Lab

- Understanding the principles and terminology of radiographic projection
- Practice simple 'out of Bucky' examinations

Lab 5 – Patient positioning terminology (option)

Outcomes

At the end of the Lab, students will be able to:

18. List the named general and specific patient positions
19. Consider patient position in relation to x-ray room scenario
20. Position a patient, and collimate to a given anatomical area
21. Set receptor type, size, SID, tube charge and tube voltage values given on the worksheet
22. Identify an image orientation e.g. Head-First (Portrait), Transverse (Landscape)
23. Correctly orientate a radiograph

Activity:

a) Left Knee examination – Lower Limb scenario

i) On the console, select the 'Examination Tab' - Select 'Lower Extremity' as the region, 'Knee XR Lt' as the study 'Recumbent' as patient orientation, and 'AP' as the projection.

ii) In the room, select 'Lower Limb' from the scenario picker

iii) Select a 24 x 30cm (12 x 10in) receptor and place it at the foot of the table.

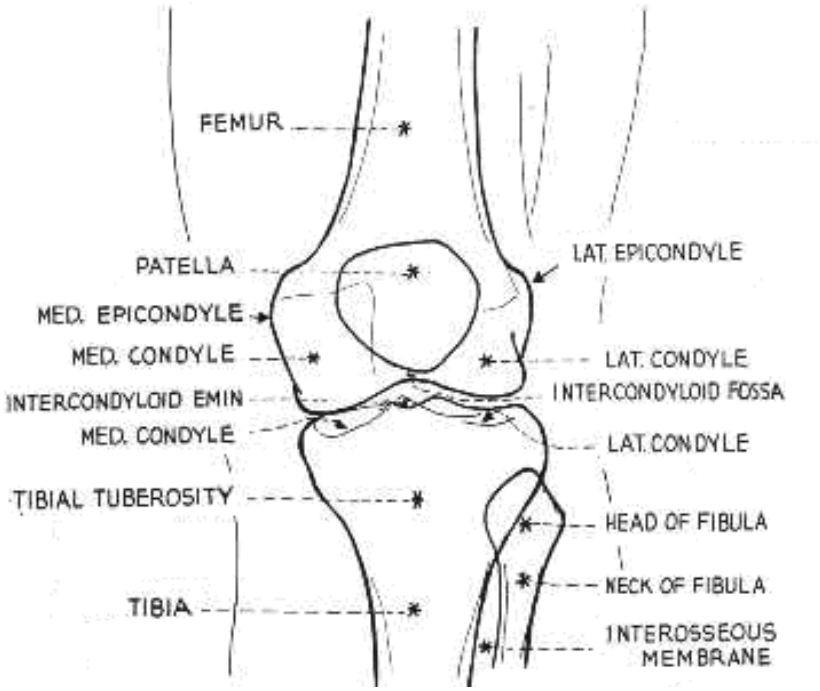
iv) Choose and position the 'L' side marker

v) Admit the patient into the x-ray room and lay them on the table

vi) Raise the table to working height; check the SID is 100cm (40in)

vii) Position patients left leg, receptor, floating top table and x-ray tube to include the Lt. Knee as shown in the diagram overleaf

viii) Review image



Meschan, I. 1951 *An Atlas of Normal Radiographic Anatomy* Saunders, London

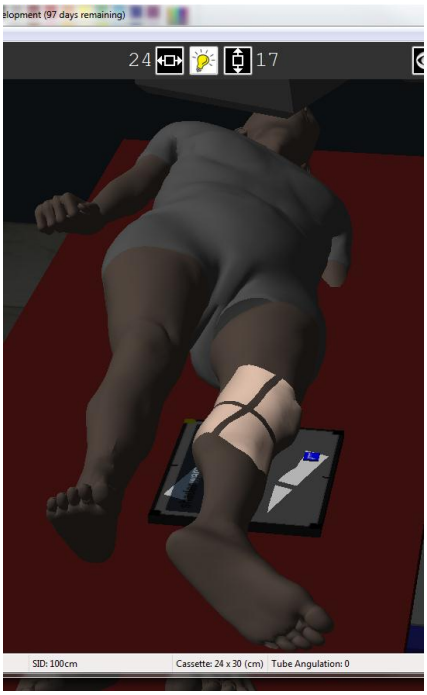
b) Left Knee - Lateral Projection

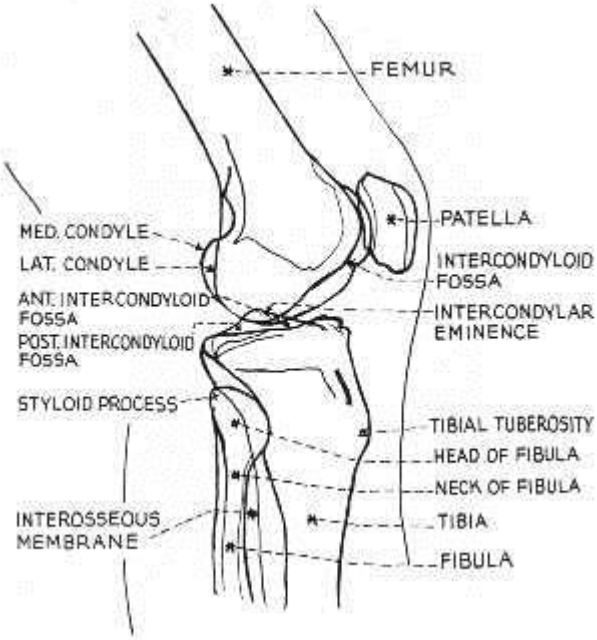
i) On the console, select the 'Examination Tab' - Select 'Lower Extremity' as the region, 'Knee XR Lt' as the study 'Recumbent' as patient orientation, and 'Lateral' as the projection.

ii) In the room, rotate the patient into a left posterior oblique position

iii) Position patients left leg, receptor, floating top table and x-ray tube to include the Lt. Knee as shown in the diagram overleaf

iv) Review image





Make notes:

What questions would you like to ask?

c) **Discuss Patient positions**

Many radiography books are confused on this point. However, it is important to be specific. Position only refers to posture and gravity. It only refers to the patient, not the patient table or x-ray tube; one can describe a patient's position without any mention of the equipment.

With respect to gravity

- Erect (Upright)
  - Anatomic
  - Weight-bearing
- Semi-erect (Fowlers, Semi-recumbent)
- Recumbent
  - Supine (Dorsal Decubitus)
  - Prone (Ventral Decubitus)
  - Trendelenburg
  - Laterals (Right/Left Decubitus)
  - Obliques
    - Left/Right Prone Decub.
    - Left/Right Supine Decub.

Specific posture

- Flexion/Extension
- Internal/External rotation
- Moving (auto-tomography)
- Stress

Hand/wrist

- Norgaard (Ballcatchers)
- Stecher
- Ulna/Radial deviation

Elbow/Forearm

- Supinated
- Pronated

Foot

- Inversion/Eversion

Pelvis and Hips

- Frog-Leg (Cleaves)

Cervical Spine

- 'Open Mouth'
- 'Swimmers'

Notes:

1) When a patient is stood erect, there is no way of telling where they are facing using positioning language

2) A seated patient is erect, semi-erect or recumbent depending on what body part is being examined. So you might say "the patient was seated with the right hand recumbent" or "the patient was seated erect for examination of their facial bones"

3) Both recumbent and decubitus mean 'lying down'

4) Very rarely the patient is asked to move while being exposed. This is called Auto-tomography. It is used to blur structures that are projected over areas of interest, e.g. ribs or mandible

5) Sometimes patients are asked to hold weights or bear their own weight to test joints. A special case is where a joint is stressed with lateral forces while exposed.

