

Curricula for Subspecialty Training

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Introduction

This appendix contains curricula for training in three subspecialties of clinical radiology: interventional radiology; breast imaging; and neuroradiology/interventional neuroradiology. It is important that it is read in conjunction with the main document, Structured Training in Clinical Radiology.¹

Curricula for the subspecialties listed below may be added to this appendix in future. Appropriate training for all the listed subspecialties is encouraged and supported by the Royal College of Radiologists. The curricula indicate the training and experience that should be offered in the fifth year of training (which can be undertaken in a modular fashion during Years 4 and 5 where this would be advantageous to the trainee or the training scheme).

Where sixth year subspecialty training is required or desirable, the curricula in this appendix show how fifth and sixth year training can be integrated.

The curricula in this appendix do not refer to subspecialty training that will have been undertaken in Years 1-4; these requirements are contained in the main document. The fifth year subspecialty curricula in this appendix assume that Years 1-4 core training in the subspecialty has been achieved.

The term "subspecialty", as used in this document, refers to training undertaken as an integral part of the structured training programme, which is intended to lead to the award of a Certificate of Completion of Specialist Training (CCST) in clinical radiology.

The subspecialties encouraged and supported by the Royal College of Radiologists (RCR) include:

- System-based subspecialties:

Cardiovascular Imaging

Chest Imaging

ENT/Dental Imaging

Breast Imaging

Musculoskeletal Imaging

Gastrointestinal Imaging

Uroradiology

Obstetric & Gynaecological Imaging

Neuroradiology

- Technique-based subspecialties:

Conventional Radiology

Ultrasound

Radionuclide Radiology

Computed Tomography

Magnetic Resonance

Interventional Radiology (including angiography and minimal access therapy)

- Disease-based subspecialties:

Oncological Imaging

Trauma Imaging

- Age-based subspecialties:

Paediatric Imaging

-Breast Imaging

1 Introduction

1.1 This curriculum outlines the training requirements for both symptomatic and screening work in Year 5 of specialist registrar training (this training may be undertaken in a modular fashion in Years 4 and 5 if it is advantageous to the trainee or the training scheme). The special training requirements for those involved in the National Health Service Breast Screening Programme (NHSBSP) are also outlined in the NHSBSP Quality Assurance Guidelines for Radiologists.²

1.2 All specialist registrars will have obtained a basic knowledge of breast diagnosis as a specialist registrar in Years 2, 3 or 4 of their radiology training, mainly as an observer. The subspecialty training outlined will extend this role into the practical situation.

1.3 Those clinical radiologists who wish to devote essentially all their time as consultants in breast imaging, should undertake 12 months of subspecialty training in breast imaging.

1.4 Those clinical radiologists who wish to practise breast imaging as one of a mixture of activities as a consultant should normally undertake 6 months of subspecialty training in breast imaging.

2 Objectives

2.1 The aim of establishing a curriculum for subspecialty training in breast radiology is to ensure:

- an in-depth understanding of breast disease with a particular knowledge of the nature of breast cancer in all its guises;
- a clear understanding of the role of imaging in the early diagnosis of breast cancer;
- development of the necessary clinical and management skills to enable radiologists to become an integral part of a multidisciplinary breast team in both symptomatic and population screening settings.

2.2 Experience will be documented in a log-book. If adequate experience cannot be gained in one training centre, it will be necessary for the trainee to have a period of attachment at other training centres. There may be, in any case, a need for trainees to visit other departments at home or abroad to follow particular interests in greater depth. Those who will be involved in the NHSBSP are required to attend one of the national training centres.

3 Overview of Training

3.1 The main document to which this appendix is attached, Structured Training in Clinical Radiology, outlines core and optional knowledge as well as experience during the first four years of training.¹ The trainee undergoing subspecialty training now needs to become actively involved in the work of the breast clinic in an educational environment of one-to-one graduated supervision.

