Index of Medical Imaging

Jonathan McConnell

WILEY-BLACKWELL

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DEDICATION

For Karen,
Kate and Lucy
who have always supported me in so many ways.

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Index Layout and Acknowledgements

This index is designed to allow easy access to descriptions and discussions of many aspects of medical imaging. It consists of multiple lists, tables and discussions linked to (among others) radiography, computed tomography (CT), magnetic resonance imaging (MRI) and components such as radiological contrast agents, responses to contrast reactions and MRI safety. There is a glossary of terms and definitions plus a list of abbreviations that may be encountered within radiology. Tables are given that suggest the order and type of examination that should be performed as defined by the United Kingdom's Royal College of Radiologists. As a reader all you need to do is find the section you need from the contents list or by thumbing to the position of the item using the thumb tabs on the edge of the pages.

The author, having come from UK practice and having had the opportunity to work in both New Zealand and Australia, hopes the index reflects a wider appreciation of the possible approaches that may be adopted in diagnostic imaging using ionising radiation. Names and terms not seen frequently in one country's practice but described under an alternate label are presented with the intent that this exchange of information will be to the advantage of the patient. Furthermore, in this age of boundary blurring no apology is made for the evident mixture of traditional information that was once the realm of one branch of the profession rather than another.

The index is primarily intended for use by the student or newly qualified radiography practitioner. It may also have value among other professional groups who are also crossing boundaries in their roles or who may be looking for a resource that will support them in their decision making when the computer is unavailable or unable to give an immediate answer in a clinical situation.

Without the help of the following, this index would not have come into being: Jane Carmody, MRI supervisor, Olympic Park Radiology, Melbourne; Geoffrey Dick, CT supervisor, Box Hill Hospital, Melbourne; Peter Kutschera, CT supervisor, Dandenong Hospital, Melbourne.

Chapter 1

Positioning Terminology

The standard anatomical position is assumed, with the individual standing facing the observer with feet turned slightly outwards and hands abducted away from the body and palms flat and visible. In respect to this, several terms can be discussed from this starting position to describe positioning and relations of structures.

Relational terms

Anterior	towards the front of the body; alternative term is ventral
Posterior	towards the back of the body; alternative term is dorsal
Medial	towards the midline of the body
Lateral	away from the midline towards the side of the body
Proximal	towards the origin of the structure
Distal	away from the structure's origin (or further from the body)
Superior	towards the head (cranial or cephalad) or above
Inferior	towards the feet (caudal/caudad) or below
Oblique	from the anatomical position rotation of the body in either direction

Anatomical planes

Sagittal	The mid or median sagittal plane vertically divides the body into two equal (right and left) halves.

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Other sagittal planes are subsequently parallel with this.

Coronal — A second vertical plane that can pass through the body to divide it into anterior or posterior sections lying at right angles to the mid-sagittal plane.

Transverse — These are also termed axial planes; the transverse plane divides the body into superior and inferior sections so generating horizontal cross-sections.

Body movements

Understanding body movements is important so that the correct position is adopted for images that may be produced.

Flexion	bending a joint to bring the components closer to each other
Extension	stretching of a joint to separate or elongate joint components relative to each other
Supination	a movement that allows the anterior surface to lie upwards
Pronation	a movement that allows the anterior surface to lie downwards
Adduction	movement of a limb towards the midline (or closer to the body)
Abduction	movement of a limb away from the midline
Inversion	rotation of a joint towards the midline
Eversion	rotation of a joint away from the midline
Internal rotation	rotation towards the centre of the body
External rotation	rotation away from the centre of the body
Decubitus	to lie on a surface of the body and direct a horizontal beam X-ray toward the patient, e.g. dorsal decubitus is to lie on the back with image receptor alongside the patient and effectively a lateral projection is generated by the horizontal ray. Lateral decubitus would have the patient lying on their side.

Chapter 2

Digital Radiography Considerations

Digital radiography, it has been argued, is seen as a massive leap forward in terms of image archiving, manipulation and dose saving. There are, however, a few points that should be remembered when using these systems as the situation is not as simple as it may first appear.