Lab 6 - Radiographic projection terminology (option)

Outcomes

At the end of the Lab, students will be able to:

24. List the named radiographic projections and understand the need for orthogonal projections
25. Tailor collimation and patient position to achieve required aesthetic outcome
26. Choose the correct projection according to the path of the central ray
27. Manually alter receptor size, SID, mAs and kVp values given

a) Left Leg Examination

i) On the console, set the examination to be 'Lt Leg' - with the patient position correctly identified as 'recumbent'

ii) Set the projection to be 'AP for Tibia and Fibula' (second time choose 'Lateral…')

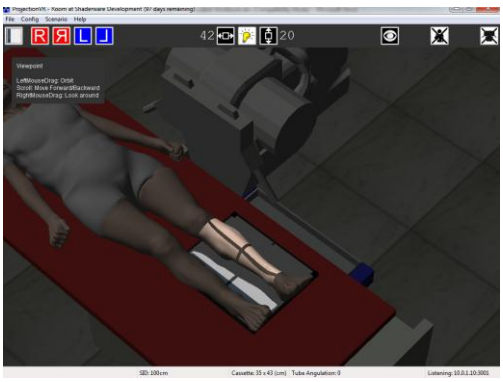
iii) In the room, select 'lower limb' from the scenario picker

iv) Choose the 35x43cm (17x14in) receptor and place it at the foot of the table on the table top.

v) Pick the appropriate side marker and position it on what will be the Lateral aspect of the receptor

vi) Admit the patient into the x-ray room and lay them supine on the patient table (second time rotate them to 'left decubitus')

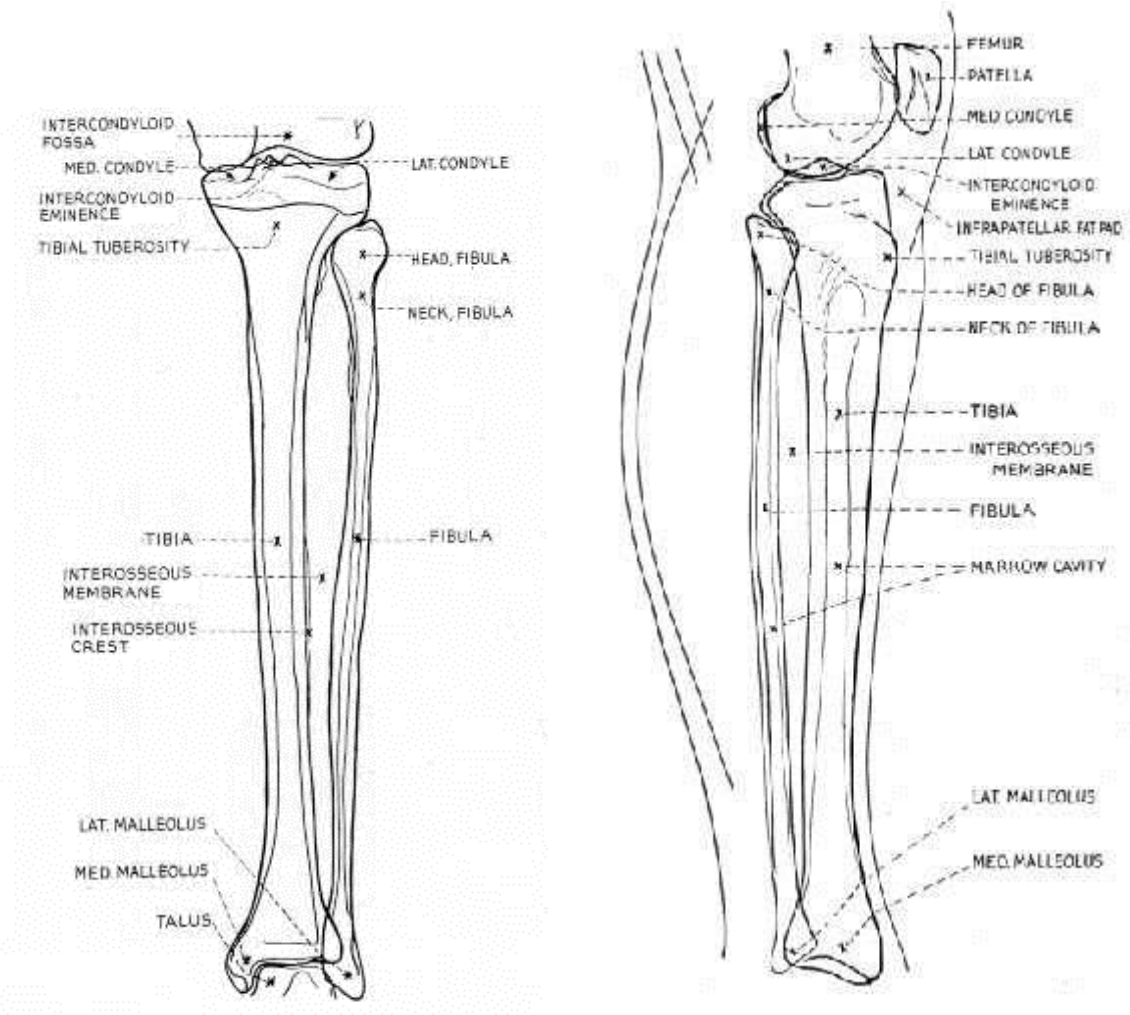
vii) Raise the table to working height. Check the SID is 100cm



viii) Position patient's lower limb, receptor, table top and x-ray tube to include the anatomy as shown in the following diagrams, with the collimation following the long axis of the long-bone

ix) Review image

x) Repeat these steps to achieve the lateral projection



Meschan, I. 1951 *An Atlas of Normal Radiographic Anatomy* Saunders, London

b) Review images

What questions would you like to ask?

c) Discuss Projections

Projection specifies a) the direction of travel of the x-rays, specifically the central ray, through the patient, so it is described in terms of the surfaces of the patient and b) the position of the receptor plane, again, in respect to the patient. The patient surfaces mentioned include: Anterior, Posterior, Oblique, Dorsal, Palmar/Plantar, Lateral, Medial, Inferior, Superior. The projection is the surfaces in order of the x-rays incident on them.

If the receptor is parallel to the patient's axial plane, then the projection is called 'Axial', but this is where the logic breaks down. If the receptor is parallel to the patient's sagittal plane it is called 'Lateral', being parallel to the patient's coronal plane is simply ignored. There is an assumption that the receptor plane will be perpendicular to the central ray, otherwise an angle away from perpendicular will be given.

<table>
<tr>
<td>
Antero-Posterior (AP)
Postero-Anterior (PA)
Medio-Lateral (Lat)
Latero-Medial (Lat)
Antero-Posterior Oblique

Right Posterior Oblique (RPO)
Left Posterior Oblique (LPO)

Postero-Anterior Oblique

Right Anterior Oblique (RAO)
Left Anterior Oblique (LAO)

Axial

Inferosuperior (IS)
Superoinferior (SI)

</td>
<td rowspan="8">
Notes:

1) Projection does not specify the patients posture or how the patient is oriented with respect to gravity, that is position.

2) So called 'Lateral' projections of upper limbs are nearly always Latero-Medial projections, with the medial aspect resting against the receptor.

3) The only 'true' Axial projections are where the receptor is parallel to the patients' axial plane. Where this is not the case the projection is named a 'half-axial' or as a standard projection with the addition of '...with cranial (or caudal) angulation'. In these cases the central ray is not perpendicular to the plane of the receptor.

