Structured Training in Clinical Radiology
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References
1 Introduction

1.1 The first version of this document (published in December 1995) was produced in response to the need to formalise the curriculum for specialist training in radiology, consequent upon the Calman Report.1 The second edition (published in March 1999) expanded this document in a more detailed and structured form. This new edition replaces all former editions.

1.2 The purpose of this document is to define the present curriculum in each year of training. Training is delivered in a modular fashion and training objectives are identified for all the constituent subspecialties of clinical radiology.

1.3 The training objectives identified in this document are listed on the modular training objectives forms which are included in the Specialist Registrar Personal Portfolio.

1.4 These training objectives are used to assist trainee appraisal and assessment during the period of specialist training and when achieved can verify that training has taken place to the required standard for the Certificate of Specialist Training (CCST) to be awarded.

1.5 Training for the CCST must take place in departments accredited for training by the Royal College of Radiologists (RCR). Training schemes are centred on teaching and specialist hospitals and include rotations to District General Hospitals. All training schemes are visited by the RCR for the purpose of accreditation, on a four-yearly cycle.

1.6 For the purposes of this document it is assumed that the academic year begins on 1 September and ends on 31 August of the following year.

1.7 Clinical Radiology

1.7.1 The specialty of clinical radiology involves all aspects of medical imaging which provide information about anatomy, function and diseased states, and those aspects of interventional radiology or minimally invasive therapy which fall under the remit of departments of clinical radiology.

1.7.2 A clinical radiologist requires a good clinical background in order to work in close collaboration with colleagues in other medical disciplines, and should be demonstrably conversant with: the basic sciences relevant to diagnostic and functional imaging; the pathological and functional aspects of disease; current clinical practice as related to clinical radiology; the full range of clinical radiology as indicated in this document; the administration, management and medico-legal aspects of radiological practice; and the basic elements of research in clinical radiology.

1.8 Outline of Training Programmes in Clinical Radiology

1.8.1 Each trainee in clinical radiology undertakes a programme of structured training over a minimum period of five years in order to achieve a level of competence in all aspects of clinical radiology that will enable him/her to practise as a specialist.

Basic sciences relevant to clinical radiology are taught in the first year. In addition, the trainee is introduced to interpretative reporting, practical procedures and communication skills.

Thereafter, there should be 36 months of structured training to cover interpretative and procedural skills in all the required subspecialties (see Section 4).

A final twelve months of training will be required to allow for: (i) training in one subspecialty for those who wish to declare a special interest or; (ii) a year devoted to a mixture of two or more subspecialties. This twelve months will usually be undertaken in the fifth year, but may be scheduled in a modular fashion during the fourth and fifth years of training. Additional year(s) of subspecialty training may be needed for subspecialists dedicated to a single subspecialty, e.g. neuroradiology, interventional radiology and radionuclide radiology. In radionuclide radiology this can lead to dual accreditation. Separate curricula will be published for such dedicated subspecialty training.

1.8.2 The current examination structure is as detailed below.

The First FRCR Examination comprises physics, radiological anatomy and radiological techniques. Provided they have passed the First FRCR Examination, candidates are eligible to sit the Final FRCR Examination, which is an intermediate examination comprising a mixture of all the subspecialties within
clinical radiology. The Final FRCR Examination is in two parts: Part A (MCQ component); and Part B (oral/reporting component).

1.8.3 Trainees entering a radiology training programme are required to have a minimum of two years of appropriate clinical experience. In the UK this would comprise one year of pre-registration and one year of post-registration clinical experience.

1.8.4 A period of research is encouraged. Six months of full-time research in any aspect of diagnostic imaging is allowed as part of the five years of accredited training. At the discretion of the Warden, up to twelve months of the five years of accredited training may be spent in clinically based research.

1.8.5 Trainees who hold the FRCR may apply for a CCST on successful completion of five years of accredited structured training.

1.8.6 Trainers are expected to:
   - have substantial expertise in their subspecialty;
   - be accredited by the RCR for continuing medical education as part of their continuing professional development;
   - have demonstrated an interest in training;
   - have appropriate equipment available;
   - have a sufficiently large throughput of cases;
   - have appropriate teaching resources.

1.9 This document should be read in conjunction with the published curricula for each of the subspecialties in clinical radiology and the most up-to-date version of the following documents issued by the RCR. The dates of the current versions are provided in the reference list.

   First Examination for the Fellowship (Clinical Radiology)2 Final Examination for the Fellowship (Clinical Radiology).3
   Regulations for Training in Clinical Oncology and Clinical Radiology.4
   Regulations for the Examinations for the Fellowship of the Royal College of Radiologists in Clinical Radiology.5
   Royal College of Radiologists Training Accreditation in Clinical Radiology, Guidance Notes for Training Schemes.6

1.10 With the publication of this version of Structured Training in Clinical Radiology, the following RCR document is withdrawn:

2 Basic Principles

2.1 The aim of the curriculum is to produce well-trained competent clinical radiologists capable of being appointed as and undertake the duties of a consultant to the accepted standard.

2.2 This standard has to be achieved before the issue of the CCST in Clinical Radiology and entry onto the Specialist Register.

2.3 A major component of training in clinical radiology is achieved by the apprenticeship system with the trainee undertaking an increasing number of radiological tasks. Each component of the training programme should have a clearly defined structure with supervision of the trainee by senior colleagues (trainers). A named consultant/s will assume overall responsibility for each subspecialty module of training. Training in more than one subspecialty may take place during a rotational attachment.

2.4 Each module of training will define all of the core training objectives. The core training objectives will detail the core knowledge and core skills to be achieved and the core experience to be acquired by the trainee during training. Some of the core experience will be optional.

2.4.1 Core knowledge is the knowledge required by a competent trained radiologist. In this document core knowledge has been defined in terms of clinical systems, incorporating elements of anatomy and radiographic/radiological techniques covered in the curriculum for the First FRCR examination. Knowledge relating to imaging techniques (e.g. CT, ultrasound, MRI and radionuclide radiology) are incorporated into the relevant system and no longer defined separately. Core knowledge includes:

- clinical knowledge, that is medical, surgical and pathology, relating to the specific body system;
- knowledge of current clinical practice;
- knowledge of the indications, contraindications and potential complications of radiological procedures;
- knowledge of the management of procedural complications.

