Radiology history in North-East Scotland in the 20th and 21st centuries

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Sadly, Alexander MacDonald and Francis Smith died on 16th January and 27th May 2022 respectively, after their contributions were received, but before completion of the final version. This work is dedicated to them.

Historical context

Radiology is a relatively young specialty, with x-rays first being invented in November 1895 by Wilhelm Roentgen in Wurzburg. Aberdeen was quick to adopt the new technique. James Mackenzie Davidson, an ophthalmologist in Aberdeen, visited Roentgen in Wurzburg soon after publication of his paper in 1896, to find out about the new technique. John Levack worked with Davidson and had x-ray equipment installed in his home in Golden Square in Aberdeen. He was appointed as medical electrician at Aberdeen's Royal Infirmary, then at Woolmanhill, in 1896. Their application in Scotland to medical diagnosis occurred rapidly and is well documented in John F Calder's book entitled "The History of Radiology in Scotland (1896-2000)", (Dunedin Academic Press, Edinburgh, 2001).

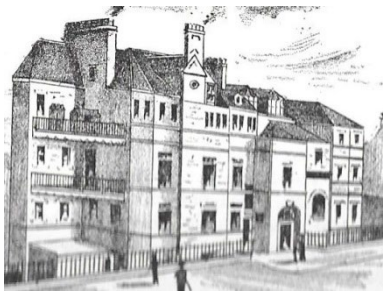
The text and images that follow have been contributed by radiologists, radiographers and a radiology administrator, who lived and worked in Aberdeen in the latter half of the 20th century and, in some cases the early 21st century. The intention was never to provide a comprehensive document, but to give an account of how it was, by those who were there. The authors represent a small sample of staff from what is an increasingly large multi-disciplinary team comprising radiographers, radiologists, clinical scientists, nurses, porters, administrators and managers. An account of paediatric radiology is given first as this sets out the historical context well, technological developments over time, illustrates the multi-disciplinary team and involvement of radiologists across many modalities and sub-specialty areas. Elizabeth Stockdale's account gives an excellent description of radiology services being at the heart of patient care but also of the relentless effort required to find funds for new equipment, often from charitable donors or public fundraising events.

Radiology is characterized by constant technological evolution, interspersed with "game-changing" developments that have altered patient care in major ways. Over just 50 years these have included invention of positron emission tomography (PET), computed tomography (CT), magnetic resonance imaging (MRI) (see section 6 for Aberdeen's contribution to this), picture archiving and communication systems (PACS), new ways to treat disease using interventional radiology (IR) and the introduction of artificial intelligence (AI). It has been an exciting time to be a radiologist in the North-East of Scotland.

1. Paediatric Radiology Dr Elizabeth J Stockdale

Great improvements have been made over a comparatively short time in the imaging of children, with the recognition of Paediatric Radiology as a specialty, with specialist training for personnel, the production of guidelines for the care of children and of dose-reduction strategies. There have been technological advances in x-ray equipment, new modalities have been introduced including ultrasound, axial imaging and nuclear medicine, increasing diagnostic accuracy. "Wet plates" and handwritten reports have given way to digital images and voice-dictated reports. The service in Aberdeen could not have been developed without the dedication and of its staff radiologists, radiographers, dark room technicians, and secretaries, members of the radiation protection service and engineers, and the support and encouragement of radiologists from the adult sector and paediatric surgical and medical colleagues.

In 1877, when the first Aberdeen children's hospital was established, the population of Aberdeen City was 9,181, expanding to 213,224 by 2021. In 1877 there were just 14 beds but there are now 85 beds and since 2012 the age limit for patients has increased from 14 to 16.The new RACH is now one of three designated Paediatric Major Trauma Centres in Scotland and together with Aberdeen Maternity Hospital's neonatal unit (NNU) is the Regional Neonatal Surgery Centre.



Royal Aberdeen Children's Hospital, Castle Hill: 1877-1928

The first hospital overlooked the harbour at Castle Hill. It was named "The Royal Aberdeen Children's Hospital" by Queen Victoria in 1894. Dr John Levack was appointed radiologist to the hospital in 1900. He had established an X-ray department in 1896 in Aberdeen Royal Infirmary which was then at Woolmanhill, only a year after Roentgen's discovery of X-rays. According to the *Aberdeen Press and Journal* of 14 September 1912, Queen Mary, the hospital's patron, visited, and entered the "Electrical and Roentgen Ray" room. Dr Levack was presented to her. "Here there was a very interesting practical demonstration. Her Majesty expressed a desire to have an explanation the rays, and minutely explained the operation of the apparatus, and showed how was possible to look through the hand so that any foreign body might located and dealt with". The Queen commented on the overcrowded building and said a new one should be built. Fundraising was interrupted by WW1, during

which time Dr Levack also was in charge of the X-ray department of the first Scottish General Hospital, Aberdeen. Dr Alexander Coutts Fowler was appointed assistant radiologist in 1924. He had interrupted his undergraduate studies, serving "with great distinction" as a surgeon probationer on Special Ships in WW1. He subsequently qualified and later became a radiologist.

Royal Aberdeen Children's Hospital Foresterhill: 1926-2003

The new children's hospital was opened in 1929 at Foresterhill, "built on the pavilion system, with four wards each of 32 beds, built to last 30 years". But it had to last for 78 years. Its radiological department was always cramped and remained so in spite of some later improvements. Both Drs Levack and Fowler moved with their staff to the new hospital, but Dr Levack retired in 1930 succeeded by Dr Fowler as radiologist in charge, assisted by Dr William Hubert Milligan. Dr Fowler died in 1933 aged only 37, and Dr Milligan took over. He had served with distinction in WW1 and in WW2 as Radiologist to the 12th Scottish General Hospital near Cairo, returning to RACH in 1948 and retired in 1958. In 1948 the Voluntary hospitals such as RACH were taken over by the State, and most of the substantial RACH endowments were given to other hospitals, much to its detriment.

Dr William H Milligan

Miss Queenie McEwan

In 1958, Dr Milligan was succeeded by Mr Archie Stewart, a surgeon who had also served in the RAMC in WW2 with distinction in Africa, Sicily and Italy Following post- war work in paediatric surgery, he trained in radiology. He was assisted from time to time by Dr Michael Allen, whose main remit was at the City Hospital. Miss Queenie McEwan was combined Superintendent Radiographer and Physiotherapist during part of Dr Milligan's and Mr Stewart's tenure. She retired in 1962 and was succeeded by Miss Ruth Florence who retired in 1989 and was succeeded by Miss Sheila McDonald who had worked as radiographer at RACH since 1974 As well as providing radiological services for children, lateral pelvimetry for maternity patients was performed at RACH. Mr Stewart also undertook biplane paediatric cardiography at ARI. Inadequate space and staffing continued to be a problem. On Mr Stewart's retirement in 1979, Dr Tony Bayliss (APB,) who had been appointed in 1975, held the fort at RACH until Dr Elizabeth Stockdale (EJS) who trained at Great Ormond Street Hospital and in radiology at St George's Hospital was appointed in 1980. She retired in 2008. APB undertook a session at RACH until the early 1990's. In the early 2000's he moved to Hexham. Sadly, he died in 2011. He was a wonderful colleague and is greatly missed.

By 1980, RACH was a tertiary referral teaching hospital, its catchment area including the North- East of Scotland with Orkney and Shetland. The paediatric radiology department, together with axial imaging at ARI, provided comprehensive cover to the wards and clinics and to the neonatal unit (NNU) of the Maternity Hospital. As an extension of their hospital duties, Paediatric radiologists were required to attend court to present evidence in cases of suspected non-accidental injury. Before digital imaging Aberdeen radiologists also had to report, on a rota basis, boxes of films from Orkney and Shetland which arrived by ferry, and conduct clinics there. They also, on a rota basis, reported films from the chest clinic at the City Hospital before it closed.

In 1989, after a number of improvements, RACH was deemed "Hospital of the year" out of over 200 hospitals by the *Sunday Times* "beating off challenges from some of the finest hospitals in the UK", We decorated our department with cheery wallpaper and many toys and a beautiful garden was created just outside the waiting room. One of our registrars, a member of the Magic Circle, even gave very popular magic shows in the waiting room. However, the fabric of the hospital was failing. The small consultant's room housed reporting facilities, and an extensive film and book collection. Crowded weekly Friday afternoon clinical meetings had to be held there, to use the multi-viewer, with coffee and home bakes supplied. The ceiling collapsed in the early nineties fortunately not on a Friday, missing EJS who had just left the room, but smashing everything else.