4) There are eponymous projections, named after the first person to describe them, e.g. 'Townes' these can be called projections or methods (view is NEVER correct)

5) An oblique projection can be taken by moving the patient with a fixed central ray OR angling the central ray, e.g. a trauma patient will be supine when having 'trauma obliques'. Unless special equipment is used, the central ray will not be perpendicular to the receptor during these projections.

6) Despite possible complex angulations of the central ray and receptor to obtain a simple projection when a patient is immobile, the resultant projection will still be called by it's simple name
</td>
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<tr>
<td>
Specific

Tangential

</td>
</tr>
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<td>
Foot/toes

Dorsi-plantar (DP)

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<tr>
<td>
Hand/fingers/thumb

Dorsi-palmar (DP)
Robert's Method*

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Elbow

Coyle Method

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Shoulder

Neer Method
Garth Method

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<td>
Pelvis and Hips

Clements-Nakayama Method
'Lateral shoot through' (Danelius-Miller Method)

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<tr>
<td>
Skull/Face

Townes Method (Half-Axial)
'Reverse Townes' (Haas Method)
Occipito-Frontal (OF) (Caldwell Method)
Optic Foramina (Rhese Method)
Schuller method (TMJ)
Sub-Mento Vertex (SMV)
Verto-Mental

</td>
</tr>
</table>

d) AP and Lateral Humerus examination (option)

i) On the console, set the region to be ‘Upper Limb’, study to be ‘Humerus XR Rt’ with the patient position correctly identified as ‘erect’

ii) Set the projection to be ‘AP’ (second time choose ‘Lateral…’)

iii) In the room, select 'Erect' from the scenario picker

iv) Select a suitably sized receptor and place it ON the erect Bucky surface (look at the area to be demonstrated to guide your choice)

v) Select the appropriate side marker and position it on the receptor

vi) Check the SID and as necessary move the x-ray tube to the required position.

vii) Admit the patient into the x-ray room

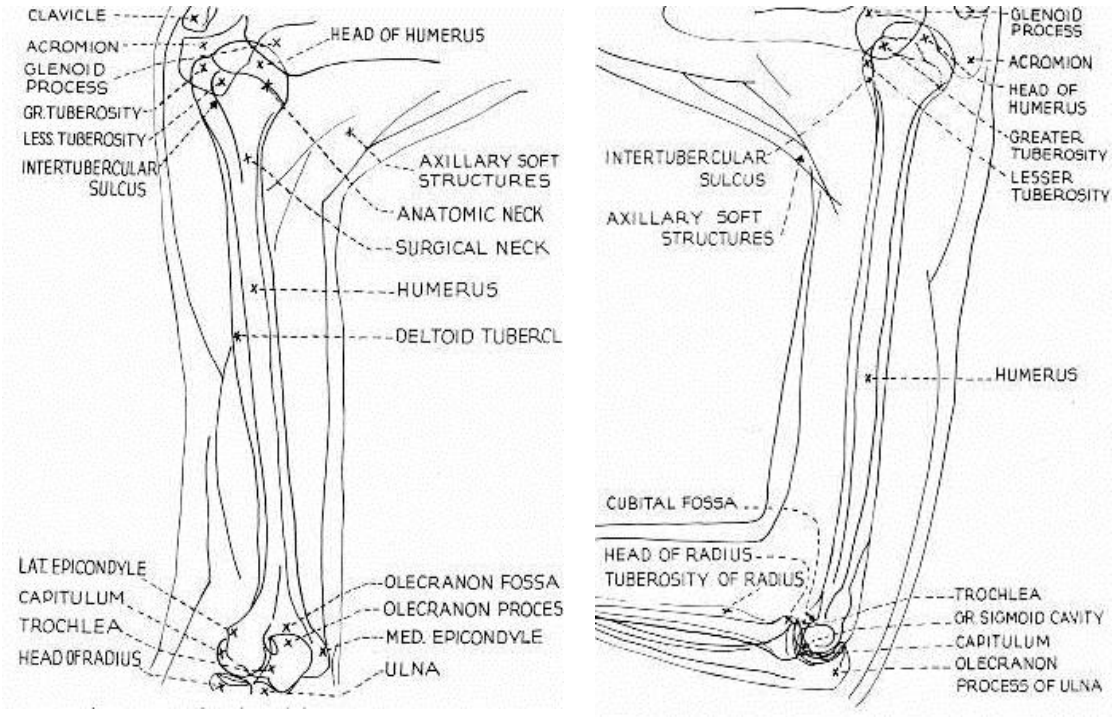
viii) Position the patient to achieve the first required radiographic projection

ix) Collimate to include the right Humerus as shown in the diagram

x) Increase the set exposure factors to 63kV, 8mAs

xi) Repeat steps iv-ix, selecting ‘Humerus: Lateral (Scapula Y)’

xii) Decrease the set exposure factors to 65kV and 8mAs



Meschan, I. 1951 *An Atlas of Normal Radiographic Anatomy* Saunders, London

e) Review images

Make notes:

What questions would you like to ask?

f) Questions

Are these projections AP and Lateral?

Are they Orthogonal?

Chapter

3

Radiographic Procedure

This chapter contains two Labs that develop the student's procedural awareness.

LAB 7 - Radiographic procedural sequence

Aims of Lab

- Understanding both table top and table Bucky procedural steps for projection radiography
- Practice simple Bucky examinations

LAB 8 – Image criteria terminology & process

Aims of Lab

- Point out the task of internalising radiographic criteria for all examinations
- Explain the fundamental nature of image critique and the AABCS Method
- Practice 'hanging' a radiograph
- Make students aware of DICOM and DICOM image tools

LAB 7 - Radiographic procedural sequence

Outcomes

At the end of the Lab, students will be able to:

28. List the procedural steps outlined and identify the differences between table top and Bucky procedures
29. Place a receptor in a Bucky tray, and keep the centre of the receptor and the central ray in sync.
30. Collimate to a receptor in the Bucky
31. Manually set receptor type, SID, mAs and kV values given on the worksheet

a) Pelvis examination - AP

i) On the console, set the region to be 'Abdomen/Pelvis', study to be 'Pelvis XR' with the patient position as 'Recumbent'

ii) Set the projection to be 'AP'

iii) In the room, select 'Recumbent' from the scenario picker

iv) Admit the patient to the room; give them an appropriate name.

v) Raise the table to working height

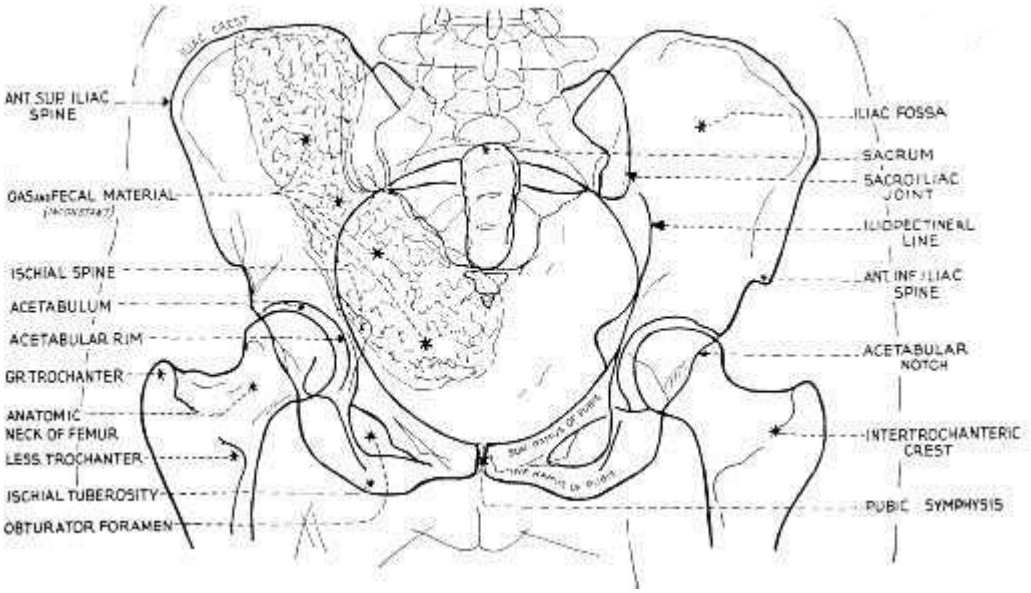
vi) Select a suitably sized receptor and place it in the Bucky tray (look at the area to be demonstrated to guide your choice and orientation)