3.2 The trainee needs to be involved in both symptomatic diagnosis and the process of breast cancer screening, and needs to have a clear understanding of the relationship between these two activities.

3.3 As training in breast diagnosis is a mixture of image interpretation and practical procedures, it is essential that the trainee is exposed to at least a minimum number of screening and symptomatic cases.

3.4 The trainee will gain clinical knowledge and experience by participating in breast symptomatic clinics, assessment clinics in the NHSBSP, and the regular multidisciplinary meetings with the breast team.

3.5 As audit is an integral part of the process of breast cancer screening the trainee will have a ready-made analysis of the proficiency of his or her activities. The trainee will also be expected to complete a specifically focused audit involving screening or symptomatic work. An understanding of the process of interval cancer analysis should be acquired.

3.6 The trainee should participate in research, and should be encouraged to pursue a project up to and including publication. An understanding of the principles and techniques used in research, including the value of clinical trials and basic biostatistics, should be acquired.

4 Core Requirements

4.1 A sound understanding of the basis of breast diagnosis, including:

- the embryology, anatomy and physiology of the breast;
- the pathology of the breast in benign and malignant conditions;
- the epidemiology of breast cancer;
- the principles of population screening for breast cancer.

4.2 Substantial knowledge of the techniques involved in:

- mammographic principles, grid and film screen combinations;
- equipment choice for screening and assessment;
- radiographic positions, coned and magnification views;
- specimen radiography;
- radiation dose and patient risk-benefit factors;
- digital imaging.

4.3 Detailed and extensive experience in imaging of the breast, including an understanding of:

- early mammographic evidence of malignant disease;
- normal variants;
- the role of ultrasound, radionuclide and magnetic resonance imaging.

4.4 Expertise in breast interventional techniques including:

- aspiration of cysts;
- fine needle aspiration cytology using stereotaxis and ultrasound;
- guided core biopsy;
- guided localisation for biopsy and treatment.

4.5 Familiarity with the organisation of breast cancer services including:

- the structure of the NHSBSP;
- the principles of triple assessment and rapid diagnostic clinics;
- cancer units and cancer centres;
- the role of the Programme Manager and the Clinical Director;
- the interface between screening and symptomatic services;
- NHSBSP Quality Assurance Guidelines for Radiologists.

4.6 Minimum experience per month for training in breast screening:

- interpretation of screening mammograms-400 cases;
- experience of x-ray and ultrasound procedures-20 cases;
- involvement in assessment clinics-four clinics.

4.7 Minimum experience per month for training in symptomatic breast disease:

- interpretation of symptomatic cases-40 cases;
- experience of x-ray and ultrasound procedures-eight cases;
- involvement in triple assessment clinics-four clinics.

-Interventional Radiology

1 Introduction

1.1 This curriculum outlines the training requirements for interventional radiology in Year 5 of specialist registrar training (this training may be undertaken in a modular fashion in Years 4 and 5 if it is advantageous to the trainee or the training scheme). It also outlines the requirements for a sixth year of training for those who wish to become dedicated interventional radiologists.

1.2 This document aims to outline a curriculum for training in general interventional radiology, concentrating on vascular, gastrointestinal and urological intervention, thus covering most of the procedures carried out by interventional radiologists. Interventional procedures in other organ systems are excluded as they have special requirements, and will be addressed as appropriate in the training documents of other subspecialties. Biopsy and fluid collection drainage techniques are practised by all radiologists and are not addressed in this document.

1.3 Specialist registrars in clinical radiology will have undergone training in interventional procedures in the second, third and fourth years, prior to subspecialty training, and will therefore already have obtained the basic skills.

2 Objectives

2.1 The aim of establishing a curriculum for subspecialty training in interventional radiology is to ensure:

- a detailed knowledge of current theoretical and practical developments;
- extensive hands-on experience with graded supervision;
- in-depth understanding of indications, contraindications and complications of interventional procedures as well as their relative efficacy compared with other treatment options;
- development of clinical knowledge relevant to interventional radiology.