Installation of up-to-date equipment was a priority, often acquired with a combination of funding from the Health Board and significant contributions from the most generous people of the North-East, with various campaigns publicised by *the Aberdeen Press and Journal* and the *Evening Express*.

1980: Baby having EMI CT head scan at ARI

1983: Dr Tony Bayliss accepting a cheque from senior Management members, Weetabix Ltd. towards an ultrasound machine for RACH

1988: new cine- flouorscopy and sound system for maxillo-facial examinations. L to R: Mr Oliver Fenton, Plastic Surgeon, Miss Ruth Florence, Dr Stockdale, Mr Sandy Taylor of CLAPA, Mrs Beverly Reynolds, Senior speech Therapist.

1995: Dr Stockdale accepting a cheque from Mr Rick Cowie and Mr Sandy Rose, East Coast Moped Club, for a new ultrasound machine for RACH.

A dedicated paediatric image intensifier was installed in 1981. In 1983 an ultrasound machine was funded by the Health Board, the Cliff Richard Children's Hospital Appeal sponsored by Weetabix, and the Rothienorman, Fisherford, Fyvie and Auchterless Women's Circle. Before this the little patients had to travel with their nurse to ARI for ultrasound. An updated ultrasound machine was obtained in 1988. In 1995, with help from Professor George Youngson, under the Mrs Monro bequest, a theatre portable image intensifier was obtained to replace the ageing non-motorised mobile. This was later replaced by a C arm intensifier, subsequently connected to PACS in the new hospital. Also in 1995 part of Mrs Monro's bequest together with donations from the East Coast Moped club, school children from Methlick and an Aberdeen Scout group, provided funding towards a colour Doppler ultrasound machine. In 1998, a new general table was installed which incorporated the latest dose reduction devices as did the replacement paediatric image intensifier installed in 1999. This was part funded by DHL following a large party at the Beach Ballroom, with support from KLM, British Midland Airways, McCall's the kilt makers and the Women's Royal Voluntary Service.

1998: Miss Ruth Florence (first left) performed the opening ceremony for the new general table, seen here (left to right) with Dr Bayliss, Miss McDonald, Dr Stockdale, Graham McKenzie (imaging services manager) Mrs Isla Kelman, Mrs Beryl Farquhar, Mrs Lynn Campbell, Andrew Alexander (Siemen's manager) and Ms Kay Clubb.

Aberdeen was no exception to the difficulty in obtaining equipment and staffing: the 1999 report for the Standing Scottish Committee of the RCR regarding manpower and equipment in all Scottish radiology departments [written by Professor Jamie Weir, Dr Elizabeth Stockdale, Dr Ruth McKenzie (RHSC, Glasgow) and Alexander Stockdale] demonstrated the lack of manpower and funding for equipment and urged proper planning and provision, given the crucial role of radiology in patient management.

Academic involvement: we hosted the successful 1996 meeting of the British Paediatric Imaging Group (later the British Society of Paediatric Radiology, BSPR) and meetings of the Association of Paediatric Radiographers. RACH radiology participated in a Europe-wide exercise by the Lake Starnberg group of the European Society of Paediatric Radiologists, the results of this study establishing important guidelines for the improvement of training, use of equipment in paediatric radiology and dose-reduction strategies. Following this,

recommendations by the BSPR and the Paediatric Radiology group of the RCR fed into of the paediatric section of “Making the Best Use of a Department of Clinical Radiology ” (co-edited by Professor Gillian Needham, Aberdeen) and into the Ionising Radiation (Medical Exposure) Regulations. Papers relating to paediatric doses were produced at RACH with members of the bio-medical physics and bio-engineering department, and published in the Journals of the BIR. EJS was a member of the radiology section of the United Kingdom Children's Cancer Study Group. Her 2005 Strathclyde MBA dissertation was on “Risk Management in an NHS department of Paediatric Radiology

As a teaching department, radiology registrars, senior registrars and student radiographers had for many years rotated through the department and became extremely welcome and valued members of the team, many going on to join the permanent staff.

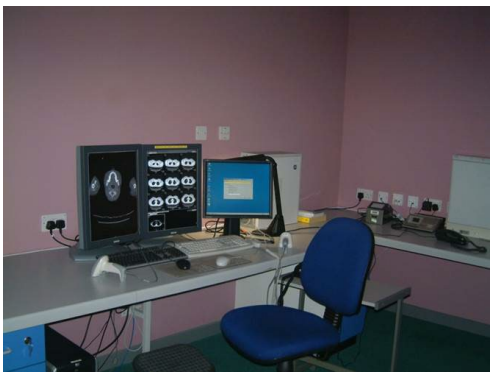
Dr Lesley Gomersall was appointed consultant in Aberdeen in 1995, with sessions at RACH, retiring in 2021. She and Miss Sheila McDonald established the programme for ultrasound evaluation of developmental dysplasia of the hip, and at ARI, Dr Gomersall and Professor Weir took a special interest in paediatric CT scans.

Professor Weir, together with Dr Phillip Booth, consultant neonatologist, led the cardiac scanning service for RACH and NNU.

Dr Karen Duncan was also appointed, with sessions at RACH, and retired in 2021. She also performed head scans in the NNU, led radiology meetings there and established a Head Ultrasound Training course. Dr Duncan, Miss McDonald and senior radiographer Ms Kay Clubb all performed antenatal scans at Aberdeen Maternity Hospital. Dr Duncan also undertook mammography sessions and was the lead for radiology audit in Aberdeen.

Dr Angus Thompson was appointed consultant in 1995 also with sessions at RACH from which he retired in 2016. Now continuing to work at Woodend Hospital, particularly in musculo-skeletal radiology, he had bought this expertise to the department. He is currently chair of the Area Medical Committee Following in the footsteps of many Aberdeen radiologists he served with the forces in the RAMC TAVR from 2004 to 2009.

Dr Stockdale reporting hard copy films on tapes which were then transcribed.



Part of PACS digital reporting room, in new RACH. Computerised images, voice dictation.

Developments in image production are well illustrated in the Neonatal Unit (NNU) at Aberdeen Maternity Hospital. Very few babies could be cared for intensively before the unit

for 38 babies was built in 1988, thanks to £1m raised by the Friends of the Special Nursery. Plain films were performed there, with screening at RACH. In the early days, heavy film cassettes had to be taken up the road to the NNU by the radiographer, and when the films had been taken were returned to RACH and developed as wet plates which had to be dried before the radiographer returned them, all delaying the management of the patient. Later an automatic film processor was installed at RACH, and then a small dedicated processor was set up in a cupboard in the NNU. A radiographer on-call room was made available there to increase the response time. In 2003, prior to its roll out at the new hospital which was under construction, a successful pilot Picture Archive and Communication System (PACS) was installed in the NNU. Images could be seen almost instantaneously, and were transmitted to the x-ray department of the old children's hospital, where they were reported by voice dictation, and incorporated digitally into the system where they could be read by the staff. An up-to-date ultrasound machine enabled retention and transmission of the images to RACH.

The new Baird family hospital is due to replace the 84 year old maternity hospital at the end of 2023 and will incorporate the NNU, gynaecology and breast services. It will have appropriate imaging facilities and will be linked by corridor to the new children's hospital.

Royal Aberdeen Children's Hospital, Foresterhill: from 2004

In planning the new hospital, it was ensured that the radiology department was co-terminus with the ground floor paediatric accident and emergency and outpatient departments and readily accessible the wards and theatres. An enormous amount of work was undertaken by our staff in the closure of the old department and its transfer to the new, and there was meticulous removal and reassembly of the fluoroscopy unit by the Siemen's engineers. The Archie Foundation (RACH charity) appeal raised £5M, part of which enabled the funding of a new general table and ultrasound machine. The new department is spacious and well planned, with child-friendly décor and facilities. The meetings room is also connected to the Picture Archiving and Communication System (PACS) and to other hospitals for video-

conferencing. The room designed for an MRI machine was unfortunately taken over by the IT department. The reporting room contains the latest equipment for PACS and monitors for viewing the images and reports are placed in strategic places through the hospital. A corridor connects the hospital to ARI, facilitating access to its imaging modalities. It opened on 25th January 2004. The PACS system worked perfectly. Many tutorials on its use were given to staff groups who would use the system, which was subsequently rolled out to the adult hospitals and could incorporate images from most imaging modalities. Miss McDonald (now Mrs Cameron) retired in 2013, after almost 40 years working at RACH, and was succeeded by Mrs Susan Robertson who had also trained at ARI and RACH.

Miss McDonald in the "filmless" processing room.