vii) Check the SID is 100cm (40in). This will require passing the detent

viii) Collimate to the receptor size

ix) Select the appropriate side marker and position, then close the Bucky tray

x) Position the patient via the floating table top to obtain radiograph of the pelvis



Meschan, I. 1951 *An Atlas of Normal Radiographic Anatomy* Saunders, London

b) Review images

Make notes:

What questions would you like to ask?

Fill in the table on the next page comparing the procedure to obtain these radiographs with those that you took with the receptor visible on the table top.

Procedural Steps

Table Bucky	Table top/Chest Stand

LAB 8 - Image criteria terminology & process

Outcomes

At the end of the Lab, students will be able to:

32. Define the AABCS system of radiograph critique
33. List general points on a radiography criteria checklist (Adequacy)
34. Discover the fundamental importance of side markers and 'metadata'
35. Open a DICOM image in a viewer
36. Compare resultant radiographic image against explicit radiographic criteria

a) Ankle Examination

i) On the console, set the region to be 'Foot/Ankle', study to be 'Ankle XR Lt' with the patient position as 'Recumbent' and set the projection to be 'AP'

ii) Enable DICOM pass-through from the 'File' menu (if not already set) and log in.

iii) In the room, select 'Lower Limb' from the scenario picker and select the equipment type to 'CR'

iv) Choose the 18x24cm (10x8in) cassette and place it at the foot of the table on the table top.

v) Pick the appropriate side marker and position it on what will be the Lateral aspect of the receptor

vi) Admit the patient to the room; give them an appropriate name.

vii) Raise the table to working height; check the SID is 100cm (40in)

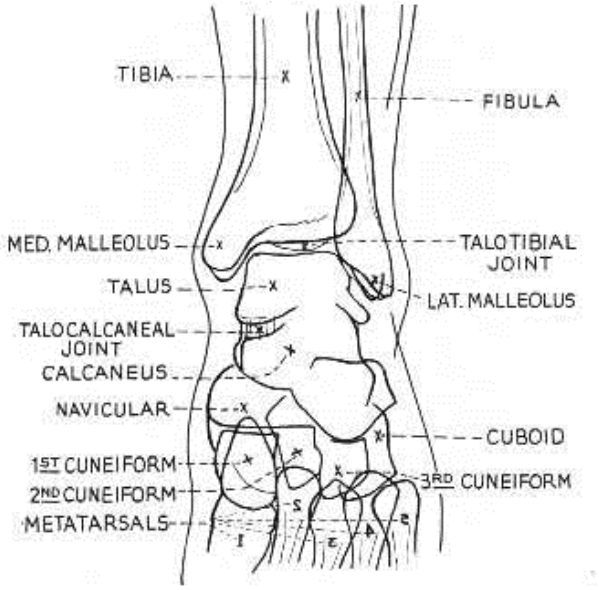
viii) Position the patient to obtain required projection of the correct anatomical area

ix) Collimate to include the Ankle as shown in this diagram

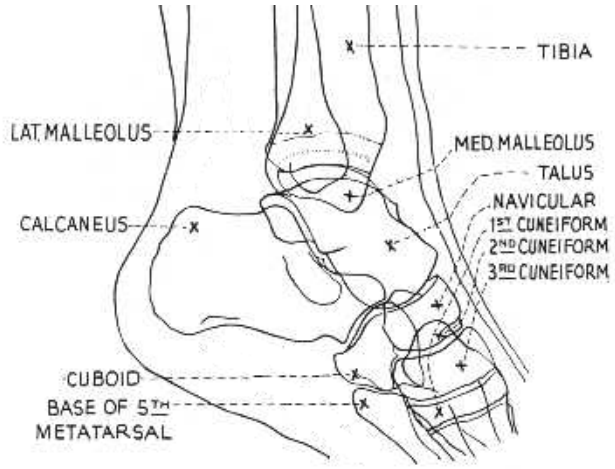
x) Review the Image using the Image Criteria Checklist

b) Repeat the steps for the Lateral projection

c) Open the resultant DICOM file using a DICOM viewer* or PACS system. Review the image and the metadata using the tools available in the DICOM viewer**



Meschan, I. 1951 *An Atlas of Normal Radiographic Anatomy* Saunders, London



d) Discuss radiographic critique

The AABCS Method of Radiographic Critique

Adequacy **A**lignment **B**ony cortex **C**artilage **S**oft tissue	**Notes:** This system is key, because in focusing on the interpretation, the radiographer never loses sight of the reason the examination is being carried out. **C**linical **H**istory must always be reviewed prior to using ABCS

Teesside University image criteria for adequacy

Item	*Notes*
Choose Adequate Viewing Conditions	The ambient light level affects the ability to subtle differences between dark shades. The monitor must be capable of presenting an image with adequate brightness and resolution. The viewer must have the minimum tool set.
Demographic checks	Hospital Name, Hospital Number, Date, Time Patient Name, DOB, Hospital Number
Anatomy	Does the anatomical area tally with that requested
Marker s and legends	Minimum of R or L (never both). An **arrow** for which way is up, **times** if a series of images has been taken, **pre** and **post** an event/intervention, **mobile**, if carried out away from the department, **comparison** if a normal limb has been irradiated, **bone age…**
Projection	Does the central ray pass through the anatomy as indicated (AP, Lateral, etc.). The central ray should pass through the centre of the area of interest (see Protection).
Patient Position	The area of interest must all be within the collimation. Is patient general position correct and correctly identified in the metadata. Is any specific position correctly achieved? Are any anomalies annotated e.g. Decubitus
Structures Shown	Relevant joints, structures and superimposing structures should be visualised in the acceptable standard required
Collimation	There should be **4 visible collimation marks** on the radiograph at all times.
Image Quality	All **4 radiographic contrasts** should be visible on the image without noise degradation . The Exposure Index must be higher than the agreed maximum for that examination. Check for artefacts, unsharpness and distortion
Protection	The Exposure Index must lower than the agreed maximum for that examination. Recorded dose measurements must be below the local Diagnostic Reference Level (DRL). Shielding must be correctly applied or a reason for its omission documented

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Footnote: Shaderware Ltd recommend SanteViewer as a free DICOM Viewer and ClearCanvas as a free PACS archival solution.

e) Questions

What generally is the correct way to 'hang' a radiograph?

Does this image 'pass' using the criteria?

Can radiographers issue a written comment on the radiograph?

What can be the result if side markers are not present?

What data is commonly held with the radiographic image in a DICOM object?

Which is easier to operate with CR or DR? Why?