2.4.2 Core skills are the practical procedures that are necessary for the trainee to be capable of performing independently but will be supervised during the training period until the necessary level of competence is achieved. Core skills must be assessed at a local level.

2.4.3 Core experience is acquired by the trainee during training.

The RCR recognises that, within the confines of Calman training, it is not possible for trainees to become competent in all aspects of radiology and therefore distinguishes between core skills, (which indicates an essential skill), and core experience. Core experience consists of observation, participation, knowledge and understanding of procedures and investigations not routinely performed by a trainee radiologist, but which should be available in most training schemes.

2.4.4 The skills that must be acquired and assessed for each module of structured training as well as the core knowledge and core experience appropriate to that module are listed on the modular training objective forms included in the Personal Portfolio.

2.4.5 Standardised log books should be used for documenting the skills and experience attained. Log books are mandatory for all interventional procedures irrespective of subspecialty.

2.4.6 The RCR expects that trainee appraisal takes place within each module of training. The purpose of appraisal is to assess the progress of the trainee through each module to anticipate and correct any deficiencies in training at an early stage.

2.4.7 Currently the First FRCR and Final FRCR Part A examinations test knowledge by MCQ format. Interpretative, analytical and communication skills are assessed in final FRCR Part B.

2.5 Training schemes will be expected to offer training in a significant proportion of the optional objectives. It is however recognised that the amount of training in the optional objectives will vary from training centre to training centre according to the facilities available. Both core and optional objectives will be reviewed by the RCR from time to time as practice changes and newer techniques are introduced.

2.6 Years of training activity are not synonymous with years of achievement.

2.7 The trainee will be required to develop those basic skills in research methodology which are necessary to structure and perform research under appropriate guidance. These skills will include the ability to review
published articles critically and to perform effective literature searches on a given topic. An appreciation of the effective application of research findings in everyday practice will also be required.

2.8 The Specialist Registrar Personal Portfolio will be used to document that training is progressing satisfactorily through to the award of the Certificate of Completion of Specialist Training (CCST). The Portfolio, which includes the log book, will be reviewed at each annual assessment.

2.9 Individual progress will be reviewed and evaluated annually. This review will consider the evidence available from the in-training assessments and the processes used to generate this evidence. The RCR recommends that the Regional Dean should collaborate with the Head of Training and the RCR Regional Postgraduate Education Adviser when overseeing these assessments. College Tutors should also be involved in the process. The RCR also encourages the inclusion of an external assessor (such as a consultant clinical radiologist from another training programme) in the annual review process.
3 The First Year

For most trainees the first year of training represents their first opportunity to learn and acquire radiology skills.

3.1 Overview

At the end of the first year the trainee should:

- feel confident in his/her choice of clinical radiology as a career;
- have mastered the basic sciences of clinical radiology (physics, radiological anatomy and radiological techniques) to the level of the First FRCR Examination (see Section 3.2);
- be familiar with the concepts and terminology of diagnostic and interventional radiology;
- understand the role and usefulness of the various diagnostic and interventional techniques in all age groups;
- understand the responsibilities of a radiologist to the patient including the necessity for informed consent;
- be familiar with the various contrast media, drugs (including intravenous sedation) and monitoring used in day to day radiological practice, and be aware of indications, contraindications, doses (adult and paediatric) and the management of reactions and complications;
- be competent in cardiopulmonary resuscitation;
- understand the principles of radiation protection and be familiar with the legal framework for protection against ionising radiation. The trainee should also demonstrate that he/she is capable of safe radiological practice;
- be familiar with safety requirements for radionuclide radiology and imaging with non-ionising radiation (e.g. ultrasound and magnetic resonance);
- have learnt and performed core radiological and radiographic procedures (see Section 3.3);
- have developed, under supervision, core reporting skills (see Section 3.4);
- understand and practice clinical audit and risk management.

3.2 Basic Sciences

An introductory course on basic sciences relevant to clinical radiology is held during the first year. The core of knowledge required to pass the First FRCR Examination has been defined by the RCR (First Examination for the Fellowship, Clinical Radiology).2

3.2.1 Physics

The RCR recommends 40 hours of formal tuition in physics prior to attempting the First FRCR Examination. This teaching is given primarily by medical physicists supplemented by clinical radiologists. Candidates for the First FRCR Examination will be expected to supplement this tuition by a substantial amount of self-directed learning.

In addition, the candidate is expected to be familiar with basic practical aspects of radiological physics and radiation safety including the current ionising radiation regulations.

Core knowledge

the syllabus identified for the First FRCR Examination including the relevant knowledge of radiation protection, ionising radiation, production of x-rays, the X-ray image, the principles of: tomography including CT, diagnostic ultrasound, magnetic resonance (MR) imaging and radionuclide imaging.

3.2.2 Radiological Anatomy

The RCR requires formal tuition in radiological anatomy prior to attempting the First FRCR Examination. This teaching should be given by consultant clinical radiologists. Candidates will be expected to supplement this tuition by a substantial amount of self-directed learning.

Knowledge of anatomy is enhanced by supervised reporting of radiographs in conjunction with consultant trainers. It is expected that each trainee will devote at least three hours (one session equivalent) to this aspect each week.

Core knowledge

knowledge of regional anatomy relevant to radiological practice for each body system.
3.2.3 Radiological Techniques

The RCR requires formal tuition in radiological and radiographic techniques prior to attempting the First FRCR Examination. This teaching should be given by clinical radiologists and radiographers. Candidates will be expected to supplement this tuition by a substantial amount of self-directed learning.

Core knowledge

familiarity with the technical aspects of the core radiological and radiographic procedures, typically acquired through a formal training programme supervised by recognised trainers.

3.3 Clinical Skills—Radiological and Radiographic Techniques and Procedures

In the first year of training the trainee must be introduced to, and begin to acquire some of the practical skills that will eventually be required of a consultant clinical radiologist. There should be a structured programme to cover the breadth of routine clinical radiological practice before starting the more focused subspecialty training modules.