2.2 Experience will be documented in log-books. If adequate experience cannot be gained in one training centre, it will be necessary for the trainee to have a period of attachment at other training centres.

3 Overview of Training

3.1 Structured Training in Clinical Radiology¹ outlines the core of knowledge required during the first four years of training and an optional category in which practical experience is not essential but a theoretical knowledge is required. Basic skills in interventional procedures will have been obtained prior to subspecialist training.

3.2 The interventional radiology experience obtained in the first four years will count towards the total experience of subspecialty training in interventional radiology.

3.3 For training purposes interventional radiology can be divided into vascular and non-vascular procedures. Whether a trainee trains in all intervention, or selects either vascular or non-vascular intervention, depends on their ultimate goal.

3.4 As training in interventional radiology is predominantly hands-on, it is essential that trainees are exposed to at least a minimum number of procedures and that they are the first or sole operator in at least 50% of these. This is to ensure that they develop the necessary manual dexterity and experience the most common complications and how to rectify them.

3.5 Clinical knowledge will be obtained by a variety of means such as participation in ward rounds, attending outpatient clinics, close liaison with the appropriate surgical and medical teams and combined clinical and radiological meetings. Clinical acumen will form part of the assessment made by the trainer.

3.6 The trainee should undertake an audit of his/her interventional activities and participate in research.

4 Core Requirements

4.1 The core requirements for a radiologist working essentially full-time in interventional radiology, and a radiologist doing a mixture of activities one of which is interventional radiology, are similar apart from the total number of procedures performed. The numbers quoted are approximate but are considered achievable in the time given and will ensure a satisfactory level of experience.

4.2 Radiologists who devote essentially all their time to interventional radiology will be expected to undertake complex procedures; acquisition of the necessary expertise requires the trainee to undertake a larger number of interventional procedures.

4.3 The groupings that follow are based on the concept of modular training.

4.4 The procedures listed in the core and optional requirements will be reviewed at intervals, along with the minimum number of procedures required, as it is recognised that some procedures will become obsolete and new techniques will be developed.

4.5 All interventional radiologists must have a thorough knowledge of the techniques required to perform sedation and analgesia procedures, as well as patient monitoring throughout and following the procedures, and should be familiar with existing guidelines.

4.6 It is the responsibility of the trainee to be aware of the current local and national guidelines in obtaining informed patient consent.

4.7 The trainee is expected to keep abreast of other imaging modalities relevant to their practice.

5. Subspecialty Training in Vascular Interventional Radiology

Procedure	More than one subspecialty interest		Dedicated interventional radiologist	
	Core	Optional	Core	Optional
Diagnostic arteriography (peripheral, central and selective)	100		150	
Percutaneous balloon angioplasty of the lower limb, renal, visceral and upper limb arteries	65		130	
Thrombolysis IVC filter insertion/retrieval	25		50	
Embolisation Vascular stent insertion				
Alternative arterial access sites (eg axilla, brachial, radial, popliteal)	5		10	
Percutaneous central venous access	10		10	
Foreign body retrieval Percutaneous aspiration thrombectomy		Yes	10	
Peripheral aneurysm exclusion Percutaneous atherectomy				
Transjugular intrahepatic porto-systemic stent shunts (TIPS)				Yes
Chemoembolisation				
Aortic stent grafting (thoracic/abdominal)				
Coronary interventional procedures				

6. Subspecialty Training in Non-Vascular Interventional Radiology

6.1 Uradiology

Procedure	More than one subspecialty interest		Dedicated interventional radiologist	
	Core	Optional	Core	Optional
Renal tract access	20		40	
Ureteric dilation/stent insertion	5		10	
Percutaneous nephrolithotomy		Yes		Yes
Varicocele embolisation		Yes		Yes
Pelviureteric junction (PUJ) procedures		Yes		Yes
Fallopian tube recanalisation		Yes		Yes