Chapter

4

Radiographic Science

This chapter contains four Labs that develop the scientific underpinning of radiographic practice. The basic concepts are introduced.

LAB 9 - Magnification

Aims of Lab

- Demonstrate magnification and introduce the object-image:source-image ratio
- Practice more complex receptor handling techniques

LAB 10 - Distortion one

Aims of Lab

- Demonstrate distortions and errors due to incorrect use of projection
- Practice more complex projections

LAB 11 - Distortion two

Aims of Lab

- Demonstrate how position alters projection, i.e. PA position with caudal angulation is analogous to AP position with cranial angulation
- Discuss reasons for choice of patient position and projection
- Practice more complex projections

LAB 12 – kVp, mAs, grid & SID

Aims of Lab

- Demonstrate the basic effect of the given exposure parameters on the x-ray beam as it leaves the x-ray tube and exposes the patient and receptor
- Demonstrate the effect of using a grid in between the patient and receptor

LAB 9 - Magnification

Outcomes

At the end of the Lab, students will be able to:

37. Change receptor orientation
38. Position the patient to minimise magnification of the area under investigation
39. Estimate changes in SID to combat or use magnification

a) AP Femur

i) In the console, select 'Lower Extremity' as the region, 'Femur XR Rt' as the study, Recumbent as position and and 'Femur: AP (Distal Anode)' as the projection.

ii) In the room, select 'Recumbent' from the 'scenario picker' and DR

iii) Admit the patient, giving them THE SAME NAME as the previous Lab

iv) Position the patient on the table and raise the table to working height.

v) Select 35x43cm (17x14in) receptor and place it in the Bucky tray. Orientate the receptor appropriately ('Oblique' with the yellow dot uppermost).

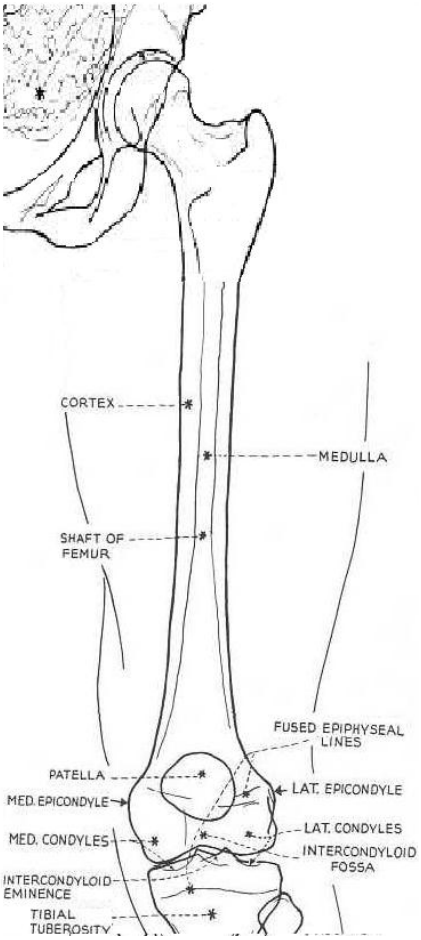
vi) Add a side marker on the lateral aspect

vii) Check the SID is 100cm, and alter accordingly.

viii) Collimate to include the region shown in the diagram overleaf

ix) Increase the set exposure factors for use of the anti-scatter grid (70kV, 12.5mAs)

x) Expose and Review the Image using the Image Criteria Checklist



b) If you cannot fit the femur on this cassette, repeat the exposure - change the SID to 120cm and increase the mAs to 20.

c) If you cannot fit the Femur on this cassette, repeat the exposure - take cassette out of Bucky and position it on the table top under the femur, still using 120cm SID, reduce the mAs to 8.

Meschan, I. 1951 *An Atlas of Normal Radiographic Anatomy* Saunders, London

d) Questions

How does the SID affect the image size?

How does receptor position (table bucky, table top) affect image size?

LAB 10 - Distortion one

Outcomes

At the end of the Lab, students will be able to:

40. Use tube angulation to obtain projections without complex overlying anatomy and the minimum of distortion

41. Be aware that radiographic anatomy is different to the real anatomy due to perspective distortion ('key-stoning') and differential magnification ('barrel distortion')

42. Practice radiographic projection using the technique of 'off-centring'

a) Two projections of the clavicle

i) In the console, select 'Upper Extremity' as the region, 'Clavicle XR Rt' as the study, erect as position and 'Clavicle: AP' as the projection.

ii) In the room, select 'erect' as the 'scenario'

iii) Select a 24 x 30cm (12 x 10in) receptor, and place it on the erect Bucky surface. Rotate it to landscape orientation.

iv) Select the 'R' side-marker and place it on the receptor to appear on the lateral aspect of the patient. Rotate it to be legible

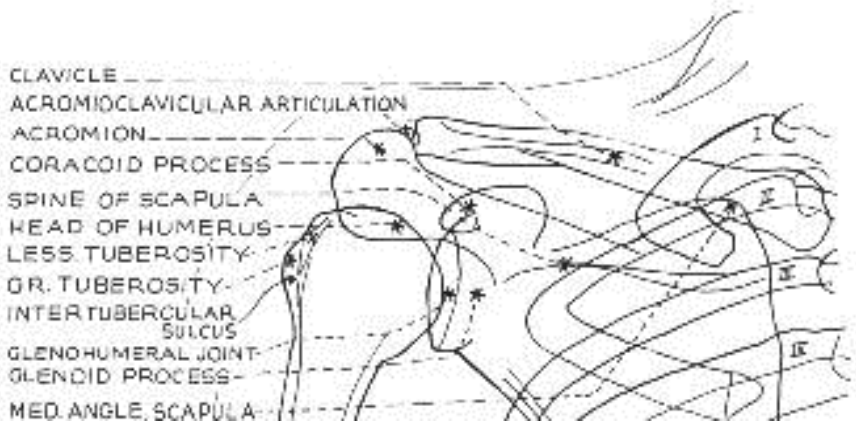
v) Check the SID and as necessary move the x-ray tube to 100cm (40in)

vi) Collimate to just within the receptor boundaries using the LBD

vii) Admit the patient into the x-ray room 

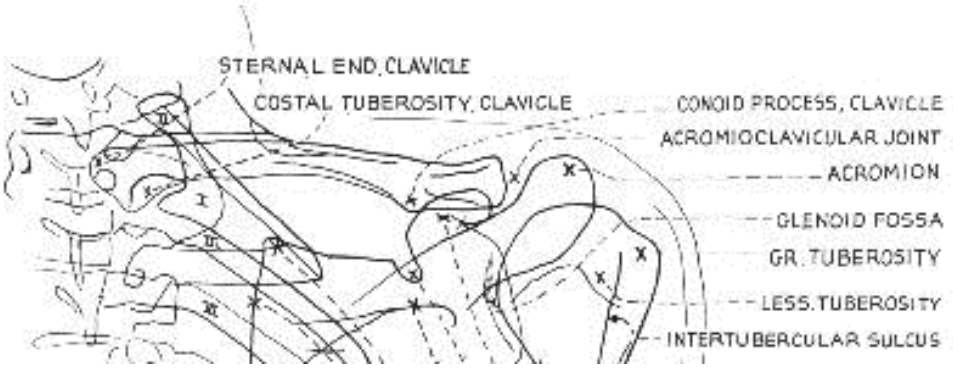
viii) Position patient, receptor, chest stand and tube to include right clavicle as shown in the diagram overleaf.

ix) Increase tube voltage to 62kV and ensure tube charge is 8mAs; expose the patient and review the result.