The trainee should become familiar with the techniques listed below and their application to the relevant body systems. The procedures listed as core skills in Sections 3.3.1-3.3.11 will have been performed or overseen by the trainee under the supervision of a recognised trainer. Where options are given, the trainee should observe as many of these options as possible. Optional experience objectives in Year 1 usually become core objectives in Years 2-4 of training.

In the case of plain film radiography, trainees should become familiar with the radiographic technique even if they do not take the radiographs personally.

3.3.1 Breast

Core
- mammography
- ultrasound

Optional
- interventional procedures (e.g. biopsy, cyst puncture)
- magnetic resonance imaging

3.3.2 Cardiac

Core
- plain radiography

Optional
- echocardiography
- radionuclide radiology
- computed tomography
- magnetic resonance imaging
- angiography
- interventional procedures (e.g. angioplasty)

3.3.3 Chest

Core
- plain radiography
- conventional and high resolution computed tomography including CT pulmonary angiography
- radionuclide radiology- ventilation/perfusion scans

Optional
- ultrasound
- magnetic resonance imaging
- angiography
- interventional procedures
3.3.4 Gastrointestinal

Core
- plain radiography – abdomen
- contrast swallow
- contrast meal
- contrast small bowel study
- contrast enema
- transabdominal ultrasound
- sinogram
- computed tomography

Optional
- postoperative T-tube cholangiogram
- intraoperative cholangiogram
- endoscopic retrograde cholangiopancreatography (ERCP)
- percutaneous transhepatic cholangiogram (PTC)/biliary drainage
- radionuclide radiology
- magnetic resonance imaging
- endoluminal ultrasound – upper and lower GI tract
- angiography
- interventional procedures

3.3.5 Head and Neck Imaging including ENT

Core
- plain radiography
- computed tomography
- sialography

Optional
- ultrasound – neck
- magnetic resonance imaging
- dacrocystography – contrast
- dacrocystography – isotope

3.3.6 Musculoskeletal including Trauma

Core
- plain radiography including trauma
- radionuclide radiology
- computed tomography
- magnetic resonance imaging

Optional
- ultrasound
- arthrography
- angiography

3.3.7 Neuroradiology

Core
- plain radiography
- computed tomography of the brain and spine
- magnetic resonance imaging of the brain and spine

Optional
- angiography (conventional, CT angiography and MR angiography)
- myelography/CT myelography
- transcranial and carotid ultrasound including Doppler
- radionuclide radiology
3.3.8 Paediatrics

Core
- plain radiography
- transabdominal ultrasound
- routine contrast examination of the gastrointestinal tract
- routine contrast examination of the urinary tract (IVU, MCU)

Optional
- ultrasound of the neonatal head
- radionuclide radiology
- computed tomography and magnetic resonance imaging with particular reference to technique, sedation and anaesthesia

3.3.9 Reproductive System

Core
- transabdominal and pelvic ultrasound (including obstetric)

Optional
- hysterosalpingogram
- scrotal ultrasound
- computed tomography
- magnetic resonance imaging
- endovaginal ultrasound

3.3.10 Uroradiology

Core
- plain radiography
- intravenous urogram
- transabdominal ultrasound
- nephrostogram
- cystogram
- urethrogram
- radionuclide radiology
- computed tomography

Optional
- endoluminal ultrasound
- magnetic resonance imaging
- antegrade / retrograde pyelogram
- nephrostomy
- angiography

3.3.11 Vascular

Core
- lower limb venography
- doppler ultrasound of the lower limb
- percutaneous arterial diagnostic procedures

Optional
- interventional procedures – angioplasty
  non-invasive vascular arterial imaging including Doppler ultrasound, MR and CT
  radionuclide radiology

3.4 Clinical Skills-Interpretative/Communication and Report Writing

In the first year of training the trainee must begin to acquire some of the interpretative, reporting and communication skills that will eventually be required of a consultant radiologist.
The RCR recommends a minimum requirement of two sessions per week to be devoted to reporting. For the core, the trainee will have interpreted and formally reported the following under the supervision of a recognised trainer.

Core
- all core procedures and techniques performed by the trainee
- a selection of radiographs taken for trauma
- a selection of urgent in-patient and out-patient radiographs
- some selective reporting of a range of patient referrals for non-urgent radiographs

Optional
- reporting of ultrasound, radionuclide, computed tomography and magnetic resonance investigations
- reporting of special procedures not performed by the trainee
- reporting of paediatric investigations

3.5 Appraisal and Assessment

The first year in clinical radiology is often a difficult year of transition for trainees. Heads of Training and College Tutors are encouraged to offer advice, a mentor system and a counselling service during the year. The following milestones should be acknowledged.

3.5.1 The trainee must meet with the College Tutor and / or the Head of Training at the beginning and after three months in post, to identify any difficulties and suggest solutions.

3.5.2 Entry for the First FRCR Examination requires the candidate to obtain the approval of both the Head of Training and the medical physicist responsible for the physics course.

3.5.3 Candidates failing the First FRCR Examination should be counselled by the Head of Training and / or the College Tutor on each occasion.

3.5.4 All trainees should be assessed at the end of the first year as defined in Section 2.9. The possible outcomes of this assessment are listed below.

Progress into the second year of training.
Conditional Progress into the second year of training. A specific action plan will be formulated with the trainee to redress deficiencies in performance of the trainee. Progress will be re-assessed as appropriate within the second year of training.
Failure, if the trainee is so far short of the objectives of the first year training programme such as to prevent the trainee continuing through the training programme. The RCR recommends that repetition of the first year should only be recommended for well founded reasons.
4 Core Training (Second, Third and Fourth Years)

During the second, third and fourth years of training, trainees should receive structured training in all the constituent subspecialties of clinical radiology. The phrase “fourth year of training” is not meant to be taken literally. The fourth and fifth years of training will incorporate twelve months devoted training for one or two subspecialties for those who wish to declare a specific subspecialty interest (or interests). Although this twelve-month period will usually comprise the fifth year of training, it can be distributed in a modular fashion through the fourth and fifth years.

By the end of the fourth year a trainee will usually have had the opportunity to pass the Final FRCR Examination prior to further subspecialty training.