Computed radiography

In computed radiography a photo-stimulable phosphor is the image receptor. X-radiation is captured as a 'shadow' representation of transmission of the beam through the patient, energy amounts being dependent upon what materials the beam passes through, i.e. greater absorption through bone, least through gas-filled structures, and varying according to the thickness of soft tissues elsewhere. The captured energy is released by spraying laser light onto the phosphor; this releases light detectable by a photomultiplier system which amplifies the signal and converts it to a digital data stream. The data stream is then applied to a monitor whereby the data represents grey values on a scale. These are reconstructed in a matrix (pixels) to generate images familiar to the viewer as the radiograph.

Direct digital radiography

Direct digital systems do a similar job but use amorphous silicon or selenium linked to a thin film transistor that has rows and

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columns of switches equal to the pixel in the image. When the switch is activated the energy stored by the transistor system downloads its information, again as a data stream, though this time a conversion process is not necessary, thus making for a faster response time. These systems are built into equipment as bucky devices or connected to tables and erect stands via cabling or wireless download capabilities so that the receptor can be used in ways similar to (though heavier than) the cassette approach seen in computed radiography.

Patient information

Patient information is applied to each image through the network system termed PACS (Picture Archiving Communication System) which communicates with the Hospital and Radiology Information System (HIS or RIS). The radiographer should ensure an anatomical marker is visible in the imaging field, as digital addition of this information afterwards is not best practice.

Exposure and digital radiographic systems

Digital radiographic systems are able to correct for poor exposure factor selection (overexposure by up to 500% and underexposure by about 80%), which at first sounds advantageous. However, this has led to the phenomenon of 'dose creep' whereby imaging staff have gradually increased exposures to avoid image noise generated by underexposure, in the knowledge that overexposure is compensated for by the system. This, over time, has resulted in much higher average exposure factors than those seen in the old film and intensifying screens that gave instant feedback through the analogue image that demonstrated an overly light or dark image. The only way the radiographer can measure the results and relative dose received by the patient is to look at the 'Exposure Index' value delivered by the equipment. This number is a measurement of the energy received by the CR or DR system and corresponds to relative image density. Understand how the system you are working with represents this value, as terms such as 'S value' from Fuji, 'lgM' from Agfa and variations in the position of a decimal point may lead to confusion; e.g. Kodak gives values between 1600 and 2200 whereas Agfa will display 1.6–2.2 as indications of energy deposited in the system. It is also important to know the speed at which the image was processed. Standard processing would be 100 for extremities, but selection of a faster speed would create the same amount of image blackening for a lower radiation dose. This is advantageous but, if the signal level in the subsystem drops too far, noise is introduced. Furthermore, knowing the speed and exposures can be a useful indication of how to reduce dose while maintaining adequate image quality.

Key elements to keeping dose within acceptable limits and improving image quality include:

- Centralising of the body part to the receptor as images are read from a central point and therefore are electronically adjusted based on this.
- Keeping collimation tight and aligned with cassette edges.
- Using a single cassette per image as this allows shuttering of extraneous screen to improve viewing conditions, better reading of the image data according to selected algorithm and, depending on cassette type, better use of available pixels to enhance spatial resolution.
- Ensuring the correct reconstruction algorithm is applied to the examination. The image may be affected where more than one exposure is added to a single receptor. As a result scatter beyond the collimators causes spurious analysis of the image histogram by the computing system. Take care as each system works slightly differently.

Correct viewing of the image monitor is also crucial to ensuring that a good-quality image is sent to the radiologist's monitor for interpretation. View all images by looking straight at the monitor and not off eye-line, as this can give the impression that all is well with the image when the image quality sent for interpretation is poor. Remember, the radiographer's workstation does not have the same detail functions as the radiologist, so an apparently acceptable image may be grossly unacceptable when viewed elsewhere.