Meschan, I. 1951 *An Atlas of Normal Radiographic Anatomy* Saunders, London

b) Repeat exposure, selecting examination/projection Rt. Clavicle: AP Half-Axial' with 15-20 degree cranial angulation



Meschan, I. 1951 *An Atlas of Normal Radiographic Anatomy* Saunders, London

c) Turn the patient to face the receptor and modify the technique to produce a PA Half axial projection

d) Questions

What is different about the angulation of the tube?

Examine the medial end of the clavicle on both AP and PA angled projections, which is largest?

What were the differences in side marker placement between the two radiographs?

e) Extension activitiy

Williams describes an infero-superior projection of the clavicle (Carver and Carver (2006, p82). A similar projection was outlined in Clark (1949, p49)

Which is likely to produce less distortion of the clavicle, this technique or the previous techniques? Which is a true axial?

LAB 11 - Distortion two (option)

Outcomes

At the end of the Lab, students will be able to:

43. Use tube angulation to obtain projections with the minimum of distortion
44. Understand that angulation of the patient and angulation of the central ray do NOT give the same results (in a general room).
45. Practice radiographic projection 'off-centring' the Bucky

a) Facial Bones

i) In the console, select 'Head' as the region, 'Sinuses XR' as the study, erect as position and 'PA Half-Axial (OM, Waters, Parietocanthal)' as the projection

ii) In the room, select 'Head' as the 'scenario'

iii) Select a 24 x 30cm (12 x 10in) receptor, and place it in the erect Bucky. Rotate it to landscape orientation.

iv) Select the inverted 'R' side-marker and place it on the receptor to appear on the Rt lateral aspect of the patient.

v) Check the SID and as necessary move the x-ray tube to 100cm (40in)

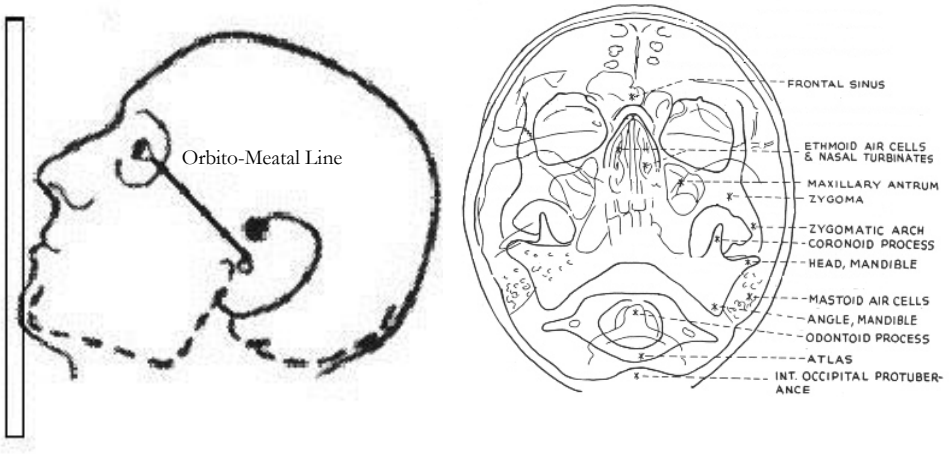
vi) Collimate to just within the receptor boundaries using the LBD

vii) Admit the patient into the x-ray room

viii) Position the patient facing the Bucky

ix) Position the patient to obtain OM position by raising the chin (as in the diagram over the page)

x) Increase tube voltage to 65kV and ensure tube charge is 20mAs; expose the patient and review the result.



b) Repeat the exposure as a projection but this time with the patient Anatomical, facing the Bucky (Orbito-Meatal Line parallel to the floor) and the central ray angled down 45 degrees.

c) Questions

What shapes are the collimation areas on the two images?

Which is more diagnostic? Why?

LAB 12 – Dose Area Product, kVp, mAs, grid & SID (core)

Outcomes

At the end of the Lab, students will be able to:

46. Define Dose Area Product (DAP)
47. Define Entrance Surface Dose (ESD)
48. Define Mean Pixel Value (MPV)
49. State the basic effect of collimation on DAP, ESD and MPV
50. State the basic effect of SID, mAs, and kVp on DAP, ESD and MPV
51. State the basic effect of anti-scatter grids on ESD and MPV

a) Dose Area Product and MPV (how to estimate patient and receptor exposure)

i) Pick QA and QA TEST XR as the exam. Select NO PATIENT and QA TEST as the projection

ii) Select a 24 x 30cm (12x10in) receptor and place it on the Bucky surface or table top

iii) Collimate EXACTLY to the receptor size with the SID at 100cm (40)

iv) Admit the 'patient' (pick 'test object' from the admittance menu)

v) Expose the receptor directly (Tube Voltage 50kV, Tube Charge 2mAs) – record DAP, SID, Tube Charge (mAs), and MPV.

vi) Select a 35 x 43 cm (17x14 in) receptor and place it on the Bucky surface

vii) DO NOT ALTER THE COLLIMATION OR EXPOSURE - Alter the Source Image Distance until the collimation roughly fits the new receptor. Expose this and record DAP, Tube Charge, SID and MPV

viii) Alter nothing but the mAs; change this to 5, and re-expose on a 24 x 30 cm receptor. Record DAP, mAs, SID and MPV.

Exp	DAP ($cGy*cm^2$)	SID (cm)	Tube Charge (mAs)	Entrance Surface Dose (ESD)	Mean Pixel Value (MPV)
1					
2					
3					

b) Questions

Does Dose Area Product (DAP) alter when SID alone alters?

What is the effect of increasing the SID?

Does the tube charge (mAs) setting affect the DAP reading? Does the collimation?

How does SID affect MPV? ESD?

How does Tube Charge (mAs) affect MPV? What about ESD?

c) Review table

Make notes: What questions would you like to ask?

d) EXTENSION ACTIVITY - Anti scatter grids

i) Take the 24 x 30 8:1 aluminium covered anti-scatter grid receptor and put it on the Bucky surface and expose using the same tube voltage and charge. Record DAP, mAs, SID, ESD and MPV

ii) Take a 35 x 43 (14x17) 8:1 carbon fibre covered anti-scatter grid receptor and place it on the Bucky surface and expose the same. Record the details

iii) Take a 24 x 30 receptor and place it in the erect Bucky and expose it the same. Record the details

Exp	DAP (cGy*cm2)	SID (cm)	Tube Charge (mAs)	Incident Dose (ESD)	Mean Pixel Value (MPV)
4					
5					
6					

e) Question

Does use of the anti-scatter grid/Bucky alter the DAP reading?

Does it affect the MPV?

Does it affect Incident Dose?

Chapter

5

Patient Practice

This chapter contains three Labs that present patient specific cases to the student to work through..