6.2 Gastrointestinal Radiology

Procedure	More than one subspecialty interest		Dedicated interventional radiologist	
	Core	Optional	Core	Optional
GI dilations and stents	10		20	
Transjugular/plugged liver biopsy	5		10	
Percutaneous gastrostomy	5		10	
Percutaneous biliary drainage procedures and/or stent insertion		Yes		Yes
Endoscopic procedures		Yes		Yes

7. Dedicated Interventional Radiology Training in Year 6

7.1 A trainee who wishes to become, in effect, a full-time interventional radiologist should spend at least two years in subspecialty training. One year of this experience can be obtained during the fifth year of radiology training (or in a modular fashion in the fourth or fifth years of training if it is advantageous to the trainee or the training scheme).

7.2 A sixth year is necessary to increase the trainee's experience and enable him/her to perform more complex procedures.

Curriculum for Subspecialty Training -Neuroradiology

1 Introduction

1.1 This curriculum outlines the training requirements in neuroradiology, including interventional neuroradiology, in Years 5 and 6 (the first subspecialty year of training may be undertaken in a modular fashion during the fourth and fifth years of training if this is advantageous to the trainee or the training scheme).

1.2 This document outlines the training curriculum for a consultant neuroradiologist. A minimum of one year full-time training in neuroradiology is essential, but two years are recommended. This recommendation conforms to the advice of the British Society of Neuroradiologists in their document *Effective Neuroradiology*³. All training posts should be approved and accredited for training by the Training Accreditation Committee of the RCR.

1.3 The specialist registrar's entry into neuroradiology training as a subspecialty would normally take place at the end of Year 4 of clinical radiology training, following success in the Final FRCR Examination. Thus, Years 5 and 6 would be devoted to neuroradiology training.

1.4 Specialist registrars in clinical radiology will have undergone some training in neuroradiology in the first four years prior to subspecialty training and will therefore already have obtained basic skills.

1.5 The content of training needs to be flexible and appropriate to the ultimate goal of the trainee. Neuroradiology is an expanding specialty with development of interventional services, paediatric neuroradiology and functional brain imaging, including spectroscopy. Some trainees may wish to obtain extra training in these areas.

2 Objectives

2.1 The aim of establishing a curriculum for subspecialty training in neuroradiology is to ensure that the trainee acquires:

- a detailed knowledge of current theoretical and practical developments in the specialty;
- clinical knowledge relevant to neuroradiology, so that they can, with confidence, discuss with their colleagues the choice of best imaging method;
- a knowledge of the relevant pathophysiological, biochemical and clinical aspects of neurological diseases;
- an in-depth understanding of the indications, contraindications and complications of procedures;
- direct exposure to interventional procedures to provide them with a full knowledge of the technical problems and risks of the procedures. Some hands-on experience with graded supervision will be required by all trainees in neuroradiology, but will vary from straightforward procedures to more complex procedures depending on the trainee's future job goals.

3 Overview of Training

3.1 *Structured Training in Clinical Radiology*¹ identifies the core of knowledge required during the first four years of training with some optional categories in which practical experience is not essential, but a theoretical knowledge is required (see Section 4.2.13 of *Structured Training in Clinical Radiology*¹). Basic skills in neuroradiology will therefore have been obtained prior to subspecialist training.

3.2 A department of neuroradiology responsible for training must provide at minimum on-site access to appropriate modern CT, MRI, and digital subtraction angiography. Many centres will also provide access to relevant ultrasound, radionuclide imaging and magnetic resonance spectroscopy.

3.3 Clinical knowledge will be obtained by a variety of means, including close liaison with the appropriate surgical and medical teams and combined clinical and radiological meetings. The following clinical interrelationships are necessary:

- neurology (paediatric and adult);
- neurosurgery (paediatric and adult);
- neuropathology;
- neurophysiology;
- neuro-anaesthesia/critical care and emergency medicine.