During the first three years of training, individual trainees will have had the opportunity to assess their aptitude for, and interest in, the various subspecialties, so that they are in a position to decide the most appropriate areas on which to focus their training in the fifth year.

4.1 Overview

4.1.1 The framework for the second, third and fourth years will consist of rotations which should give appropriate experience in the areas identified below.

System-based subspecialties:

– breast imaging
– cardiac imaging
– chest imaging
– gastrointestinal imaging
– head and neck imaging including ENT/dental
– musculoskeletal and trauma imaging
– neuroradiology
– obstetric imaging & gynaecological imaging
– uroradiology
– vascular imaging including intervention

Technique-based subspecialties:

– radionuclide radiology

Disease based subspecialties:

– oncological imaging

Age based subspecialty:

– paediatric imaging.

4.1.2 The core knowledge for each system-based module includes the techniques and radiological anatomy assessed in First FRCR. The trainee will also be expected to have knowledge of how multisystem disease may be manifest in other systems.

4.1.3 Technique-based subspecialties (CT, MRI, ultrasound, interventional and radionuclide radiology) are incorporated (for the purposes of defining structured training) within each system-based module and are no longer defined separately in the portfolio, but are defined in this document for reference. Because some training schemes deliver training centred on technique-based rotations the core competencies necessary to be acquired are listed (4.2.17-4.2.21). There is no requirement for training schemes to re-organise training to align with system-based modules, providing core knowledge, skills and experience are acquired during the period of structured training.
4.1.4 In many training schemes it will be possible for trainees to receive training in more than one subspecialty at the same time, and there may also be opportunities to link certain subspecialties (e.g. computed tomography and oncological imaging). Because of the complexities of such rotations and the inherent differences between different training schemes, the RCR leaves it to individual training centres to determine the order of rotations and their duration.

4.1.5 Training schemes must ensure that their trainees are able to achieve all the core training objectives for each subspecialty and most of the optional objectives.

4.1.6 Each trainee will participate in an appropriate on-call rota in which he/she will be responsible to a named consultant. This should commence before the end of the second year of training.

4.2 Clinical Skills

4.2.1 The following sections delineate the core training objectives (knowledge, skills and experience) that will be acquired during the second, third and fourth year rotations. Where an optional objective is given, practical experience is not essential but a theoretical knowledge is still required.

4.2.2 Each component of the training programme will have a clearly defined structure for the supervision of the trainee by senior colleagues (trainers). There will be a named consultant who will assume overall responsibility for the training given during that period, including the techniques performed and reports issued by the trainee.

4.2.3 The trainer will also be responsible for undertaking appraisal of the trainee at the beginning, during and at end of the rotation and may be involved in the end of rotation assessment.

4.2.4 Core Competencies

Core knowledge
• secure knowledge of the current legislation regarding radiation protection
• able to offer advice as to the appropriate examination to perform in different clinical situations

Core skills
• participation in reporting plain radiographs which are taken during the general throughput of the normal working day of a department of clinical radiology
• performing any routine radiological procedures that might be booked during a normal working day
• performing and reporting on-call investigations appropriate to the level of training with the appropriate level of supervision attendance at and conducting clinico-pathological conferences and multidisciplinary meetings
• competence at reviewing studies on a workstation and familiar with undertaking imaging manipulation and post-processing

4.2.5 Breast

Core knowledge
• knowledge of breast pathology and clinical practice relevant to clinical radiology
• understanding of the radiographic techniques employed in diagnostic mammography
• understanding of the principles of current practice in breast imaging and breast cancer screening
• awareness of the proper application of other imaging techniques to this specialty (e.g. ultrasound, magnetic resonance imaging and radionuclide radiology)

Core skills
• mammographic reporting of common breast disease

Core experience
• participating in mammographic reporting sessions (screening and symptomatic)
• participation in breast assessment clinics
• observation of breast biopsy and localisation

Optional experience
• performing breast biopsy and localisation
4.2.6 Cardiac

Core knowledge
- knowledge of cardiac anatomy, and clinical practice relevant to clinical radiology
- knowledge of the manifestations of cardiac disease demonstrated by conventional radiography
- familiarity with the application of the following techniques:
  - echocardiography (including transoesophageal)
  - radionuclide investigations
  - magnetic resonance imaging
  - angiography

Core skills
- reporting plain radiographs performed to show cardiac disease

Optional experience
- supervising and reporting radionuclide investigations, computed tomography and/or magnetic resonance imaging performed to show cardiac disease
- experience in echocardiography (including transoesophageal)
- performing/observing coronary angiography and other cardiac angiographic and interventional procedures

4.2.7 Chest

Core knowledge
- knowledge of respiratory anatomy and clinical practice relevant to clinical radiology
- knowledge of the manifestations of thoracic disease as demonstrated by conventional radiography and CT
- knowledge of the application of radionuclide investigations to chest pathology with particular reference to radionuclide lung scintigrams
- knowledge of the application, risks and contraindications of the technique of image-guided biopsy of chest lesions

Core skills
- reporting of plain radiographs performed to show chest disease
- supervising and reporting radionuclide lung scintigrams
- supervising and reporting computed tomography of the chest, including high-resolution examinations and CT pulmonary angiography
- drainage of pleural space collections under image guidance

Core experience
- observation of image-guided biopsies of lesions within the thorax
- familiarity with the applications of the following techniques:
  - magnetic resonance imaging
  - angiography

Optional experience
- supervising and reporting magnetic resonance imaging
- angiography
- bronchography
- bronchial stenting

4.2.8 Gastrointestinal (including liver, pancreas and spleen)

Core knowledge
- knowledge of gastrointestinal anatomy and clinical practice relevant to clinical radiology
- knowledge of the radiological manifestations of disease within the abdomen on conventional radiography, contrast studies (including ERCP), ultrasound, CT, MRI, radionuclide investigations and angiography
- knowledge of the applications, contraindications and complications of relevant interventional procedures
Core skills