Chapter 3

Plain Radiography Projections

Cross-references in this chapter are to entries in the named projections section in Chapter 4. Projections are suggested singularly on digital cassettes or plates to avoid the issues discussed in Chapter 2.

LOWER LIMB EXAMINATIONS

Foot

ANTEROPOSTERIOR HALLUX (DORSIPLANTAR FIRST OR GREAT TOE)

The patient's shoes, socks and dressings are removed to prevent artefacts. The patient can lie supine on the examination table with a pillow under the head (or sit on the examination table/trolley) with the knee flexed so the foot rests flat on an 18 × 24 cm image receptor. If immobilisation is required, use a large foam pad along the medial border of the leg or flex the other knee to support the affected side.

Use a vertical IR (incident ray) centred to the first metatarsophalangeal joint. Some authors recommend an angle of 10–15° toward the calcaneum to prevent foreshortening of the phalangeal and metatarsal long axes, and correct visualisation of the toe will occur. Ensure collimation to include the neighbouring (second) toe and expose using a 100 cm SID.

LATERAL PROJECTION OF THE TOE

This projection is usually reserved for the hallux as being the structure that bears most weight distally. The affected leg should

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be rotated medially, facilitated by flexing the affected knee, until the great toe is in a lateral position. To ensure that the toe can be adequately visualised, insert a small foam pad between the adjacent toes and, in the case of the great toe, wrap a small bandage around the smaller toes and extend the bandage around the posterior aspect of the heel. Ask the patient to hold the bandage so that the toes will be pulled inferiorly so that the great toe is separated from its neighbours.

Centre a vertical IR to the metatarsophalangeal joint and collimate to include the digit and metatarsal base.

DORSIPLANTAR OR ANTEROPOSTERIOR PROJECTION OF THE FOREFOOT

Similar to the AP/DP of the hallux, where the patient flexes the knee so the foot can be placed in contact with the 18 × 24 cm image receptor that is positioned transversely, so the forefoot is placed so that it rests on one half. Using a vertical IR, centre to the shaft of the third metatarsal and collimate on four sides to include the whole of the forefoot from toes to the cuneiforms and cuboid.

WEIGHT-BEARING DORSIPLANTAR PROJECTION OF THE FOREFOOT

To show the impact of metatarsus primus varus (precursor to hallux valgus) and the impact of weight on the feet.

The patient stands on the image receptor placed transversely to accommodate both feet at once. Provide a lead rubber full apron as the X-ray tube is brought to a point around the waist while angled 15° towards the patient. The IR is centred between the feet at the mid-shaft point of the first metatarsal and collimated to include the forefeet from mid-foot to toes.

See also: Kandel, Kite, Simmons methods for clubfoot.

OBLIQUE PROJECTION OF THE FOREFOOT

Start with the patient in the AP/DP position and rotate the leg at the hip so that the foot is turned internally and the sole of the foot forms an angle of approximately 30° to the image receptor.

Immobilisation of the patient can be achieved by a number of methods, including the placing of a radiolucent foam immobilisation pad under the raised side of the sole of the foot, or by supporting the medial side of the knee with a larger pad to prevent further internal rotation at the hip.

With a vertical IR, centre to the third metatarsal shaft and collimate to include from toes to the cuneiforms and cuboid at 100 cm SID.

TANGENTIAL PROJECTION OF THE SESAMOIDS

There are two methods.

Patient traction method

Rest the heel on the image receptor and slightly plantarflex/extend at the ankle. Hook a bandage around the toes of the affected side and ask the patient to pull towards them and downwards to remove the toes from the field of view. Using a vertical IR, centre to the head of the third metatarsal and collimate the beam to include the base of the foot, with the medial and lateral borders both in the field of exposure.

See also: Holly method, Causton method.

Patient prone method

Lie the patient prone on the table with the toes of the foot resting of the image receptor. Flex at the ankle so that an angle of approximately 20° is formed between the vertical and the plantar aspect of the foot. Support the foot accordingly with sandbags and pads, and ensure the long axis of the foot is not rotated relative to the receptor surface. Using a vertical IR, centre to a point at the level of the third metatarsal head. Collimate to include all soft tissue borders.