LAB 13 –Supine Abdomen radiography

Aims of Lab

- See the process of interpreting and justifying radiographic request cards
- Gaining confidence in patient positioning and radiographic projection
- Experience making judgements against a radiography criteria
- Translate anatomy/pathology knowledge to radiographs

LAB 14 – Supine CXR

Aims of Lab

- See the process of interpreting and justifying emergency radiographic request cards
- Gaining confidence in patient positioning and radiographic projection
- experience making judgements against a radiography criteria
- Translate anatomy/pathology knowledge to radiographs

LAB 15 – Formative assessment

Aims of Lab

- Test student learning
- Give students feedback
- Evaluate workbook outcomes

LAB 13 –Supine abdomen radiography

Outcomes

At the end of the Lab, students will be able to:

52. List indications for a plain supine abdomen examination
53. Follow an efficient procedure throughout
54. Position a patient and choose a projection to ensure area of interest is included in the radiograph
55. Critique the resultant radiograph against a given criteria to judge acceptability and write a comment on findings

REQUEST

BELLWOOD ACUTE NHS TRUST - X-RAY REQUEST FORM

A&E DEPARTMENT PLAIN FILM EXAMINATION ONLY

Patient Details: Dr Pradeep Kaur	Hospital Unit No: 1125-7689
Date of Birth: 30/10/1966 Age: 45	26 Great Western Road, Bellwood, BL1 3WD
CHI Number: 3010616420 Patient Tel No: 020 455 6753	
Registered GP: Dr Monroe (345629)	

Please circle where appropriate

NURSE ESCORT TROLLEY CHAIR WALKING

Examination Requested: K UB Duration of symptoms 8/24	Clinical Justification: Pain right loin suggesting renal colic ? kidney stone Relevant Previous History (including previous surgery) None

LMP..... (females aged 12 – 50, including Abdomen, Lumbar Spine or Pelvic area)

SIGNATURE... S Finch..... DATE:...12/1/12.....

(It is a medico-legal requirement that this form is signed by the referrer)

IMAGING GUIDELINES: Requests will be expected to comply with the RCR Guidelines "Making the best use of a Department of Clinical Radiology"

Radiologist/Radiographer Use Only

ARE YOU OR MIGHT YOU BE PREGNANT? YES/NO

Signed.....(Patient)

Signed..... (Staff) Date..... DEPT.....

Patient id verified: YES/NO Request clinically justified: YES/NO

EXAM: PREP:

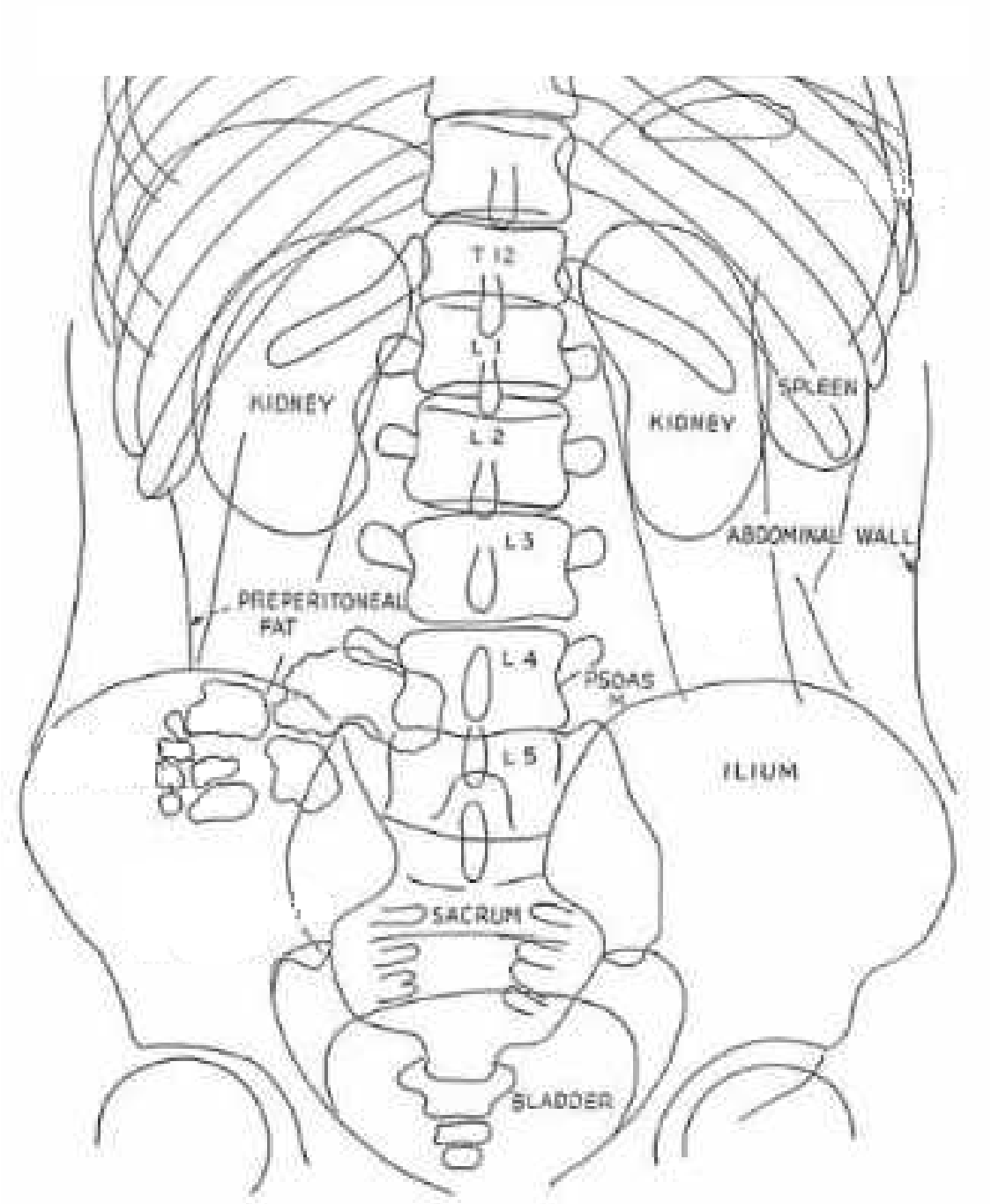
EXPOSURE/DOSE INFORMATION

DAP MAS KVP

Standard Indications for imaging

- Bowel gas patterns in obstruction, intussusceptions, volvulus,
- Investigation of biliary and renal lithiasis
- Control or preliminary films for contrast studies
- ? Aortic Aneurysm when sclerotic and with calcifications

Question
Do you proceed? (Fill in the request form where required at each stage)
.



Exposure Chart

Exam	SID	kVp	mAs	Grid	Receptor
Plain Abdo	115	70	20	Yes	Regular

Radiographic Criteria:

"Dogs Always Make Perfect Pets Showing Considerable IQ, Pups Can't Handle ABC's"

1. **Collimation**: Borders only top and bottom (to ensure abdominal margins visible)
2. **Area included**: from T11/12 to Symphsis Pubis.
3. **Projection/Position:** No rotation; Judge symmetry from iliac wings, obturator foramina (if visible), ishial spine and outer lower rib margins.
4. **No Movement**:: No respiratory movement. Judge from sharp.rendition of ribs and gas margins.
5. **Density and Contrast**: Judge from visualisation of psoas muscle, lumbar transverse processes and ribs.

Radiographers Comment

Signed: Date:

Don't forget to complete the paperwork!

LAB 14 –Supine chest radiography

Outcomes

At the end of the Lab, students will be able to:

56. List indications for a supine CXR examination
57. Position a patient and choose a projection
58. Critique the resultant radiograph against a given criteria to judge acceptability and write a comment on findings
59. Consider pathology and its possible impact on exposure factor selection

REQUEST

BELLWOOD ACUTE NHS TRUST - X-RAY REQUEST FORM

A&E DEPARTMENT PLAIN FILM EXAMINATION ONLY

Patient Details: Dr Pradeep Kaur	Hospital Unit No: 1125-7689
Date of Birth: 30/10/1966 Age: 45	26 Great Western Road, Bellwood, BL1 3WD
CHI Number: 3010616420 Patient Tel No: 020 455 6753	
Registered GP: Dr Monroe (345629)	

Please circle where appropriate

NURSE ESCORT TROLLEY CHAIR WALKING

Examination Requested:	Clinical Justification:
CXR	Recent Resucitation after MI.
Duration of symptoms Previous angina 9 years, MI 2 years	Relevant Previous History (including previous surgery) Renal Colic confirmed on previous x-ray

LMP..... (females aged 12 – 50, including Abdomen, Lumbar Spine or Pelvic area)

SIGNATURE...D Hill..... DATE:...11/1/2012.....