- reporting plain radiographs performed to show gastrointestinal disease
- performing and reporting the following contrast examinations:
  - swallow and meal examinations
  - small bowel studies
  - enema examinations
- performing and reporting transabdominal ultrasound of the gastrointestinal system and abdominal viscera
- supervising and reporting computed tomography of the abdomen
- performing:
  - ultrasound-guided biopsy and drainage
  - computed tomography-guided biopsy and drainage

Core experience

- performing and reporting the following contrast medium studies:
  - cholangiography (T-tube)
  - sinogram
  - stomagram
  - GI video studies
- experience of the manifestations of abdominal disease on MRI with particular reference to the solid viscera
- experience of the current application of radionuclide investigations to the gastrointestinal tract in the following areas:
  - liver
  - biliary system
  - gastrointestinal bleeding (including Meckel’s diverticulum)
  - abscess localisation
  - assessment of inflammatory bowel disease
- experience of the application of angiography and vascular interventional techniques to this subspecialty
- experience of the relevant application of the following interventional procedures:
  - percutaneous biliary stenting
  - balloon dilatation of the oesophagus / stent insertion
  - porto-systemic decompression procedures (TIPSS)

Optional experience

- observation of ERCP and other diagnostic and therapeutic endoscopic techniques
- endoluminal ultrasound
- performing percutaneous cholangiography
- observation of percutaneous gastrostomy
- familiarity with performance and interpretation of the following contrast studies:
  - proctogram
  - pouchogram
  - hemiogram

4.2.9 Head and Neck Imaging including ENT/dental

Core knowledge

- knowledge of head and neck anatomy and clinical practice relevant to clinical radiology
- knowledge of the manifestations of ENT/dental disease as demonstrated by conventional radiography, relevant contrast examinations, ultrasound, CT and MRI
- awareness of the application of ultrasound with particular reference to the thyroid and salivary glands and other neck structures
- awareness of the application of radionuclide investigations with particular reference to the thyroid and parathyroid glands

Core skills

- reporting plain radiographs performed to show ENT/dental disease
- performing and reporting relevant contrast examinations (e.g. barium studies including video swallows, sialography and dacrocystography)
- performing and reporting ultrasound of the neck (including the thyroid, parathyroid and salivary glands)
- supervising and reporting computed tomography of the head and neck for ENT problems
• supervising and reporting computed tomography for orbital problems
• supervising and reporting magnetic resonance imaging in of the head and neck for ENT problems
• reporting radionuclide thyroid investigations

Optional experience
• performing biopsies of neck masses (thyroid, lymph nodes etc)
• observation or experience in performing ultrasound of the eye
• supervising and reporting computed tomography and magnetic resonance imaging of congenital anomalies of the ear
• reporting radionuclide parathyroid investigations

4.2.10 Musculoskeletal including Trauma

Core knowledge
• knowledge of musculoskeletal anatomy and clinical practice relevant to clinical radiology
• knowledge of normal variants of normal anatomy, which may mimic trauma
• knowledge of the manifestations of musculoskeletal disease and trauma as demonstrated by conventional radiography, CT, MRI, contrast examinations, radionuclide investigations and ultrasound

Core skills
• reporting plain radiographs relevant to the diagnosis of disorders of the musculoskeletal system including trauma
• reporting radionuclide investigations of the musculoskeletal system, particularly skeletal scintigrams
• supervising and reporting computed tomography of the musculoskeletal system
• supervising and reporting magnetic resonance imaging of the musculoskeletal system
• performing and reporting ultrasound of the musculoskeletal system
• supervising CT and MR of trauma patients

Core experience
• experience of the relevant contrast examinations (e.g. arthrography)

Optional experience
• familiarity with the application of angiography
• awareness of the role and, where practicable, the observation of discography and facet injections
• observation of image-guided bone biopsy

4.2.11 Neuroradiology

Core knowledge
• knowledge of neuroanatomy and clinical practice relevant to neuroradiology
• knowledge of the manifestations of CNS disease as demonstrated on conventional radiography, CT, MRI, myelography and angiography
• awareness of the applications, contraindications and complications of invasive neuroradiological procedures
• familiarity with the application of radionuclide investigations in neuroradiology
• familiarity with the application of CT and MR angiography in neuroradiology

Core skills
• reporting plain radiographs in the investigation of neurological disorders
• supervising and reporting cranial and spinal computed tomography
• supervising and reporting cranial and spinal magnetic resonance imaging

Core experience
• observation and reporting of cerebral angiograms
• observation of carotid ultrasound including Doppler
• experience in MR angiography and CT angiography to image the cerebral vascular system

Optional experience
• performing and reporting cerebral angiograms
• performing and reporting myelograms
• performing and reporting transcranial ultrasound
• observation of interventional neuroradiological procedures
• observation of magnetic resonance spectroscopy
experience of functional brain imaging techniques (radionuclide and MRI)

4.2.12 Obstetrics and Gynaecology

Core knowledge
- knowledge of obstetric and gynaecological anatomy and clinical practice relevant to clinical radiology
- knowledge of the physiological changes affecting imaging of the female reproductive organs
- knowledge of the changes in fetal anatomy during gestation and the imaging appearances of fetal abnormality
- awareness of the applications of angiography and vascular interventional techniques
- awareness of the applications of magnetic resonance imaging in gynaecological disorders and obstetrics

Core skills
- reporting plain radiographs performed to show obstetric and gynaecological disorders
- performing and reporting transabdominal and endovaginal ultrasound in gynaecological disorders
- supervising and reporting computed tomography in gynaecological disorders
- supervising and reporting magnetic resonance imaging in gynaecological disorders

Core experience
- performing and reporting hysterosalpingography
- performing and reporting transabdominal and endovaginal ultrasound in obstetrics

Optional experience
- supervising and reporting magnetic resonance imaging in obstetric applications (eg assessing pelvic dimensions)
- observation of fetal MRI
- observation of angiography and vascular interventional techniques in gynaecological disease

4.2.13 Oncology

Core knowledge
- knowledge of clinical practice relevant to clinical radiology
- familiarity with tumour staging nomenclature
- familiarity with the application of ultrasound, radionuclide investigations, computed tomography and magnetic resonance imaging, angiography and interventional techniques in oncological staging, and monitoring the response of tumours to therapy
- familiarity with the radiological manifestations of complications which may occur in tumour management