See also: Lewis method.

ANTEROPOSTERIOR/DORSIPLANTAR PROJECTION OF THE FOOT

Using a 24×30 cm image receptor placed in a longitudinal fashion to accommodate the whole foot, place the plantar surface of the foot flat to the receptor and centre the vertical IR to the base of the third metatarsal.

Some centres use a vertical beam, others recommend an angle of 10° towards the ankle to ensure perpendicularity of the central ray to the metatarsal to project a clear joint space. Collimate the beam on four sides to include the whole foot.

(MEDIAL) OBLIQUE PROJECTION OF THE WHOLE FOOT

From the AP/DP position, internally rotate the leg at the hip so the knee of the affected limb turns medially, thus allowing the sole of the foot being radiographed to be raised to form an angle of at least 30° but no more than 45° to the image receptor. Provide immobilisation sponges beneath the foot to prevent movement unsharpness. Use a vertical IR, centre to the third metatarsal shaft and collimate to include the foot and distal end of the tibia and fibula.

See also: Talar neck view and Grashey method for alternative approaches.

LATERAL PROJECTION OF THE FOOT (MEDIOLATERAL)

Turn the patient onto the hip of the affected side, i.e. a lateral recumbent position, and rest the patient's head on a pillow. Flex the leg of the affected side at the knee so the foot turns into a lateral position resting on its lateral border. The other leg is flexed at the knee so the unaffected limb is behind the one being examined.

It may be necessary to raise the knee of the affected side so that the plantar aspect of the affected foot is perpendicular to the image receptor; if so, provide immobilisation. Dorsiflex at the ankle to ensure the ankle joint is also truly lateral. With the foot placed along the long axis of the receptor, use a vertical IR at 100 cm SID centred to a point at the level of the base of the medial or first cuneiform. Collimate the beam to include the distal 2 cm of the tibia.

WEIGHT-BEARING LATERAL PROJECTION OF THE FOOT

Used for the evaluation of pes planus, hallux rigidus and hallux valgus.

With a horizontal IR, place the image receptor on a step stool or custom-built holder, supported vertically with its long axis parallel with the long axis and lateral side of the foot. As the foot is raised into the centre of the image, place wooden blocks in front of the cassette for the patient to stand on.

When standing with the weight being transmitted through the foot of the affected side, the patient may need to support themselves with a handle (preferably secured to the wall). Centre the horizontal IR to the base of the fifth metatarsal (navicular region). Collimate the beam to include the whole of the foot and distal 1–2 cm of the tibia.

See also: Lunge position, Schuss position.

LATERAL PROJECTION OF THE CALCANEUM (OS CALCIS)

As for the mediolateral projection of the foot, but centre the vertical X-ray beam to a point 2 cm inferior to the medial malleolus.

See also: Prayer position.

AXIAL PROJECTION (PLANTODORSAL) OF THE CALCANEUM

The patient is seated on the table with the leg of the affected side extended and the ankle dorsiflexed so that the plantar aspect of the foot is perpendicular to the image receptor. Loop a short bandage around the foot at about the level of the toe bases, so that gentle pressure can be applied to maintain the perpendicularity of the foot relative to the image receptor. This will be uncomfortable for the patient to maintain, especially following injury.

Angle the IR to form an angle of 40° ↑ (i.e. towards the head or, in this case, the ankle joint; ↑indicates up or cranially from IR start position; ↓indicates down or caudally from IR start position) and centre to the base of the third metatarsal – you may need to displace the receptor to capture the elongated image. Use 100 cm SID and employ a kV between 75 and 80 to penetrate the tissue.

See also: Harris and Beam method, Lilienfeld method.

SUBTALAR VIEWS

Although CT has taken over the majority of the imaging of this part of the body, specific areas of the subtalar joints can be evaluated using variation of ↑ angulation (10, 20–30 and 40°) with the medial oblique and just 15°↑ angulation to show the whole subtalar region with the lateral oblique. A general overview is possible with medial or lateral oblique and 20°↑ angulation.