One of the two cheery ultrasound rooms.

New Screening room.

General room.

With its child and parent-friendly ethos and up to date buildings and equipment, the North-East has a modern children's hospital to be proud of.

Acknowledgements: sincere thanks are due to Ms Kirsty Smith, Archivist, Aberdeen Journals Ltd. for her help and Aberdeen Journals Ltd. for their permission to quote articles and use images.

2. Neuroradiology Alexander F MacDonald (b 1929 d 2022 Neuroradiologist ARI 1964-1992), Pat Skinner and Linda Reid Neuroradiographers

The first cerebral angiogram was performed by a Portuguese doctor, Antonio Cetano de Abreu Freire Egas Monica, in 1927. He also introduced lobotomy, and was a Nobel prize winner in 1949, after a long medical and political career. Lumbar air encephalography, as a less invasive successor to ventriculography was first successfully performed by Walter Dandy in USA in 1919.

In the 1950s, the first, and probably best Scottish Neuroradiologist, Tony Donaldson, established the sub-specialty in Edinburgh, encouraged by the then doyen of neurosurgery, Norman Dott. Aberdeen followed suit once Sandy MacDonald took up post as Consultant Neuroradiologist in 1964. His over-riding principle was that no Grampian patient should receive an examination inferior to any other Scottish teaching hospital. Achieving this, in the face of the rapacious nature of the Scottish Central belt NHS, has not always been easy.

Encephalography

Prior to the invention of computed tomography (see below) the only way to visualize intracranial or spinal masses was by contrast examination. This meant that neuroradiologists performed many examinations requiring technical skills under x-ray control. Introducing gas or liquid that could be distinguished from soft tissues and bone on x-ray led to air encephalography and myelography. Lumbar encephalography initially using air, then O2, then CO2 became a very useful investigation, with CO2 being better tolerated than air or O2.

Ventriculograms and lumbar air encephalograms were carried out on a Princeps X-ray unit which comprised of a motorised chair which could be flattened into a table and raised or tilted to the required position. Ventriculograms involved injecting air through a surgical opening in the skull, draining the cerebrospinal fluid from the ventricles and replacing it with air or gas. Due to the complexity and invasiveness of the procedure, it was only undertaken when there were serious indications that there was a definite intracranial abnormality. Lumbar air encephalograms involved a lumbar puncture to remove the spinal fluid from the subarachnoid spaces and replacing it with gas. It was the best examination for observing the inner and outer surfaces of the brain.

Myelography

A cervical myelogram involved the patient lying prone on the table, chin supported, and head immobilised. These were initially also carried out on the Princeps unit. A mesh grid was taped onto the side of the neck and an x-ray taken to ascertain the level of puncture. Once the contrast was injected it was important to keep the contrast within the cervical area, therefore the patient's neck was kept in the extended position. This was an uncomfortable position for the patient, especially if they had back and/or neck pain. A lumbar myelogram involved inserting a lumbar puncture needle at L3/4 and contrast media being injected to visualise the cauda equina and lumbosacral nerve roots. This was to assess if there was a bulging lumbar disc, causing pain down the leg. Myelography's problems initially were with irritant contrast media, with Myodil, an oil-based contrast medium, resulting in arachnoiditis in some patients. Safer and better tolerated water-soluble media were fortunately solved world-wide, with Aberdeen keeping pace. Myelography, eventually with water soluble ionic then non-ionic

contrast media, became the standard investigation for spinal lesions, especially intra-thecal, and used various entry points where appropriate, including, lumbar, lateral cervical, and cisternal.

Angiography

Carotid and vertebral angiography was originally undertaken with direct puncture into the carotid and/or vertebral arteries in the patient's neck. Iodised contrast media was then injected into the artery which subsequently outlined the main arteries in the brain and images were taken at timed intervals. Once the film was processed and reported, it was stored in a film bag, which was filed in the departmental film store. Films were pulled for review on wards, in theatre or at multi-disciplinary meetings and not infrequently went missing, a problem circumvented by PACS.

This procedure was then superseded by the Seldinger method of femoral puncture which used a small gauge needle, catheter and wire, guided into position by an image intensifier. Femoral artery catheterization is much safer than direct puncture carotid or vertebral artery puncture and also easier for both operator and patient. Once the catheter was manipulated into the carotid and vertebral arteries, a contrast injector was connected to the catheter and images taken. X-ray film was replaced by digital images.

The indication for cerebral angiography is typically intracranial haemorrhage. When a patient is diagnosed with a subarachnoid haemorrhage (SAH) on CT scan, this is followed by an angiogram to identify the aneurysm responsible. During the procedure it's important to image the neck of the aneurysm, as this determines whether a craniotomy or embolisation will be performed. If the neck is wide, a craniotomy is done to clip the aneurysm. If narrow, embolisation is performed to pack the aneurysm with a substance to block the blood supply to the abnormal vessel. Originally a special type of glue was used, but this has been replaced by special coils of various sizes. This is an interventional neuroradiology procedure and is much less invasive to the patient than a craniotomy.

Fortunately, all the above invasive diagnostic procedures have been largely replaced by cross-sectional imaging with CT or MRI, which have become a victim of their own success. CT and MRI are easier for the patient, much less tiring for the radiologist, but is also responsible for the inexorable increase in requests for these examinations, along with an ageing multi-morbid population, resulting in a dramatic increase in workload and sometimes long waiting times for appointments. Embolisation is now restricted to a few specialist centres and SAH patients from Grampian are treated in Edinburgh. National PACS enables an interventional neuroradiologist in Edinburgh to view CTA or MRA images acquired in Aberdeen.

A brief history of CT

Godfrey Hounsfield worked for EMI as an engineer. In 1971 he developed the world's first CT Scanner which imaged only the head. This machine was installed at the Atkinson Morley Hospital in Wimbledon, London. At this time, Mr Christopher (Chris) Blaiklock was a registrar training in neurosurgery. He subsequently became a senior registrar in Glasgow, where the first Scottish CT scanner was installed, then a Consultant Neurosurgeon at ARI in 1974. This was to prove advantageous for the neuroradiology department at ARI as he was very keen for

a CT scanner to be installed here. There were 4 EMI ‘CT1010’ scanners purchased for Scotland in 1975/1976, which were installed in Aberdeen, Dundee, Glasgow and Edinburgh.

Dr Alexander (Sandy) McDonald was the Consultant Neuroradiologist in charge of the neuroradiology department at the time and was responsible for developing the service once the scanner was installed.

Initially a CT head scan appointment took approximately 30 minutes; the patient had to lie down on the scanning table, with their head enveloped in a large, rubberised, water bag. Each full rotation took 90 seconds to complete, and if the patient’s head moved in the water bag, this would cause motion artefact and the scanning process would have to be repeated. As a result, it was emphasised to the patient that they remain as still as possible throughout the scan. The images produced were transferred to a floppy disc from which the radiologist reported. The information was then archived onto magnetic tape. Polaroid images, and subsequently A4 film on which 6 images were printed, were stored in the patient’s CT scan folder. As technology progressed the information was transferred on to CD’s. Latterly PACS has become the storage method of choice. Today an entire CT scan takes almost the same time as one slice took in the 1970’s. These pictures of the original and present-day CT scanner, demonstrate the advancement of radiological technology over the years from the first installation in 1975 to 2022.

Original EMI CT scanner and consul

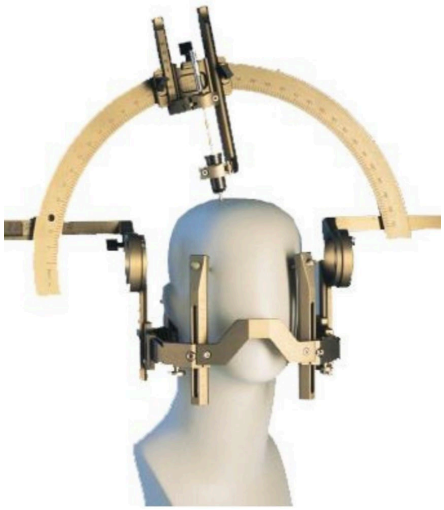
Siemens Somatom CT scanner and consul used today.

In both CT head and body scan, the procedure has been enhanced by a contrast media being injected into a vein by a motorised pump, giving exceptional detail of the organs and vessels which aids the rapid diagnosis required. CT angiography is carried out by timing image acquisition to the arterial phase of contrast circulation. Over the years CT technology has progressed to acquiring a volume of data which can be reconstructed in 3 planes; axial, coronal and sagittal. The scanner also has the ability to reformat 3D images. In today's state of the art CT scanners, the radiation dose to the patient has been reduced significantly, ensuring that the benefits outweigh the risks, provided the examination will answer a clinical question.