(It is a medico-legal requirement that this form is signed by the referrer)

IMAGING GUIDELINES: Requests will be expected to comply with the RCR Guidelines "Making the best use of a Department of Clinical Radiology"

Radiologist/Radiographer Use Only

ARE YOU OR MIGHT YOU BE PREGNANT? YES/NO

Signed.....(Patient)

Signed..... (Staff) Date..... DEPT.....

Patient id verified: YES/NO Request clinically justified: YES/NO

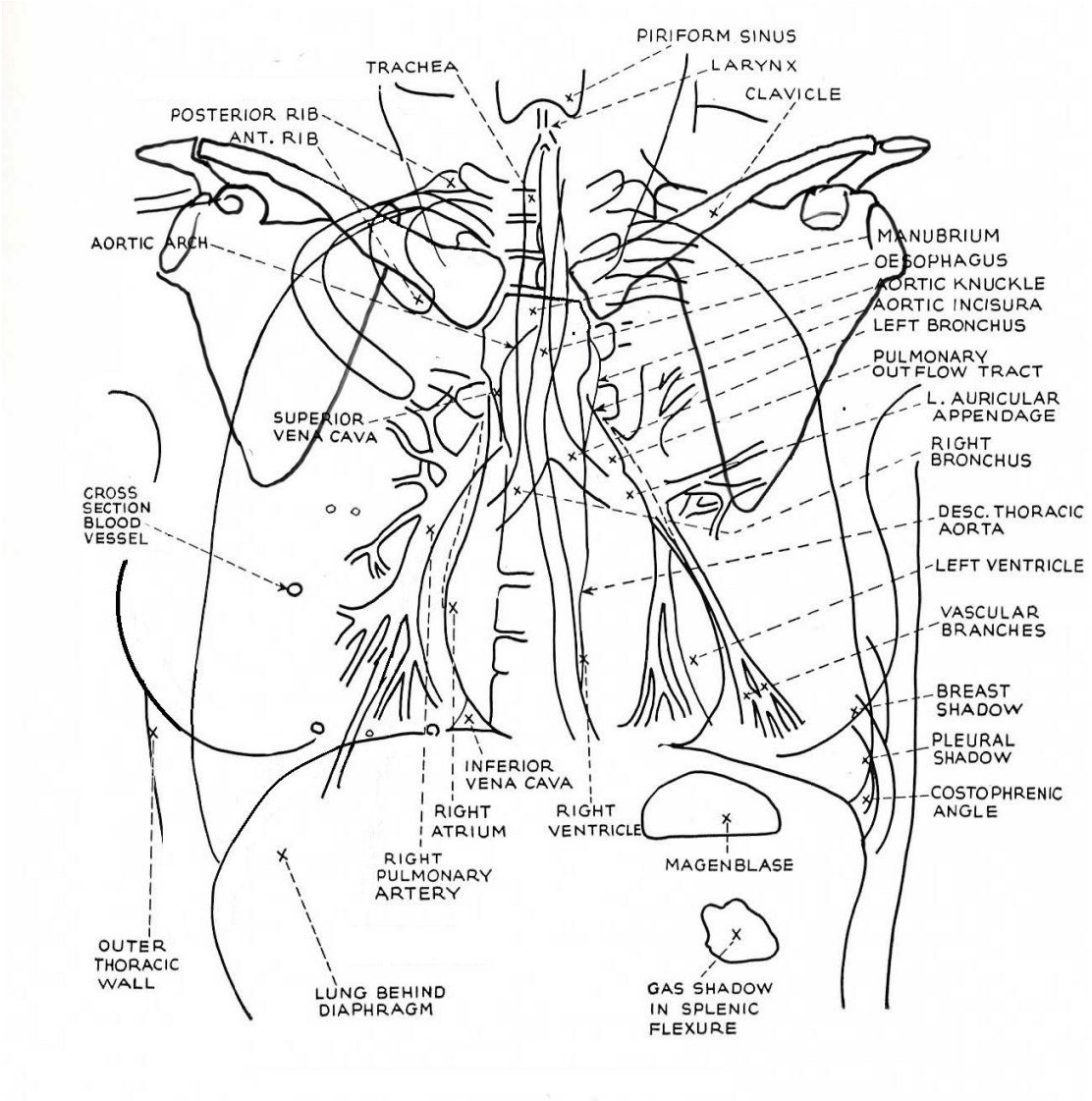
EXAM: PREP:

EXPOSURE/DOSE INFORMATION

DAP MAS KVP

Standard Indications for imaging

- Chest pain ?MI (Assessment of heart size & pulmonary oedema)
- Chest pain
- Acute aortic dissection
- Pulmonary embolus
- Pericariditis
- Pericardial effusion
- Vascular disease
- Chest trauma (If ? pneumothorax)
- Pneumonia follow up (To confirm resolution (>10 days))
- Haemoptysis (+ lateral)
- ITU (Progress check)



Question

Do you proceed? Fill in the form where required.

Exposure Chart

Exam	SID	kVp	mAs	Grid	Receptor
CXR PA	180	75	12.5	No	Regular

Radiographic Criteria

"Dogs Always Make Perfect Pets Showing Considerable IQ, Pups Can't Handle ABC's"

1. **Collimation**: Borders on all 4 sides, within skin margins and close to apicies and costophrenic angles – centred around T7
2. **Area included**: In full inspiration, both lungs from apicies to costophrenic angles. Count 8-9 posterior ribs above diaphragm (normally 10 for erect patient). First rib upper border should be included.
3. **Projection/Position**: Three posterior ribs should be visible above the clavicles. No rotation; Judge Symmetry from equidistance of sternoclavicular joints and outer rib margins from spine
4. **No Movement**: no respiratory movement. Judge from sharp.rendition of ribs, lung markings and gas margins.
5. **Density and Contrast**: Judge from faint visualisation of verebral bodies through the heart shadow and air in the trachea down to T5.

Radiographers Comment

Signed: Date:

Don't forget to complete the paperwork!

LAB 15 – Formative assessment

1) Alphabet Soup - Find the pairs with the same meaning:

A) Semi-Erect
B) Expose
C) Cranial
D) Central Ray passing through dorsal then ventral surfaces respectively
E) SID
F) 'To the tail'
G) Magenblase
H) Tube charge
I) PA
J) Supine
K) Cephalic
L) Orthogonal
M) 12 x 10
N) Central ray passing from 'front' to 'back' respectively
O) FFD
P) Dorsal Decubitus
Q) Irradiate
R) mAs
S) Perpendicular
T) Gas in Stomach
U) Caudad
V) AP
W) Lateral
X) Mediolateral
Y) 24 x 30
Z) Fowlers

2) Where does the Detent fix the ceiling suspended x-ray tube?

3) What is the LBD and what does it control?

4) What are the standard receptor sizes?

5) Why do we need to see four collimaton edges on a radiograph?

6) What does DAP stand for?

7) How do you reduce magnification on a radiograph?

8) What will the addition of an anti scatter grid do to patient dose if MPV is maintained?

9) How does SID affect MPV?

10) How does tube charge affect Incident Dose?

11) Generally, how should a radiograph be hung for viewing?

12) What should be done after selecting the receptor and before achieving the position/projection?