Medial oblique
From the AP ankle position, rotate the patient's leg internally so the long axis of the foot forms an angle of 45° to the image receptor. Angle the X-ray tube for each projection as indicated above. Centre to the subtalar region.

Lateral oblique
From the AP ankle position, externally rotate the affected leg so the long axis of the foot forms an angle of 45° to the image receptor. Ensure the ankle joint does not become malrotated as the patient may inadvertently invert the foot. Angle the X-ray tube 15°↑ from its vertical start point and centre on the talar region, collimating to include the whole of the ankle joint and calcaneum.

See also: Anthonson, Broden I and II, Feist-Mankin, Harris, Harris-Beath, Isherwood methods and Coalition view.

Ankle

ANTEROPOSTERIOR PROJECTION

Patient seated or supine on the examination table (or trolley). Remove clothing, splints, dressings, etc. if possible. Extend the affected limb to rest the heel on a 24 × 30 cm image receptor. Slightly dorsiflex at the ankle so the plantar aspect of the foot is perpendicular to IR. Ensure foot is not inverted at the ankle. Support with radiolucent foam pad if required. Centre a vertical IR between the malleoli and collimate to include at least 10 cm above the joint at 100 cm SID. This image will show superimposition of the lateral malleolus over the lateral joint space.

MORTISE PROJECTION

From AP with 15–20° medial rotation of ankle. Intermalleolar line is parallel to film. Centre vertical IR midway between malleoli. Shows a clear joint space.

LATERAL PROJECTION

Rotate patient to affected side to rest ankle on lateral border. Ensure the foot is coincident with image receptor with no space at toes or heel. Dorsiflex and prevent inversion at the ankle by rotating through the knee and hip. Centre vertical IR on medial malleolus. Occasionally a centring point 3 cm below the malleolus is more successful in demonstrating a clear tibiotalar joint and superimposing the talar domes; alternatively 5°↑ angulation centred on the malleolus is equally successful. Ensure your collimation includes the proximal 2–3 cm of the base of the fifth metatarsal.

OBLIQUE PROJECTIONS

From a mortise position rotate further to enable the ankle joint/foot to form a 45° angle with the IR for a medial oblique. Centre with a vertical IR to the ankle joint to include the distal 10 cm of the tibia and fibula. Conversely, rotate externally 45° to create a lateral oblique projection centred as with the medial description.

STRESS VIEWS

Inversion

To show lateral collateral complex integrity.

Usually performed by the requesting clinician (therefore lead rubber protection should be available) though some centres possess self-stressing devices for patients' use. Begin with the mortise position and ensure collimation light is visible so stressing motion does not lose the area from the radiation field. Allow clinician to stress and make an exposure with a vertical IR on his/her indication.

Eversion

To show deltoid or medial collateral ligament integrity.

As for inversion but allow clinician to evert at the ankle joint.

Anterior draw stress view

To show tibiotalar and talofibular ligament integrity.

Prepare a horizontal ray so that an image receptor lies along the medial border of the foot supported by a pad and sandbag. The patient rests the heel on a wooden block to elevate the whole ankle from the table top. Position as for lateral (i.e. no inversion plus dorsiflexion) and centre to the lateral malleolus. The other leg should be removed from the field for radiation protection. Gently apply a sandbag across the mid-portion of the tibia and allow to remain in place for 1 minute while the patient relaxes. Take an image that includes at least 5 cm of the distal tibia.

Over-rotated lateral projection

To show distal fibula and posterior tibial lip.

From the lateral projection, elevate the heel so the lateral border of the foot is at least parallel with the IR; use a 15° radiolucent pad to support. Patient may have to roll forwards to achieve this position. Centre as for lateral ankle.

Under-rotated lateral projection

To show posterior tibial lip.