Leksell Stereotactic Frame

Aberdeen Royal Infirmary used the Leksell Stereotactic frame in conjunction with the neurosurgical department to localised intracranial lesions such as tumours or arteriovenous malformations, prior to surgery. The procedure involved placing a frame on the patient's head and taking a CT scan. The system uses X, Y, Z coordinates to stereotactically localise any point in 3D space. The arc employs the 'centre-of-arc' principle for encompassing the surgical target in three dimensions. This enables full access to any intracranial area, in a minimally invasive manner.

Lexsell frame with calibrated arc.



Lexsell frame in situ.

Sandy Macdonald had high standards and expected nothing less from others for the benefit of patients, often much to the amusement of his loyal radiographers, including Pat Sinner and Linda Reid. He was held in highest esteem by clinical colleagues in all specialties. He trained many junior radiologists. Of the first seven who rotated into neuroradiology, six became neuroradiologists worldwide, including Canada, Australia, England, Hong Kong and even Dundee. None trained by Sandy will forget how to clean the skin prior to myelography or how to do a cervical puncture. Those who survived 6 months with Sandy joined the "*Order of Neuroradiological Stakhanovites*" (after Aleksei Gregoroevich Stakhanov who was credited with mining 102 tons of coal in less than 6 hours during the Soviet second 5-year plan).

The main challenge for neuroradiology services in future are provision of sufficient dedicated neuroradiologists and to develop a thrombectomy in acute stroke service, which the population in Grampian and the North of Scotland deserve.

3. Cardiothoracic Radiology Professor Jamie Weir

One afternoon in August 1975, two senior trainees in Radiology were sitting opposite one another in the anteroom of Grampian Health Board, situated in those days in Albyn Place. They were there to be interviewed for a new Consultant Radiology post. The Board's secretary put her head around the door and said to the two of them 'if you don't say anything stupid in your interviews this afternoon, you will both be offered a post as a second new Radiology Consultant post is now also on offer". To their knowledge, neither Jamie Weir (JW) nor Tony Bayliss (APB) said anything to upset the panel and were appointed that afternoon with APB starting on December 1st 1975 and JW on 1st January 1976.

APB had been trained in the Western Infirmary, Glasgow under Jake Davidson, where he had developed an interest in both obstetric and general ultrasound. He started the ultrasound service shortly after being appointed and oversaw the progression of the ultrasound department with purpose-built units being established in the 80's and 90's. Interventional ultrasound with drainage procedures, liver and renal biopsies, percutaneous nephrostomies and many other techniques all progressed under his guidance. In the latter stages of his career, he moved to Hexham as a Consultant Radiologist but sadly died a short time afterwards after developing a glioblastoma.

JW had also undergone ultrasound training but in the field of echocardiography, at the Middlesex Hospital in London and at Harefield Hospital, Middlesex, a specialised cardio-thoracic centre. He began the echocardiographic service in 1976 both for adults and children, including those in the neonatal unit. Only M-mode was available in those early days but with the rapidly expanding ultrasound technology, 2D imaging, colour doppler and computerisation soon became the norm. Radiographer training lead to the service developments that allowed inpatient and outpatients sessions to be undertaken throughout Grampian.

At the time of the appointments in 1975, the Radiology Consultants were; Lewis Gillanders (Head of dept), Sandy MacDonald (Neuroradiology), Ronnie Mahaffy (Vascular Radiologist), Peter Ward (Gastrointestinal and Cardio-Thoracic Radiologist), Archie Stewart (Paediatric Consultant) and Mike Allen (City hospital). Alec Simpson was the sole Radiologist at Dr Gray's in Elgin.

Peter Ward worked with one of the two Consultant Cardiologists existing in 1976, Dr J Finlayson, in performing bi-plane cardiac imaging in children for congenital heart disease. Imaging in these patients changed over the following years with the increasing accuracy of cardiac ultrasound and the appointment of a specialised cardiac and neonatal consultant, Dr Philip Booth. Cardiac catheterisations for coronary artery disease became the province of newly appointed interventional Cardiac Consultants that also in the latter days of the 90's performed their own echocardiography together with coronary artery stenting, pacemaker insertion and other invasive procedures.

JW developed the Cardiothoracic Radiology service, along with Dr Lesley Gomersall, to include per-cutaneous lung biopsy and broncho-pulmonary stent insertion, one of the first institutions in Scotland to have this facility. This was instrumental in motivating Roland Sutton and his wife Lilian to establish the Roland Sutton Academic Trust (see section 7). In 1982/3, the first whole-body scanner was purchased after the Press and Journal laser line appeal had

raised a considerable amount of funds in excess of that which was originally required for a laser for ARI. The CT whole body scanning service was initially started by JW and shortly afterwards a new post was created to help with the workload, filled by the appointment of Dr Elizabeth M. Robertson.

Dr John Calder was appointed in the early 80's as a Senior Lecturer/Hon Consultant with Lewis Gillanders as Reader and subsequently Chair of the X-ray Dept. With the move of John Calder to Glasgow, the academic aspects of departmental activity were severely limited until the creation of the Roland Sutton Academic Trust in 1990.

4. General Radiology and Radiography – Jamie Weir, Pat Skinner and Linda Reid

Concurrently with the upgrading of neuroradiology, Lewis Gillanders, the then Head of Department, was successfully leading a minor revolution in general radiology, including, for the first time, weekly conferences with clinical units, or wards, which is essential in any useful X-ray department. This was greatly facilitated by the appointment of consultant staff with additional qualifications in medicine and surgery. In the 1960s, despite very limited number of working radiologists, the general department began a fully accredited course in radiology, offering the Diploma in Medical Radiodiagnosis (DMRD), and upgrading the school of radiography. Both of these attracted radiologists and radiographers to train in Aberdeen and assisted in basic local staffing.

Department of Radiology staff circa 1986 Back row: Jeff Hussey, Ron Mahaffy, Dugald Glen. Second from back row: Sandy MacDonald, Francis Smith, Jamie Weir, Tony Bayliss, Graeme McKenzie. Middle row: Sister Thompson, Rosemary Logie, Alan Brown, Gillian Needham, Fiona Gilbert. Second from front row: Audrey Masson, Kathleen Reynolds, Iris, Betty Spowart, Doreen Ross. Front row: Peter Ward, Elizabeth Stockdale, Lewis Gillanders, Elizabeth Robertson, Douglas Davidson.

The x-ray department could not operate without radiographers. In the 1970's, radiographers studied for 2 years for a diploma in radiography. The majority of the course was undertaken in-house at Aberdeen Royal Infirmary. Anatomy lectures were delivered by the consultant radiologists whilst the radiography tutors undertook lectures in patient care, manual handling, photography and equipment. Lectures were scheduled from 9-10am or 4-5pm. This allowed the student radiographers to be allocated to an x-ray room in either the in-patient or out-patient x-ray department for the remainder of that day.

The radiation physics lectures were undertaken at Robert Gordon University.

It was a very practical course where procedures worked on the basis of 'see one, do one, teach one'. A radiographer had to be qualified for at least 3 years before being eligible to

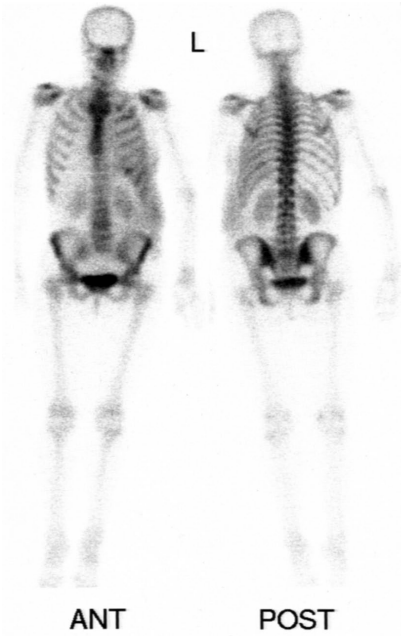
apply for a post in a specialised area of radiography; x-ray theatre, CT, mammography or ultrasound.

In Aberdeen, students of today attend the Robert Gordon University for 4 years to obtain a BSc (Hons) Degree in radiography. The students are in the x-ray department for between 4-6 weeks, 2 or 3 times a year. The course puts emphasis on the academic side, with students learning the more practical skills once qualified. As a result, they need close supervision during the first months of being in post. This was not the case in the 1970's when newly qualified radiographers were competent and confident of being part of the team and were put on the on-call rota, lone working, after 2 weeks of being in post.