Other specialties will also provide important training opportunities, e.g. ophthalmology, ENT, psychiatry and neuropsychology.

3.4 Experience will be documented in log-books. If adequate experience cannot be gained in one training scheme, it will be necessary for the trainee to have a period of secondment at other training schemes in the UK or abroad with a large active practice, if this is appropriate to his/her career needs (e.g. paediatric neuroradiology, interventional neuroradiology).

3.5 The training programme should be completely devoted to neuroradiology, with consultant supervision of all of the imaging and interventional procedures.

3.6 The neuroradiology specialist registrar should participate in neurosciences clinical audit.

3.7 The neuroradiology specialist registrar should be encouraged and given the opportunity to attend appropriate meetings and courses.

3.8 The neuroradiology specialist registrar should be involved in research, have the opportunity to present projects at meetings and progress research projects to publication.

3.9 The neuroradiology specialist registrar should participate in the neuroradiology on-call service, after adequate training and with appropriate consultant back-up.

3.10 The posts should be approved and recognised for training by the Training Accreditation Committee of the RCR. The visiting team should include a neuroradiologist.

4 Core Requirements

4.1 The core requirements for a neuroradiologist or a specialist interventional neuroradiologist are similar, apart from the total number of interventional procedures performed (Section 5.9). No precise recommendations can be made on the minimum number of procedures to be carried out during training. Nevertheless, some guidelines are provided in Sections 4.3 and 5.9.

4.2 The core procedures will need to be reviewed at intervals along with the minimum number of cases required, as it is recognised that some procedures will become obsolete (e.g. myelography) and new techniques will be developed (e.g. functional brain imaging and spectroscopy).

4.3 During the training period it is recommended that the trainee receives the following:

- CT-the equivalent of two sessions per week;
- MRI-the equivalent of two sessions per week;
- angiography-the equivalent of two sessions per week;
- interventional neuroradiology-see Section 5.9;
- study/meetings-the equivalent of one session per week;
- research-the equivalent of one session a week;
- myelography/radiculography-the opportunity to observe, and, whenever possible, obtain hands-on experience of the limited number of these procedures now carried out.

5 Interventional Neuroradiology Requirements

5.1 All specialist registrars training in neuroradiology should have a basic understanding of interventional procedures. They will therefore need some exposure to interventional techniques so that they have full knowledge of indications, technical problems, contraindications and risk of procedures. Trainees with a special interest in interventional neuroradiology will need more extensive experience.

5.2 All trainees in interventional neuroradiology should complete at least one year of diagnostic neuroradiology training.

5.3 Trainees who wish to spend a significant part of their work as a consultant in interventional neuroradiology should spend at least one year in a training post in which substantially the whole time is devoted to interventional neuroradiology.

5.4 Trainees should have adequate exposure to neurosurgical operations and ward/HDU management of acutely ill patients.

5.5 Regular involvement in neurosciences audit and mortality/morbidity meetings is necessary to understand risk management for different clinical conditions.

5.6 It is the responsibility of the trainee to be aware of the current local and national guidelines in obtaining informed patient consent.

5.7 All interventional trainees must have thorough knowledge of techniques of sedation and analgesia required to perform these procedures, as well as patient monitoring throughout and following the procedures.

5.8 Trainees should be aware of the full range of intra- and post-operative complications and their management.

5.9 The interventional trainee should participate in at least 80 neuroradiological interventional procedures of which a substantial proportion will be for intracranial vascular lesions. The trainee should be the first operator in at least a third of cases.

References

1 The Royal College of Radiologists (1999) *Structured Training in Clinical Radiology* (second edition). London: The Royal College of Radiologists.

2 *NHS Breast Screening Radiologists' Quality Assurance Committee* (1997) NHSBSP Quality Assurance Guidelines. NHSBSP.

3 The British Society of Neuroradiologists (1996) *Effective Neuroradiology*. The British Society of Neuroradiologists.