From the lateral position rotate the leg so the lateral border of the foot forms a 20° angle with the IR and support with a radiolucent pad. Centre as for lateral ankle.

Tibia and fibula

ANTEROPOSTERIOR PROJECTION

Ideally the whole of the tibia and fibula to include ankle and knee joints should be on the image. This (for most adult patients) will require an increased SID to about 120 cm with a diagonally placed image receptor. Depending on the site of interest it is usually best to ensure that joint position is most true, though having both knee and ankle in AP positions is the ideal. Position to demonstrate as above and centre a vertical IR to fall mid-shaft of the tibia, collimating to include both joints as suggested.

LATERAL PROJECTION

If the patient is able to turn, roll onto side of interest and with a knee flexed to approximately 30° roll the leg onto its lateral side again with the image receptor placed diagonally. Centre to the mid-shaft region with a vertical IR and collimate to include the whole leg.

In trauma situations you may need to take overlapping images of each joint to build a composite image. Lateral projections are attempted lateromedially with a horizontal IR and image receptor placed and supported alongside the medial aspect of the limb.

Knee

ANTEROPOSTERIOR PROJECTION

Place the extended knee joint in the centre of the image receptor. Slightly internally rotate the leg from the hip to place the patella in the centre of the joint. Use a vertical IR and centre to a point 2–3 cm inferior to the patellar apex. Collimate the beam on four sides to include 8 cm of the femur and 2–3 cm below the neck of fibula at 100 cm SID.

LATERAL PROJECTION

From the AP position, turn the patient onto the hip of the affected side and flex the knee to no more than 20°. Place a 15° pad beneath the heel so that the condyles of the femur are brought perpendicular to the film. Angle the IR 5–7° ↑ (towards the femur) and centre to a point 2.5 cm below and posterior to the patellar apex. Collimate the beam on four sides, turning the light beam diaphragm to follow the axis of the tibia such that an appropriate portion of the proximal and distal parts of the joint will be included on the radiograph.

HORIZONTAL RAY LATERAL PROJECTION

Raise the affected leg by placing radiolucent foam pads under the knee joint and also at the ankle if this is required for the patient's comfort. Support an image receptor along the medial border of the knee and rotate the leg internally from the hip until it is in a true AP position. Centre a horizontal IR angled 5–7° to the feet to a point 2.5 cm inferior and posterior to the patellar apex. Collimate to include all the joint at 100 cm SID as for the lateral knee projection.

OBLIQUE PROJECTIONS OF THE KNEE

Medial

To show proximal tibiofibular joint, distal femur, proximal tibia and fibula and the medial half of the patella.

From the AP position internally rotate the leg from the hip, raising the hip if required, should the patient be unable to achieve the rotation naturally, so that the vertical axis of the knee is at 45° to the cassette. Use100 cm SID and a vertical IR centre to a point 2.5 cm inferior to the patellar apex and collimate to include the same area as for AP knee.

Lateral

Fibular head and neck are superimposed by the tibia, lateral half of the patella is shown clear of the femoral condyles, tibial condyles are projected obliquely so seen in profile.

From the AP knee position, externally rotate the leg so that the knee forms an angle of 45° to the vertical. Centre and collimate the beam as with the medial oblique description.

INTERCONDYLAR NOTCH PROJECTIONS

90°

With the patient seated on the table and prepared for the examination, flex the knee to an angle of 130–140° from full extension. Place an oblong radiolucent foam pad with an image receptor resting on it under the knee, to reduce magnification and provide support for the knee. Angle the X-ray tube so the IR is at 90° to the knee joint and centre to a point 2 cm below the apex of the patella using 100 cm SID.

110°

Exactly the same positioning regime is employed for this projection as for the 90° one, but an angle of 110° relative to the knee joint is employed. An increased exposure may be required depending on the size of the patient's knee as the central ray is more acute. This projection is more useful for the posterior part of the intercondylar notch and may supplement the 90° projection afterwards.

See also: Beclére method, Camp-Coventry method, Frik method, Hughston method.