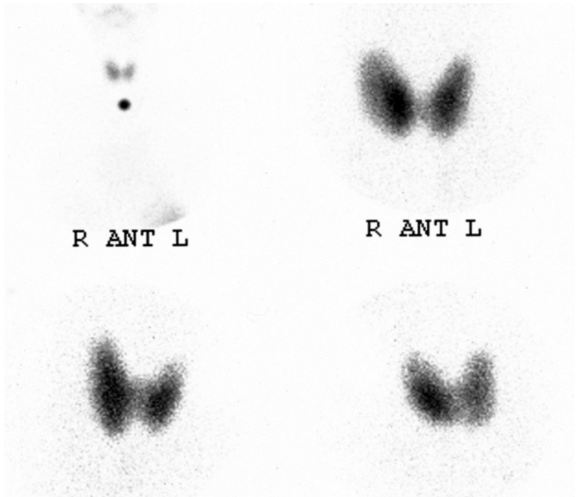
5. Radionuclide Imaging Alison Murray

Patients in Grampian, and the department of radiology in particular, have benefitted from close proximity to a world class university Department of Biomedical Physics and Bioengineering, headed up previously by Professors John Mallard then Peter Sharp. Currently Professor Roger Staff is head of Imaging Physics for NHS Grampian, while Drs Najat Salameh and Mathieu Sarracanie have recently taken on university imaging leadership roles. In addition to provision of patient facing services in nuclear medicine, positron emission tomography (PET), radiation protection, audiology, radiotherapy and ultrasound, the Biomedical Physics Department, under Professor John Mallard's leadership, is notable for development of the Aberdeen Section Scanner, for bringing positron emission tomography (PET) to Aberdeen, and for Nuclear Magnetic Resonance, now known as Magnetic Resonance Imaging (MRI) (see section 6).

Radionuclide imaging comprises examinations produced by making the patient radioactive following administration of a radiopharmaceutical, which have a radioactive part and a pharmaceutical part. For most examinations the radioactive part is a gamma emitting tracer and patients are imaged using a gamma camera, to produce planar or tomographic - single photon emission computed tomography (SPECT) images. Hybrid scanners that combine CT and gamma camera functions enable structural and molecular imaging at the same examination, which is more convenient and faster for patients and enables accurate localization of normal and abnormal radioactive uptake. Common nuclear medicine imaging investigations are bone, lung, kidney, myocardial, brain and thyroid scans.

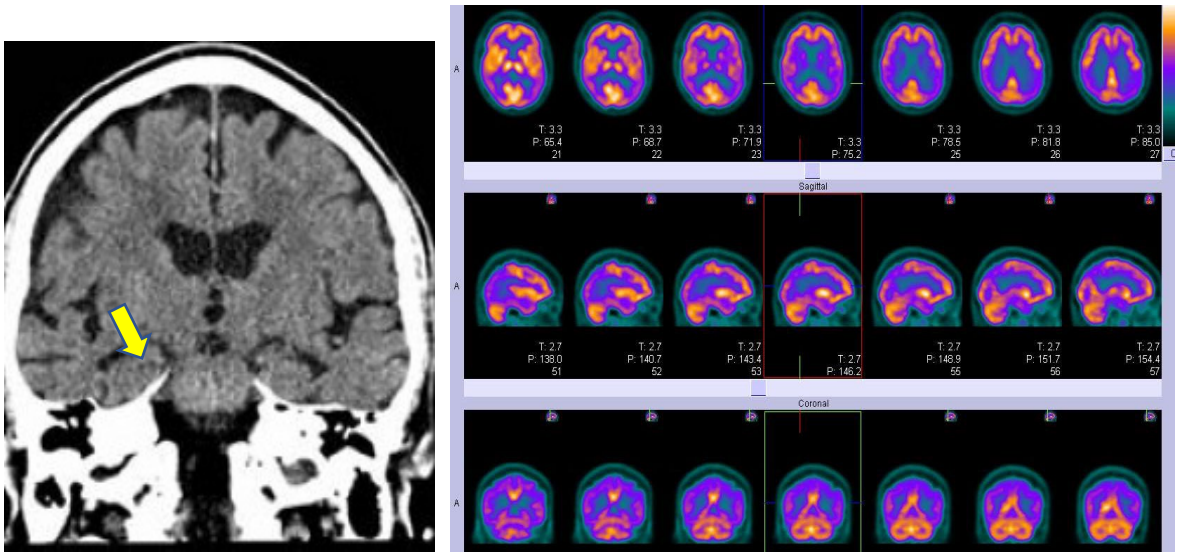


Planar anterior and posterior images of 99mTc HDP bone scan



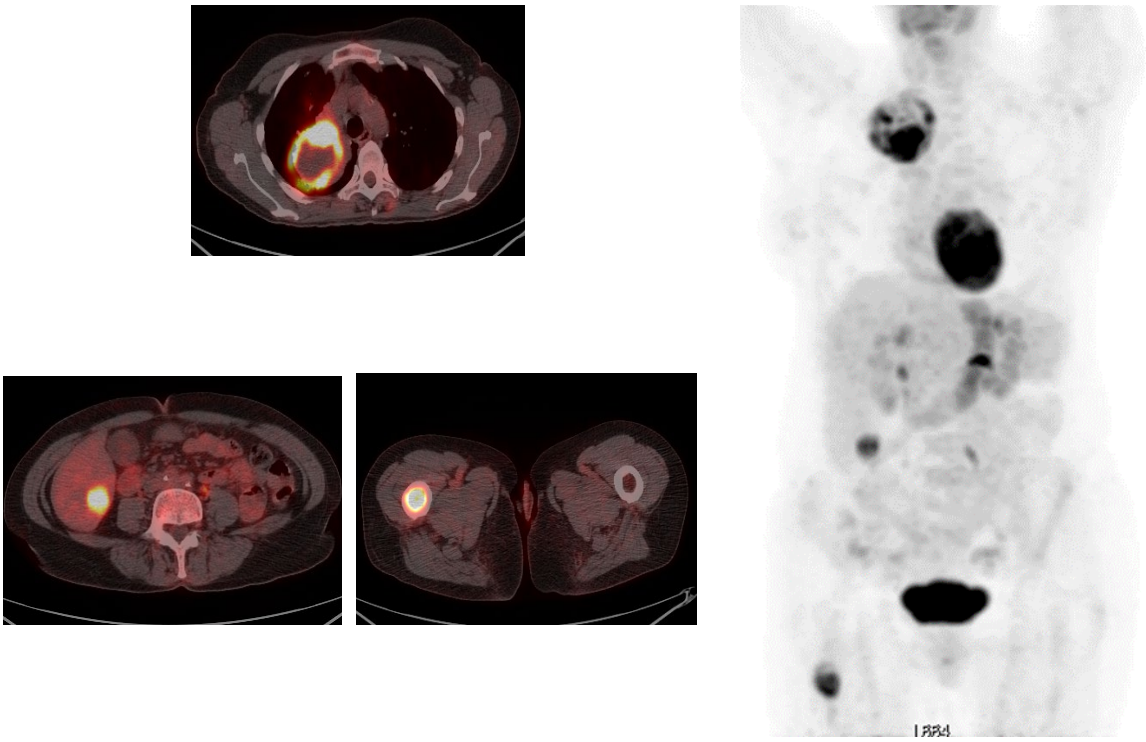
123 I thyroid scan. Thyroid imaging was developed in the 1940s following successful treatment of thyroid cancer with 131 I

Brain, myocardial and lung imaging is routinely carried out as SPECT with simultaneous CT for brain imaging. Selected other investigations, for example to visualize joints or parathyroid glands are performed as SPECT CT to optimize anatomical localization of uptake.



Brain SPECT CT in a person with Atzheimer's disease showing brain atrophy on CT (left), most obvious in medial temporal lobes (arrow) and more extensive perfusion defects on 99mTc blood flow SPECT (right)

PET requires short-lived radionuclides that decay by positron emission and require production by a cyclotron in reasonably close proximity to patients and scanner. PET CT is now the standard imaging modality for lymphoma, lung cancer, melanoma, colorectal hepatic metastases and an increasing number of tumour and non-tumour indications.



18F fluoro-deoxy glucose PET CT in a person with a large cavitating lung cancer that has metastasized to liver and bone.