Core skills
- reporting plain radiographs performed to assess tumours
- performing and reporting ultrasound, CT, MRI and radionuclide investigations in oncological staging and monitoring the response of tumours to therapy
- performing image-guided biopsy of masses under US and CT guidance

Optional experience
- familiarity with the practical application of PET imaging in tumour staging and management

4.2.14 Paediatric

Core knowledge
- knowledge of paediatric anatomy and clinical practice relevant to clinical radiology
- knowledge of disease entities specific to the paediatric age group and their clinical manifestations relevant to clinical radiology
- knowledge of disease entities specific to the paediatric age group and their manifestations as demonstrated on conventional radiography, ultrasound, contrast studies, CT, MRI and radionuclide investigations

Core skills
- reporting plain radiographs performed in the investigation of paediatric disorders including trauma
- performing and reporting ultrasound in the paediatric age group in the following areas:
  - transabdominal
  - transcranial
performing and reporting routine fluoroscopic procedures in the paediatric age group, particularly:
- contrast studies of the urinary tract
- contrast studies of the gastrointestinal system
supervising and reporting computed tomography and magnetic resonance imaging
supervising and reporting radionuclide investigations in the paediatric age group
the management of suspected non-accidental injury (NAI)

Optional experience
- the practical management of the following paediatric emergencies:
  - neonatal gastrointestinal obstruction
  - intussusception
- performing and reporting ultrasound in the paediatric age group in the following areas:
  - musculoskeletal
  - chest

4.2.15 Uroradiology

Core knowledge
- knowledge of urinary tract anatomy and clinical practice relevant to clinical radiology
- knowledge of the manifestations of urological disease as demonstrated on conventional radiography, ultrasound, CT and MRI
- familiarity with the current application of radionuclide investigations for imaging the following:
  - kidney
  - renal function
  - vesico-ureteric reflux
- awareness of the application of angiography and vascular interventional techniques

Core skills
- reporting plain radiographs performed to show urinary tract disease
- performing and reporting the following contrast studies:
  - intravenous urogram
  - retrograde pyelo-ureterography
  - loopogram
  - nephrostogram
  - ascending urethrogram
  - micturating cysto-urethrogram
- performing and reporting transabdominal ultrasound to image the urinary tract
- supervising and reporting computed tomography of the urinary tract
- reporting radionuclide investigations of the urinary tract in the following areas:
  - kidney
  - renal function
  - vesico-ureteric reflux
- performing nephrostomies

Core experience
- observation of percutaneous ureteric stent placement
- endorectal ultrasound
- performing image-guided renal biopsy under US and CT guidance
- magnetic resonance imaging applied to the urinary tract
- experience of angiography and vascular interventional techniques
- experience of antegrade pyelo-ureterography

Optional experience
- urodynamics
- percutaneous nephrolithotomy
- lithotripsy
4.2.16 Vascular and Vascular Intervention

Core knowledge

- knowledge of vascular anatomy and clinical practice relevant to clinical radiology
- familiarity with the indications, contraindications, pre-procedure preparation (including informed consent), sedation and anaesthetic regimes, patient monitoring during procedures and post-procedure patient care
- familiarity with procedure and post-procedure complications and their management
- familiarity with the appropriate applications of the following techniques:
  - ultrasound (including Doppler)
  - intravenous digital subtraction angiography
  - intra-arterial angiography
  - computed tomography and CT angiography
  - magnetic resonance imaging and MR angiography

Core skills – imaging

- reporting plain radiographs relevant to cardiovascular disease
- femoral artery puncture techniques, and the introduction of guide wires and catheters into the arterial system
- venous puncture techniques both central and peripheral and the introduction of guide wires and catheters into the venous system
- performing and reporting the following procedures:
  - lower limb angiography
  - arch aortography
  - abdominal aortography
  - lower limb venography (contrast or ultrasound)
- performing the following techniques:
  - ultrasound (including Doppler), venous and arterial
  - intravenous digital subtraction angiography
- supervising and reporting CT examinations of the vascular system (CTA) including image manipulation
- supervising and reporting MRI examinations of the vascular system (MRA) including image manipulation

Optional experience – imaging

- selective angiography (e.g. hepatic, renal, visceral)
- pulmonary angiography
- alternative arterial access (e.g. brachial, axillary puncture)
- upper limb venography
- portal venography
- pelvic venography via femoral approach
- superior vena cavography
- inferior vena cavography

Core experience – interventional

- femoral angioplasty
- iliac angioplasty
- renal angioplasty
- embolisation
- thrombolysis
- stenting
- caval filter insertion

The core training objectives for the technique-based subspecialties CT (4.2.17), MRI (4.2.18), radionuclide radiology (4.2.19) and ultrasound (4.2.20) are listed below for reference, although they have been incorporated into the system-based modules for the purpose of this document and the Specialist Registrar Personal Portfolio. Core training objectives for interventional radiology (4.2.21) are listed below but are also incorporated into the system-based modules.
4.2.17 Computed Tomography

Core
- knowledge of the technical aspects of performing computed tomography (CT), including the use of contrast media
- knowledge of the cross-sectional anatomy as visualised on computed tomography
- practical experience in supervision including vetting requests, determining protocols, the examination, and post processing and reporting of the examination in the following anatomical sites:
  - brain
  - head and neck
  - chest
  - abdomen and pelvis
  - musculoskeletal
  - vascular
- experience in performing computed tomography-guided procedures, e.g. biopsy and drainage
- familiarity with the application of CT angiography
- familiarity with post image acquisition processing

NB: these examinations may be performed during a system-based attachment, e.g. neuroradiology, or during a computed tomography attachment.

4.2.18 Magnetic Resonance

Core
- understanding of current advice regarding the safety aspects of magnetic resonance imaging (MRI)
- knowledge of the basic physical principles of magnetic resonance imaging, including the use of contrast media
- knowledge of the cross-sectional anatomy in orthogonal planes, and the appearance of normal structures on different pulse sequences
- experience in supervision including vetting requests, determining protocols, the examination, and post processing and reporting of the examination in the following anatomical sites:
  - brain
  - head and neck
  - chest
  - abdomen and pelvis
  - musculoskeletal (e.g. hips, knees, shoulders, and extremities)
- experience of the application of MR angiography and venography
- familiarity with post image acquisition processing

NB: this experience may have been gained during a system-based attachment, or during a magnetic resonance attachment.