Patella

POSTEROANTERIOR PROJECTION

Turn the patient onto their front, and extend the legs so that the patient lies flat. Slide the image receptor under the affected knee so that the knee joint and patella are included. With a vertical IR at 100 cm SID, centre to the patella and collimate to include an area similar to the AP knee projection.

WEIGHT-BEARING ANTEROPOSTERIOR PATELLA

Place image receptor in erect stand or bucky. Patient climbs a step and faces horizontal ray X-ray tube (i.e. with their back to the stand). Centre of image receptor is at the level of the knees. IR is between knees. The patient's feet are separated with toes pointing toward the X-ray tube and heels apart to achieve true AP and ensure good balance. Collimate to include both knees on one image, with maximal cover of the leg and thigh achievable by the image receptor depth relative to the patient.

POSTEROANTERIOR PROJECTION WITH FLEXION

See Rosenberg method

POSTEROANTERIOR OBLIQUE PROJECTION

See Kuchendorf method

TANGENTIAL PROJECTION

Look at the following named projections for tangential views of the patella: Brattstrom, Ficat, Hughston, Jaroschy-Hughston, Laurins, Merchants, Settegast, Skyline and Sunrise for variations of approach.

Femur

FULL-LENGTH ANTEROPOSTERIOR PROJECTION

The patient, appropriately prepared for the examination, lies with the affected side extended at the knee so the leg is flat and foot rotated vertically. Place a diagonally oriented (relative to femur) image receptor beneath the thigh so the knee to hip is included when a 120 cm SID is employed. Centre to mid-shaft of femur with vertical IR and collimate to include whole area and give gonad protection where possible. A stationary grid may be applied – remember to check for centring and other cut-off issues.

FULL-LENGTH LATERAL PROJECTION

Rotate 45° to affected side while externally rotating and flexing at the hip so the lateral border of the thigh is in contact with the image receptor. Centre and collimate to the laterally positioned femur as for AP.

SPLIT ANTEROPOSTERIOR AND LATERAL PROJECTION

In trauma or those who cannot move to have the image receptor directly beneath or are too large, two projections that overlap are taken, i.e. knee-up and hip-down. AP projections can be comfortably accommodated in the bucky device. Laterals will have to be obtained using a horizontal IR method. The knee-up approach is an extended version of the horizontal ray lateral knee, to cover more of the femur. The hip-down approach requires the unaffected limb to be lifted and supported on a stirrup or large pad and slightly externally rotated. The image receptor with grid is rested parallel with the neck of femur supported by pads and sandbag or placed in a proprietary holder. The horizontal ray is perpendicular to the neck of femur directed beneath the raised limb and collimated to ensure an overlap between the split images is produced.

For other methods employable in trauma see: Clements Nakayama, Danelius-Miller, Friedman, Kisch, Lorenz methods.

AXIAL SKELETAL EXAMINATIONS

Pelvis

ANTEROPOSTERIOR PROJECTION OF PELVIS

The patient is supine on the table; with the median sagittal plane (MSP) perpendicular, the anterior superior iliac spines (ASIS) are equidistant from the film. The extended legs are positioned with the feet slightly separated so that the toes touch, effectively internally rotating at the hips. Place the patient's hands on the chest and immobilise the ankles using sandbags and foam pads. Ensure the X-ray tube is centred to the bucky tray and place a large image receptor transversely in the tray. Using a vertical IR, centre to a point 2.5 cm above the symphysis pubis in the midline.

The image produced should show the pelvic girdle from iliac crests to include just distal to the lesser trochanters and no asymmetry of structures. Larger patients may require greater than the standard 100 cm SID to be accommodated on the image receptor.

Effect of rotation of the hip joint

With **feet vertical** the true relationship of the femoral head and acetabulum will be better appreciated and more helpful in congenital dislocation of the hip (CDH).

External rotation of the hip will allow visualisation of the lesser trochanter; however, this foreshortens the femoral neck, making fracture detection more difficult.