The department of Nuclear Medicine at Aberdeen Royal Infirmary has always been an exemplar of the multi-disciplinary team, with a well-managed group of medical physicists, technicians, radiographers, nurses and radiologists providing imaging and non-imaging investigations and radio-isotope treatments. In recent years Nuclear Medicine has been led by Clinical Scientists Dr Howard Gemmell, followed by Professor Roger Staff, working closely with senior technicians Joyce Davidson and Lesley Lovell respectively.

Professor Francis Smith was the first and only consultant radiologist appointed to work in radionuclide imaging until appointment of Dr Maggie Brooks in 1997. Alison Murray, Shona Olson, Alan Denison, Emma Ramage and Fiona Caswell have all contributed to the nuclear medicine and /or PET CT service, along with other radiological responsibilities.

A research PET facility was established and run by Biomedical Physics in the 1990s adjacent to Woodend Hospital. A research PET scanner and cyclotron were installed in the John Mallard Scottish PET Centre within ARI in 1998 and, following evidence that PET was clinically and cost-effective in the management of certain tumours provided by Professor Peter Sharp's 1997 Health Technology Board for Scotland report, a clinical PET service was provided for Scottish patients from 2005 in Aberdeen. This necessitated patients from all over Scotland to travel to Aberdeen for a PET scan and at that time Aberdeen had the only clinical PET facility North of Manchester. A replacement PET scanner was installed in ARI 2006 as part of the provision of PET nationally. This was replaced with PET CT in 2015 and a new multi-nuclear cyclotron was installed in 2021.

In 2009 with availability of PACS through-out Grampian, both access to digitized nuclear medicine images and integration with radiology were facilitated. Radiologists with nuclear medicine reporting responsibilities could both examine relevant radiological examinations, such as CT, MRI or plain x-rays and reports while reporting radionuclide examinations, improving accuracy and efficiency, and access and report radionuclide examinations from any PACS workstation, facilitating multi-tasking.

6. Magnetic Resonance Imaging Professor Francis Smith

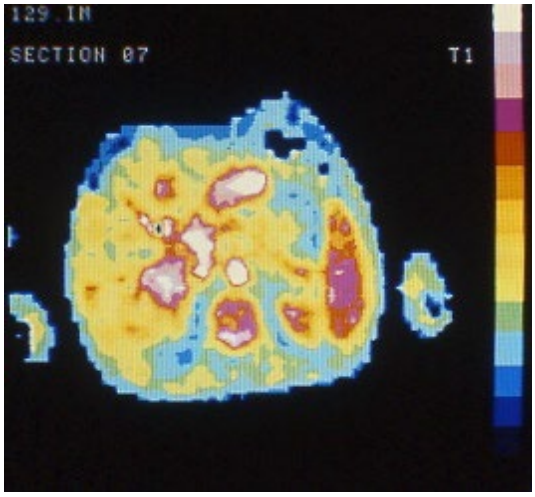
During the 1970s a team of innovative medical physicists including Jim Hutchison, Bill Edelstein and Tom Redpath invented the world's first Nuclear Magnetic Resonance (now known as Magnetic Resonance Imaging) whole body scanner in the University of Aberdeen's Department of Biomedical Physics led by Professor John Mallard. Quick to appreciate that the new technology would be most successful if it could image the whole body and was used by clinicians, the team, led by Prof John Mallard, asked radiologist Francis (Frank) Smith to help. Frank engaged the interest of consultant colleagues in ARI and the far-sighted ones began to refer him patients to image. A quotation from Prof Mallard acknowledged Frank Smith's role: "*Dr Smith was the first radiologist to explore the clinical value of MRI and during the next three years he sent us over 900 patients, the first clinical series in the world*."

An account of this Aberdeen invention that has transformed the world is given by Frank in: Smith FW Magnetic Resonance Imaging: Another Scottish First 2006 Surgeon 4: 3; 167-173.

An excellent video of the key individuals responsible for the invention and early development of MRI in Aberdeen was commissioned by Grampian Hospitals Art Trust and made by Rob Page and can be found here: https://vimeo.com/318438661

The original "Mark I" scanner, which operated at a field strength of 40mT, is now on display in the Suttie Arts Centre in Aberdeen Royal Infirmary (ARI) and is well worth a visit.

Left: Jim Hutchison in the Mark I scanner in 1979. Right: Dr Francis Smith transporting a patient from ARI across a snowy car park to the Department of Medical Physics building for MRI.



Left: the first patient scanned in 1980, showing known liver metastases but previously undiagnosed vertebral metastasis (arrowhead).

Right: the Mark II scanner and clinical team in ARI used for clinical MRI 1983 – 1992.

The new imaging modality gained clinicians confidence and the next version, “Mark II” was built in the East end of ARI in 1983, clad in covering to make it acceptable to patients and housed in a purpose-built unit. This Mark II NMR (or MRI) system operated at a field strength of 80mT, hundreds of orders of magnitude less than today’s scanners. During the 1980s it became clear that MRI was a useful imaging modality for multiple applications including imaging the heart, arteries, the brain, spine, tumours and the fetus, with advantages of lack of ionizing radiation, multiplanar capability and superb soft tissue contrast.

Despite its invention in the UK (the University of Nottingham made the first brain MRI scanner and the team in Aberdeen the first whole body scanner) and clear evidence of clinical utility, attempts to establish a company to manufacture MRI scanners did not attract sufficient financial investment. MRI manufacture was quickly taken over by large electrical manufacturers, such as Phillips, Siemens and General Electric.

A local fund-raising campaign in 1989, the “Magiscan Appeal”, raised public donations to fund the first of five commercially produced Siemens 1T scanners installed at NHS hospitals across Scotland. The Aberdeen Siemens 1T was installed in 1992, the first NHS MRI scanner in Aberdeen Royal Infirmary (ARI), with Dr Frank Smith as the lead MRI radiologist. This was followed by a Siemens open MRI scanner installed at Woodend Hospital in 1997, a 1.5T General Electric scanner in ARI in 1999 and a Fonar positional scanner at Woodend in 2002.

Apart from the GE 1.5T scanner, Frank Smith lead all fund raising campaigns and organization of these diverse MRI facilities in the North-East of Scotland.

7. Academic Radiology and the Aberdeen Biomedical Imaging Centre Fiona Gilbert and Alison Murray

Research and teaching have been championed in the Aberdeen Department of Radiology for many years. Lewis Gilllanders was appointed as consultant and reader, then subsequently head of department and professor, with John Calder appointed as a clinical senior lecturer until his move to Glasgow. Many NHS consultant radiologists undertook major research and teaching roles in addition to their clinical duties.

The academic department of radiology was officially formed in 1996 with appointment of Fiona Gilbert to the first University of Aberdeen endowed Chair of Radiology. Later in 1996 Alison Murray was appointed as clinical senior lecturer with both individuals dividing their time between NHS duties and sessions for research and teaching, effectively sharing funding for one academic post from RSAT and one consultant post from Grampian Health Board to form two clinical academic posts. Accommodation and research imaging facilities were initially lacking and space was provided in a chilly portacabin with other research teams. Following a successful grant application to the then Scottish Higher Education Funding Council (SHEFC, now SFC) with Peter Sharp and Tom Redpath of the Bio-medical Physics Department of the University of Aberdeen, funds were successfully procured for a research MRI scanner. Lilian Sutton continued her generous philanthropic support by providing funds for a new building to house the research MRI scanner and provide office accommodation for radiology research. In order to recognize her continuing and substantial support, this building was named the Lilian Sutton building, the first eponymous building named after a woman in the University of Aberdeen.

In 2006 the University of Aberdeen's medical school was re-organised and the existing departments of Academic Radiology and Bio-Medical Physics were merged. The resulting group was officially recognized as the Aberdeen Biomedical Imaging Centre (ABIC) in 2008, with Professor Fiona Gilbert as its first director. Professor Alison Murray was appointed as Professor of Radiology and took over as ABIC Director in 2012, followed by Dr Gordon Waiter, Reader in Computational Neuroimaging, in 2018. This multidisciplinary group focused around imaging has proved extremely successful and attracted radiologists, physicists, computer scientists, radiographers, psychologists and more. It is a model that was the first of its kind in Scotland and has been emulated widely.

While the aim was always to execute the highest quality research council funded hypothesis driven research, pragmatism and the need to find income to employ staff and post-graduate students, meant that a mixed funding model proved most successful. Peaks and troughs between large grants were smoothed out by income generation through provision of research MRI time to the NHS and by providing a private MRI service, not offered by the local private hospital at this time.