4.2.19 Radionuclide Radiology

Core
- secure knowledge of the relevant aspects of current legislation regarding the administration of radiopharmaceuticals
- knowledge of the technical aspects of radionuclide radiology relevant to optimising image quality
- knowledge of the radiopharmaceuticals currently available for the purposes of imaging organs and locating inflammatory collections, tumours and sites of haemorrhage
- knowledge of the relevant patient preparation, precautions (including drug effects), and complications of the more commonly performed radionuclide investigations
- knowledge and understanding of the principles and indications of the more commonly performed radionuclide investigations and how these relate to other imaging modalities, in particular knowledge of the radionuclide investigations in the following topic areas:
  - cardiology
  - endocrinology
  - gastroenterology and hepato-biliary disease
  - haematology
  - infection
  - lung disease
  - nephro-urology
  - nervous system
  - oncology
  - paediatrics
– skeletal disorders
• understanding the significance of normal and abnormal results
• knowledge of the strengths and weaknesses of radionuclide investigations compared to other imaging modalities
• experience in supervision and reporting of radionuclide investigations

Optional
• familiarity with the practical application of PET imaging

NB: ideally the training in radionuclide radiology should take place during a radionuclide imaging attachment, but it may occur in part or wholly during a system-based attachment.

4.2.20 Ultrasound

Core
• knowledge of the technical aspects of ultrasound relevant to optimising image quality
• knowledge of the cross-sectional anatomy as visualised on ultrasound
• experience in performing and reporting transabdominal ultrasound examination of structures in the following anatomical areas:
  – general abdomen (including vessels)
  – obstetric
  – pelvis (non-obstetric)
  – small parts (scrotum, thyroid, neck structures)
  – upper abdomen (including lower chest)
• experience of performing Doppler ultrasound imaging (e.g. leg veins, portal vein, carotid artery)
• performing ultrasound of the breast
• performing transcranial paediatric ultrasound
• experience in ultrasound of the musculoskeletal system
• performing ultrasound-guided interventional procedures (e.g. biopsy and drainage)

4.2.21 Interventional

Core
• familiarity with the equipment and techniques used in vascular, biliary, and renal interventional techniques
• familiarity with the indications, contraindications, pre-procedure preparation including informed consent, patient monitoring during the procedure and post-procedure patient care
• familiarity with procedure and post-procedure complications and their management
• performing nephrostomies
• ultrasound-guided interventional procedures (e.g. biopsy and drainage)
• computed tomography-guided interventional procedures (e.g. biopsy and drainage)

Optional
• performing femoral angioplasty
• performing iliac angioplasty
• observation of the spectrum of interventional procedures currently performed in the following systems:
  – vascular system (including neurovascular)
  – urinary system
  – biliary system
  – gastrointestinal system
  – musculoskeletal system
• experience of MR – guided interventional procedures

4.3 The trainee will also attain an appropriate level of knowledge in:
• clinical conditions in which radiology has a role in diagnosis and /or treatment
• applied pathology and physiology where it contributes to a better understanding of radiological signs and methods of investigation
• those aspects of clinical medicine and pathology which are essential to the safe and effective conduct of interventional procedures
• current trends and recent advances in clinical radiology
• medical ethics
• statistics and research methods.
4.4 The trainee will develop skills, as part of his/her general professional development, in:

- teaching
- clinical audit
  - clinical effectiveness
  - clinical risk management including critical film review
  - quality standards
- research
- management (see Section 4.4.1 below)
- health informatics (See Section 4.4.2 below)

Some of these aspects of training will require attendance at in-house and/or external meetings and courses at appropriate periods during training.

4.4.1 The necessary management skills fall under the following headings:

- contextual awareness—understanding the bigger picture and developing an ability to operate effectively at all appropriate levels in the NHS
- strategic thinking
- functional and operational skills, and knowledge of the day to day operation of radiology departments and other health care units
- clinical governance including clinical effectiveness, quality assurance and clinical risk management
- human resources/people management, team building, complaints procedures, professional development

4.4.2 Health Informatics

The trainee should:

- develop core skills in information technology, especially the ability to perform basic word-processing, and to access computerised medical databases, electronic mail systems and the internet
- keep abreast of developments in information management relevant to Radiology departments
- strive for best practice in patient record keeping and the transfer of clinical data and images
- comply with the Acts and Directives concerning Data Protection in clinical practice, and when using patient data for research, audit or teaching
- understand the principles and practice of evidence based medicine
- understand how clinical information is used in Clinical Governance.

4.5 The trainee should develop the following personal attributes, as part of his/her general professional development:

- self-awareness
- time management
- teamwork
- handling uncertainty
- skill in communicating with patients
- skill in communicating with colleagues

4.6 There will be an annual review of each trainee as outlined in Section 2.9. The in-training assessments should be formalised and rigorous and should be completed jointly by the trainee and assessors. The aim is to:

- verify experience and competence gained during the preceding year
- ensure that set targets have been met
- review clinical, technical and general professional development skills (listed in Section 4.4)
- identify any deficiencies in expected knowledge, practical skills or experience
- assign the appropriate outcome and complete the relevant RITA form (C, D, E, F or G).

The assessment should be formalised and completed jointly by the trainee and assessors with a copy of the assessment being sent to the Regional Dean and the RCR Regional Postgraduate Education Adviser.