Internal rotation of the hip joint brings the neck of the femur parallel to the film, allowing better visualisation.

In cases of injury an AP projection of the hip should be taken with uninjured hip in the same degree of rotation as the affected limb. This will allow clear comparison between the two sides for assessment of injury. Any forced movement should be carried out by the requesting clinician if necessary, otherwise the patient should direct how far this movement should occur.

ANTEROPOSTERIOR PROJECTION OF SINGLE HIP

The patient lies supine on the table as for the AP of both hips, with the hips internally rotated. Where possible align a vertical IR to the bucky tray which contains a 24 × 30 cm image receptor. Centre the vertical IR to a point 2.5 cm distal along the perpendicular bisector of a line joining the symphysis pubis and the ASIS of the affected side. (The centring point is directly over the femoral pulse.)

HORIZONTAL BEAM LATERAL PROJECTION OF SINGLE HIP

The patient is supine as for the AP projection of the pelvis. Place a 24 × 30 cm gridded image receptor parallel to the neck of the femur with its proximal border pressed into the soft tissues above the iliac crest. Raise the uninjured limb by flexing at the knee joint to form an angle of 90° and rest in a proprietary leg stirrup attached to the table or a large foam pad.

Centre a horizontal beam IR at a point midway between the greater trochanter and the femoral pulse so that the ray is centred to the grid and at 90° to the film. Collimate to include area of interest at 100 cm SID.

LATERAL OBLIQUE PROJECTION OF SINGLE HIP

The patient lies supine on the table and is rotated through 45° to the affected side (MSP is at 45° to table top) supporting the trunk and unaffected limb with a foam immobilisation pad. Flex the hip and knee joint of the side under examination so that they are in contact with the table top. Ensure the vertical IR is centred to the bucky grid. Use a 24 × 30 cm image receptor in the tray. Centre as for the AP single hip, i.e. at the level of the femoral pulse.

MODIFIED LATERAL (TRAUMA USE) PROJECTION OF SINGLE HIP

The patient is supine with the image receptor positioned as for the horizontal beam lateral. From this position tilt the receptor backwards 25° and support with sandbags and foam pads. Centre the IR to the femoral pulse region at the level of the greater trochanter angled ↓ to be perpendicular to the receptor. Collimate the beam to include the area of interest.

For further suggestions see also: Clements Nakayama, Danelius-Miller, Friedman, Kisch, Lorenz methods.

LATERAL OBLIQUE PROJECTION OF BOTH HIPS – FROG LATERAL (USUALLY CHILDREN)

From the AP pelvis starting position, flex the patient’s knees, externally rotate at the hips until the long axes of the femora create an angle of 40–60° with the table top and bring the soles of the feet into contact with each other. Support the legs at the knees with foam immobilising pads and sandbags. Place an appropriately sized image receptor into the bucky tray, centre a vertical bucky aligned IR at a point 2.5 cm proximal to the symphysis pubis and collimate the beam to include both hips/femoral necks. Provide gonad protection if possible, but not at the risk of occluding anatomy which will require another exposure to correct.

OBLIQUE VIEWS OF THE ACETABULUM

See: Judet views

ILIAC OBLIQUE PROJECTION

Side down: shows ilioischial or posterior column and anterior acetabular rim.

OBTURATOR OLIQUE PROJECTION

Side up: shows anterior or iliopubic column and posterior acetabular rim.

ANTEROPOSTERIOR PROJECTION FOR PUBIC BONES

Position the patient as for the AP projection of both hips. Centre the X-ray beam to the bucky but with 20° angulation ↑ for ♂ and 30° ↑ angulation for ♀. Make an exposure at 100 cm SID collimated to include the pubic and ischial rami centred to the lower border of the symphysis pubis.

See also: Taylor method for variations.

PELVIS – INLET VIEW

Position the patient as for the AP both hips, with an image receptor in the bucky. Use an IR angled 40° ↓, already centred to the bucky, to enter the patient at the level of the ASIS in the midline and include the whole of the pelvis.