Research expertise in large-scale multi-center clinical trials and audit in oncology and musculoskeletal imaging was developed by Fiona Gilbert with Alison Murray developing neuro-imaging research capability in the Aberdeen Birth Cohorts (with Lawrence Whalley, Professor of Mental Health), in occupational divers (with John Ross of Environmental and Off-

shore Medicine) and in clinical trials of novel drugs for Alzheimer's disease (with Claude Wischik and Roger Staff of Tau Therapeutics).

Not content with local contributions, Fiona Gilbert has been recognised nationally and internationally through appointment to the Chair of Radiology at the University of Cambridge and Honorary Fellowships with the Radiology Society of North America, the American College of Radiology and by being awarded the Gold medal of the European Society of Radiology. Alison Murray led major recruitment to the Wellcome Trust funded Generation Scotland project from the Aberdeen Children of the 1950s, assembling a multidisciplinary team locally and most significantly helped establish (2008) and then directed the Scottish Imaging Network: A Platform of Scientific Excellence (SINAPSE) 2017-2020. Dr Gabriella Baio was appointed to a clinical senior lecturer's post between 2014 – 2017 with expertise in cancer and molecular imaging. Dr Gordon Waiter, Reader in Medical Physics and expert in computational neuroimaging took on the role of Director of ABIC in 2018 and continues to lead a diverse multi-disciplinary research group. Staff and PhD students have been managed and supported throughout by Teresa Morris, originally secretary to the NHS Neuroradiology department, then in clinical MRI to Frank Smith before moving to University of Aberdeen in 2000 when the research MRI scanner was installed. She is currently Imaging Facilities Co-ordinator to ABIC, ably assisted for many years by Dawn Younie, who has provided unstinting secretarial services and formatted many a PhD thesis.

The appointment of Alan Denison in 2006 to Clinical Senior Lecturer in ABIC, deputy director of Medical Education at the University of Aberdeen and subsequently personal chair, lead to significant achievements on the front of medical education. He led several innovative projects including 3D anatomy for medical students and use of iPads in admission assessment. As well as reorganising radiology postgraduate teaching, his expertise has been recognised by appointment as postgraduate dean.

Radiology in Aberdeen has contributed considerably to postgraduate medical education (PGME). (see the history of PGME by Gillian Needham and Campbell Murray in this collection). Both Gillian Needham (2000-2015) and Alan Denison (2019-) have made major contributions in the role of Postgraduate Dean while maintaining their role as radiologists.

An academic radiology teaching day on the 4th floor "sun terrace`" of the Suttie Centre for Teaching and Learning, Foresterhill Health Campus circa 2010, seated L-R: Alison Murray, Lokesh Saraswat, Senthil Ragupathy, Fiona Gilbert, Standing L-R: Angus Thomson, David Nicholls, Ali Voscough, Shubhang Kulkarni, Gerald Lip, Dawn Younie, Alan Denison

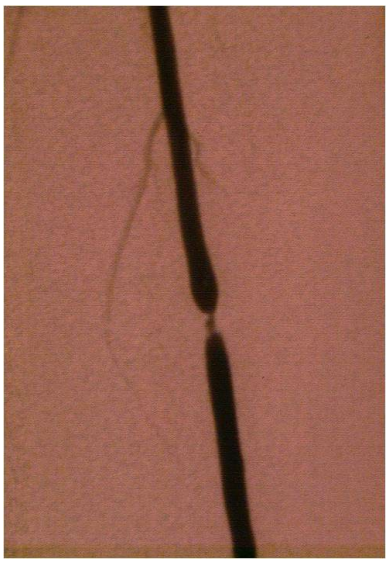
Some of multidisciplinary research group in ABIC 2015 L-R Front: Teresa Morris, Nicola Crouch, Maria Goni, Anca Sandu-Giuraniuc, Alison Murray, Gabriella Baio, Vesna Vuksanovic, Michael Stringer, Back: Julia Scheel, Nick Senn, Dorota Chapko, Clarisse De Vries, Jiabao He, Gabriel Cheung. (Thank you to Chris McNeil for taking the photograph).

Since its formation the Academic Department of Radiology and then ABIC have hosted numerous PhD students, with around 12 at any given time. Research radiology posts have included Professor Fiona Gilbert, senior lecturers Alison Murray and Alan Denison (both subsequently Professors), Gabriella Baio, now University of East Anglia, lecturers Katrin Brauer, Alim Yucel-Finn, Brian Morrissey and in 2022 Edit Franko. Since 2018 no new academic radiologist posts have been supported by the University of Aberdeen. Research radiology expertise has been provided by NHS consultant Dr Rosalind Mitchell-Hay funded through the UK Innovate funded industrial Centre for Artificial Intelligence Research in digital Diagnosis (iCAIRD) project and R&D sessions, who has an honorary research contract, and NHS colleagues involved in specific research projects.

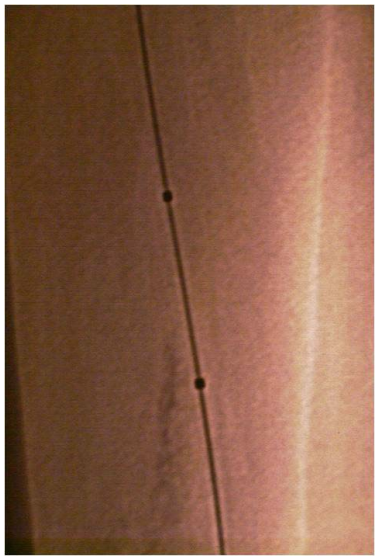
8. Interventional Radiology Peter Thorpe

Interventional Radiology is a relatively modern subspeciality that has developed rapidly over the last 50 years. It can be broadly categorised in to vascular and non-vascular IR although many fundamental skills are common to both disciplines. The procedures are performed remotely using image guidance, most commonly fluoroscopy or ultrasound. Common manoeuvres are unblocking of occluded tubes or conduits, artificially blocking tubes, venous or arterial access, targeted drug delivery, complex biopsy and more esoteric procedures such as tumour ablation by microwave heating or freezing.

Vascular angioplasty all began when Dotter opened narrowed arteries with bougies and then balloons in 1964. Improvements in materials technology were followed by improvements in technique and results. Julio Palmaz patented the first expandable stent in 1984. Made of stainless steel and laser cut into a lattice pattern, this could be laid inside an angioplastied vessel and then expanded by a balloon in a similar manner to the expansion of a lattice cut pie crust. This technique made a significant difference in longer term results compared to angioplasty alone. Self expanding stents, inserted covered by a sheath on a delivery system and then released across a narrowing were developed in the 1990s and these were applicable to more flexible tubes such as the oesophagus and colon.



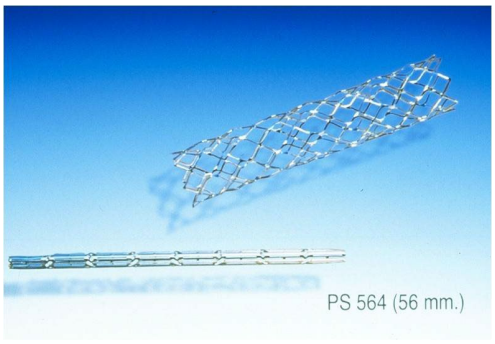
Stenosed artery

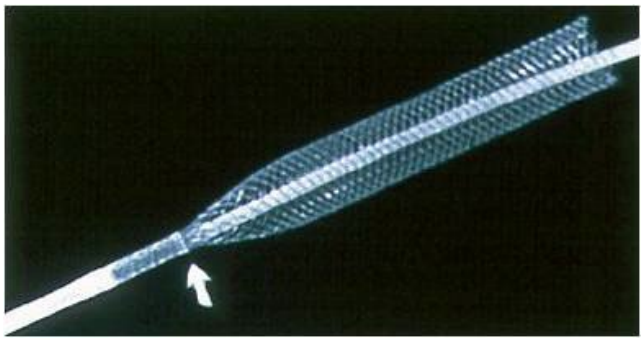


Balloon (between markers)

Balloon inflated End result

Dr Ron Mahaffy introduced a lot of these techniques to the vascular service in Aberdeen. A man of few words and a certain military demeanour, procedures were performed and taught in a defined manner but his results gained him the confidence of the vascular service and the two disciplines became closely integrated with a weekly case discussion where management would be jointly decided. Dr Jeff Hussey developed the non-vascular IR service working closely with the Urology team in particular with the image guided drainage of obstructed kidneys and renal access for percutaneous nephrolithotomy. Jeff established an oesophageal stenting service as a more acceptable palliative management of oesophageal cancer, superseding surgically or nasogastrically placed feeding tubes. Jeff also introduced colonic stenting to Aberdeen. Used as a palliative treatment for colonic cancer or an emergency treatment for an obstructed patient with a lower morbidity than surgery, the value of this technique was quickly recognised by the lower GI surgeons and Jeff amassed by far the largest series in Scotland in the early 2000's. The procedure was technically demanding and required endless patience and Jeff possessed the knack of completing a procedure where others had failed.