4.7 At the end of the fourth year the trainee should:

- have substantial experience of interpreting and reporting plain radiographs in all subspecialties
- have acquired experience of performing and reporting all core procedures as defined in Sections 4.2.5–4.2.16
- be able to advise clinicians on appropriate imaging algorithms for the investigation of standard clinical situations, e.g. jaundice
• be able to perform and give a provisional interpretation of standard emergency imaging procedures, e.g. cranial computed tomography, transabdominal ultrasound, transfemoral aortography, intravenous urography and contrast examination of the gastrointestinal tract
• have attempted the Final FRCR Examination
• have formulated a preference for their training in the fifth year (see Section 5.1)

4.8 The possible outcome of the assessments at the end of the second, third and fourth years will be:
• Progress into the next year of training.
• Conditional Progress into the next year of training. A specific action plan will be formulated with the trainee at the assessment to redress deficiencies in performance. Progress will be reassessed as appropriate within the next year of training.
• Failure, if the trainee is so far short of achieving the objectives of the previous year’s training programme.
• This will only happen in exceptional circumstances, and only after consultation between the Head of Training, College Tutor, RCR Regional Postgraduate Education Adviser and Regional Dean. The precise course of action will be formulated by this group and will depend on the individual situation, but will range from the trainee’s repeating his/her training in the areas judged to be severely deficient, to the recommendation that the trainee’s contract is not renewed.
5 Subspecialty Training (Year 5)

5.1 Overview
The fifth year of training, which may be undertaken in a modular fashion during the fourth and fifth years of training (see Section 4), contains elements of choice. Broadly, these are:

- continued training in core competencies to a higher professional level;
- development of one or more subspecialty interests;
- training in a single subspecialty, which may, with the agreement of both the RCR and the Regional Postgraduate Dean, continue into a sixth year of training.

It is envisaged that for subspecialty rotations there will be a minimum commitment of six sessions per week to subspecialty training. It will sometimes be appropriate to link system-based expertise with a technique-based expertise. Whether or not it is possible or advisable for this subspecialty training to be undertaken in the base training centre, elsewhere in the UK, or abroad, should be decided on the basis of: (a) previous assessment of progress and aspirations; (b) local availability and suitability of specialist rotations; and (c) the necessary agreements (see Sections 5.6.1 and 5.6.2).

5.2 The elements of general professional development, as outlined in Section 4.4, will also be pursued during the fifth year of training.

5.3 Annual assessments, as defined in Sections 2.9, 4.6 and 4.7, will continue during the subspecialty year with an emphasis on guidance as to future career choices. Completed log books will continue to be essential in documenting the progress of the trainee towards the completion of her/his training, and the award of a CCST.

5.4 The curricula for selected subspecialties are provided in an appendix to this document. In general terms the trainees are expected to acquire the elements identified below.

- Detailed knowledge of current theoretical and practical developments in their chosen subspecialty (or subspecialties).
- Extensive directly observed, or unobserved but supervised, practical experience in their chosen subspecialty (or subspecialties).
- Development of clinical knowledge relevant to their chosen subspecialty (or subspecialties). This could take the form of attending clinics / ward rounds.
- Full utilisation of study allowance (currently equivalent to one session per week with a maximum of thirty days in a year) to pursue research projects within their chosen subspecialty (or subspecialties) and to strive to see this work through to publication. Trainees should be assiduous in attending and presenting such work at appropriate meetings.
- Understanding of clinical audit and risk management, and its application to their chosen subspecialty (or subspecialties).
- Documentation of the extent of all relevant training in their Personal Portfolio, which will include a log book of all relevant experience.

5.5 Where the desired subspecialty training cannot be provided on-site, the RCR recommends that training schemes should make every effort to assist the trainee to obtain an attachment or fellowship at another institution if this is appropriate to his/her career needs. It is recognised that this will require consultation and agreement between the Head of Training, the RCR Regional Postgraduate Education Adviser, the Regional Dean, the Clinical Director of the department to which the trainee is attached and, where relevant, the Head of the Subspecialty Training or Fellowship. Other forms of attachment, such as a day- or week-release, may provide a suitable alternative for some trainees.

5.6 Training centres must identify a named trainer responsible for each subspecialty in which training is offered.

5.6.1 Trainers should assess the trainee’s aptitude for his/her chosen subspecialty at the earliest opportunity. The trainer, together with the College Tutor and Head of Training should advise those trainees unlikely to succeed within that particular subspecialty as soon as this becomes apparent. Trainees are advised to discuss their chosen subspecialty (or subspecialties) with suitable mentors before embarking on such training.

5.6.2 Apart from the annual review (see Sections 2.9, 4.6 and 4.7), informal continuing assessment of the trainee by the trainer will be required in order to focus the development of radiological skills.
6 Glossary of Terms

A Training Programme/Training Scheme
A department of clinical radiology (or a number of departments) which provides a programme of training matching the requirements of the RCR's structured training curriculum. Training programmes/schemes are accredited for training on a four-yearly cycle by the Training Accreditation Committee (TAC) of the RCR.

A Training Department
A department of clinical radiology which is part of accredited training within a comprehensive five-year training scheme. The training department may contribute to one or more parts of the curriculum.

CCST
Certificate of completion of specialist training. This certificate is issued by the Specialist Training Authority on the recommendation of the RCR after: (I) satisfactory completion of each of the five years of the curriculum in a department or departments accredited by the RCR; and (ii) admission to the Fellowship of the RCR.

RITA
Record of in-training assessment. An annual review of in-training assessments at which a recommendation about progress through the grade is made and forwarded to the Postgraduate Dean and the RCR. The review is carried out by a small specialty-based panel, the composition of which has been agreed by the local Specialty Training Committee.

Fellowship Appointment
An attachment, usually of six to twelve months, spent in a specialist unit, which may be away from the main training centre, designed to provide particular experience in one (or more) radiological subspecialties.

Head of Training Scheme
In centres appointing, employing and training junior radiologists, there will be one clearly identifiable person who has overall responsibility for the training programme. This is usually separate from the Clinical Director to avoid potential conflict of interest, but may on occasion be the same individual where this arrangement can be shown to be advantageous to the scheme as a whole. In all circumstances the line of accountability must be clearly understood by all.

RCR Regional Postgraduate Education Adviser
This is an RCR-appointed post subject to the approval of the Regional Dean. The holder is accountable to the Warden. He/she is primarily responsible for ensuring that the RCR's aims in regard to postgraduate education are adopted throughout the Region. He/she is normally chairman of the Regional Radiology Training Committee.

College Tutor
This is a locally appointed consultant who is responsible for supervising the needs of individual trainees. There will be at least one College Tutor in each training hospital whether it is a teaching hospital or a district hospital.
7 References