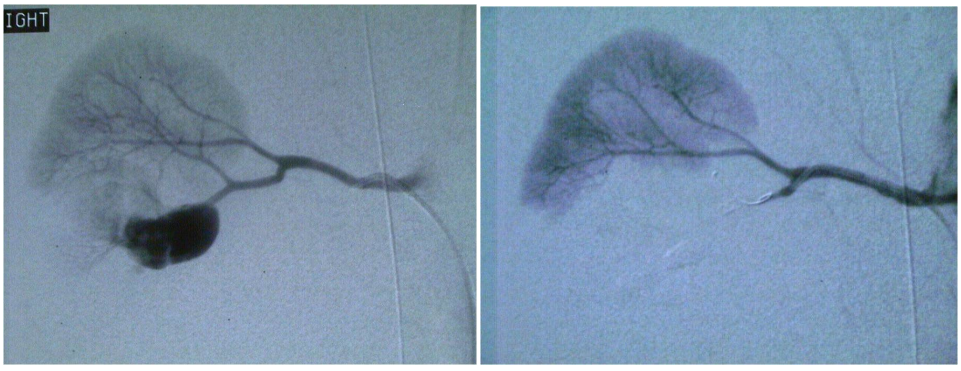




Palmaz stent Self expanding stent

Colonic stent in situ

Throughout this period the number of ailments amenable to Radiological Intervention grew and the techniques were also applicable to emergency presentations. Pyonephrosis could be easily and definitively treated by nephrostomy, Liver and pelvic injuries and acute GI bleeding could be embolised, even when surgical management had failed, damaged arteries or ruptured aneurysms could be stented with covered devices more quickly and less traumatically than surgical techniques.



Bleeding branch renal artery After embolisation

However during this period, with Jeff providing essentially a single handed service, there was no formal on call provision and out-of-hours procedures relied on the goodwill of medical, radiographic and nursing staff. Following Dr Mahaffey's retirement, Jeff took on the vascular intervention and a home grown registrar, Dr Peter Thorpe was appointed in 1997 following an interventional fellowship in Glasgow. The breadth of IR continued to grow with the first transvenous intrahepatic porto-systemic shunt performed in Aberdeen in 1998. This procedure creates a communication within the liver between the portal vein and the hepatic

veins, all performed via the jugular vein to lower portal venous pressure in cases of variceal bleeding or intractable ascites. Aortic stent grafting for abdominal aortic aneurysm, fibroid embolisation and liver tumour chemoembolisation followed. Dr Thorpe developed a radiofrequency tumour ablation service, performed with helical CT guidance and the first tumour cryoablation in Scotland was performed in Aberdeen. A formal on call service was established following Dr Thorpe's appointment, augmented by the neuroradiologist, Dr Olive Robb. The rapid expansion of IRs remit outstripped the training schemes and trained staff were in short supply but Aberdeen was fortunate to attract a very proficient Czech radiologist, Dr Jana Maskova who joined the staff in 2004. She brought neurointerventional expertise to the team and further developed the fibroid embolisation service as well as establishing prostate embolisation for benign hypertrophy.

With somewhat haphazard national workforce planning, IR consultants remain difficult to find but increased integration with vascular surgeons mean that there is now a common training scheme which promises to start to address staffing issues, at least for vascular intervention. Some other procedures have been taken on by specialty clinicians and subspecialist radiologists, certainly in the "high user" specialities such as urology. The outlook for the "orphan" procedures such as TIPSS and fibroid embolisation is less certain as many of these are dependent on the skills of experienced vascular interventionalist.

The last 40 years has been an exciting time to be an Interventional Radiologist with new technology and new applications arriving seemingly every month. Aberdeen has been at the forefront of developing and providing these services. As image guided procedures become more embedded in routine medicine, the hope is that NHS Grampian will support the continued integration of these techniques and the continued provision of these services for the people of the North East.

9. Woodend and Community Radiology Angus Thompson

Woodend Hospital opened in 1907 and over the years has functioned as military hospital during world war II and a municipal hospital from 1927 managing patients with tuberculosis. It joined the national health service in 1948 and was used to quarantine typhoid patients during the 1964 outbreak. It served as a general hospital with medical and surgical services. There have been several health service re-organisations that have impacted on the role of Woodend.

Dr Angus Thompson came back to Aberdeen in June 1995, where he had previously been a student and radiology registrar. He was appointed Clinical Service Manager for radiology within Grampian Health Care Trust which covered Woodend. Dr Jeff Hussey had been radiologist for some time at Woodend prior to this but returned shortly afterwards to Aberdeen Royal Infirmary.

Dr Peter Ward had been a radiologist at Woodend previously, where he specialised in gastroenterology. By 1995 Woodend radiology catered for geriatric assessment, orthopedics and rehabilitation. In addition, the department had a major role in providing radiographs requested by General Practitioners (GPs).

Dr. Thompson had special expertise in swallowing video fluoroscopy, a service he developed at Woodend along with dedicated Speech Therapists. In addition, he acquired skills in spinal injection therapies (nerve root and peri facet joint injections) primarily for orthopaedic referrals.

Dr Lesley Gomersall and Dr Alison Murray also provided general radiology services at Woodend from 1995.

The City Hospital (near the beach) also had a radiology department and a fluoroscopy unit. Dr Mike Allan had worked there in earlier times. By 1995 that department served GP patients but closed completely by the end of that decade.

Woodend Hospital merged with ARI and Dr. Gray's in Moray in 2004 to become known as NHS Grampian and the radiology services were once again combined providing services throughout the North East of Scotland to a population of over 500,000.

Woodend Radiology continues to specialise in non-acute geriatric and musculoskeletal services, rehabilitation and a significant GP services. As the services increased the need for more consultant sessions became obvious and in 2013 Dr Ben Winter and Dr Natasha Rose joined the team, with Dr Daniel Reynolds appointed in 2017.

Woodend and ARI radiographers also provide staff for the City Health Village in Frederick Street which opened in 2013.

10. NHS Grampian Radiology Department today Dr Dympna McAteer

The NHS Grampian Radiology Department today continues to provide state of the art clinical radiology while facing the challenge of an exponential rise in the requirement for imaging. A range of imaging services are provided at the Aberdeen Royal Infirmary site, Woodend Hospital, Dr Gray's, the community hospitals and the Islands of Orkney and Shetland. The workforce has increased over the years with an average of 30 consultants and 20 registrars in 2022 but despite this the national shortage of radiologists has resulted in a large amount of work being outsourced, initially to a private company and subsequently to the nationally established SNRRS (Scottish National Radiology Reporting Services) predominantly staffed by current and retired NHS Scotland radiologists. This is facilitated by a national PACS system allowing electronic access to all Scottish NHS hospitals imaging from anywhere in Scotland.

A large proportion of today's radiologist's workload is attendance at the ever increasing number of Multidisciplinary Teams meetings. The role of radiologist in diagnosis, staging of cancers and advising further management has never been more valued. Each subspecialty clinical team will now have one or more specialist radiologist as a key member. The COVID epidemic has led to hybrid working with many meetings now accessed remotely although most radiologists prefer patient contact and face to face meetings with colleagues.

The Emergency Care Centre with dedicated Radiography, Ultrasound and CT services has revolutionised the management of clinical emergencies. As a Major Trauma Centre we provide 24/7 access to diagnostic and interventional radiology. Following major trauma, patients will have a whole body CT scan with rapid diagnoses guiding timely and appropriate intervention.

NHS Grampian radiologists continue to be involved in a wide range of research projects through the Aberdeen Biomedical Imaging Centre and via our Cancer centre with its cutting-edge technology including most recently stereotactic ablative radiotherapy (SABR) allowing higher precision targeting of cancers than ever before.

The Nuclear Medicine Department has also been the site of major new developments in recent years including an increasing range of PET scans allowing more patient specific imaging and treatments.

The NHSG Radiologists play a major role in undergraduate education to the medical and dental students based on site in the Suttie Centre at Foresterhill. Radiologists are particularly key to the delivery of anatomy teaching but also help with undergraduate OSCE exams and interviews of prospective medical students.

Imminent future developments include the Baird Family Hospital, the National Treatment Centre and an MRI scanner at Dr Gray's hospital with a second new Interventional Radiology suite at Aberdeen Royal Infirmary.