Advances in Musculoskeletal Imaging

We pride ourselves in conducting high value clinical musculoskeletal research that translates almost immediately into proven patient care. Our Department has been at the forefront of musculoskeletal imaging in Asia over the last 20 years, with many firsts under our belt. We were the first to show the high accuracy of ultrasound in rib fracture detection and the poor accuracy of radiographs. We were the first to show a method for non-invasively measuring glenoid bone loss in recurrent dislocation, which is now routinely used in radiology departments worldwide. We were the first to show that osteoporosis is associated with reduced marrow fat and a reciprocal reduction in marrow blood flow, that these changes are more pronounced in the femoral neck, that osteoporosis is associated with increased marrow fat unsaturation and that there is a dramatic increase in marrow fat in females around menopause and soon after oophorectomy. We were also the first to develop an automated method of quantifying inflammatory change in ankylosing spondylitis, to show that tendon xanthomas are comprised mainly of cholesterol rather than water, and to develop ERAMAS, a semi-quantitative scoring system for quantifying inflammation on MRI in early rheumatoid arthritis.

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Innovation in Magnetic Resonance Imaging (MRI)

Our research focuses on developing and applying innovative new MRI technologies. One focus of our research is to develop robust, non-invasive, contrast-free technologies for detecting metabolites related to biochemical symptoms of a variety of human diseases, which can be used for early diagnosis and post-treatment monitoring. In particular, we have developed these technologies based on an acquisition approach called spin-lock. Unlike other existing spin-lock methods, our spin-lock technologies can achieve artefact-free images in the presence of MRI system imperfections – a robustness that is required for a technology used in routine clinical practice. Our previous work, including fast phase correction for 2D Fast Spin Echo acquisition, is commercially available and used worldwide.

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Experimental and Translational Imaging

Our research is primarily focused on three areas, namely: 1) imaging and the epidemiology of spine degeneration, 2) quantitative imaging of liver fibrosis, and 3) the epidemiology of intracranial aneurysm rupture in the Chinese population. Our epidemiology research on Osteoporotic Fractures in Women (MsOS) (Hong Kong) and Osteoporotic Fractures in Men (MrOS) (Hong Kong) serves as a reference for osteoporotic vertebral fractures, degenerative lumbar disc space narrowing, and degenerative spondylolisthesis in Asian populations. From our data, we have demonstrated that postmenopausal women, as compared with men, show accelerated spine degeneration due to relative oestrogen deficiency. For magnetic resonance imaging of liver fibrosis, we pioneered T1rho, 3-D analysis of intravoxel incoherent motion (IVIM), and chemical exchange saturation transfer (CEST). We expect our work on quantitative liver imaging will help to detect very early stage liver fibrosis.

Our work has also demonstrated that among the Chinese population ruptured intracranial aneurysms were mostly 2mm-5mm in size (47.1%), followed by 5mm-10mm (39.7%). This indicates that menopause may not be the only dominant factor causing a higher incidence of aneurysmal subarachnoid haemorrhage in women and that elderly patients may be at a reduced risk of rupture compared with patients who are younger with other similar risk factors. Our work has been published in over 250 peer-reviewed journals and cited more than 4,500 times according to Web-of-Science. We have also received a number of awards for our work.

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Imaging and Interventional Radiology

Imaging and interventional radiology are two major pillars in the hall of modern medicine and are instrumental in the clinical practice of almost all disciplines. The Department strongly believes in inter-disciplinary collaboration to achieve the common goal of professional and academic excellence. We are proud to have a team of clinical and non-clinical researchers who are dedicated to cutting-edge research in neurological imaging, musculoskeletal imaging, oncological imaging, MRI physics and sequencing, artificial intelligence in image analysis, interventional oncology and interventional neuroradiology. Our work has been widely recognised and published in the leading journals of our field.

DEPARTMENT OF IMAGING & INTERVENTIONAL RADIOLOGY

"We are dedicated to producing inspirational and impactful research in imaging and interventional radiology, to bring about improvements in the practice of medicine and people's lives."

Simon C. H. YU
Chairman

Treatment of Liver Cancer

Interventional radiology has an important role to play in the control of hepatocellular carcinoma, one of the commonest malignancies locally and globally. Transarterial intervention is the only treatment option when the disease has come to an intermediate stage. Our team has made an extensive study of the treatment of transarterial ethanol ablation for liver cancer, refined and standardised the techniques of the treatment, and established it as a more effective treatment than the conventional chemoembolisation, the standard transarterial intervention for hepatocellular carcinoma over the past decades.

Our team has recently made a further advancement in this field with the invention of ablative chemoembolisation, a new treatment concept that has been proven radiologically and histologically to be highly potent for loco-regional control of the cancer. It is potentially applicable to the treatment of excessively large tumours and suitable for combination therapy together with molecular targeted therapy or immunotherapy. These treatments have been well recognised and published in leading journals covering the specialty.

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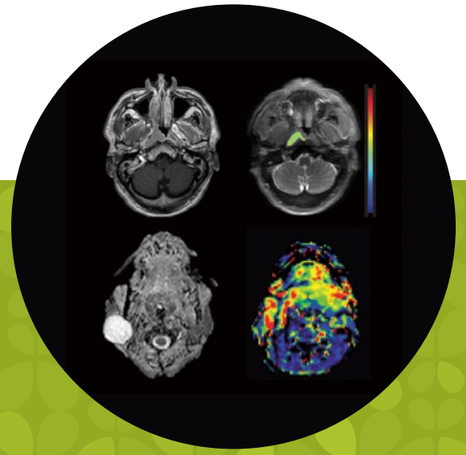

Ultrasound in Head & Neck (H&N)

Our specialist H&N ultrasound service and research was started in the early '90s, and our team remains responsible today for neck ultrasound and guided biopsies in the neck. In addition to greyscale & Doppler ultrasound, our research in H&N ultrasound extends to computational analysis of intra-nodal Doppler vascularity, using algorithms to differentiate benign from malignant disease; sonoelastography of thyroid, salivary gland masses, lymph nodes and neck masses to evaluate their nature; and the swallowing mechanism following treatment for H&N cancer, using ultrasound & video fluoroscopy. This pioneering work has resulted in multiple research articles, competitive grants, and invitations to deliver lectures and hands-on workshops at major international meetings.

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Adolescent Idiopathic Scoliosis (AIS)

Scoliosis, or curvature of the spine, affects around 4% of the population worldwide. It most commonly affects adolescent girls, with an onset between the ages of 10 and 16. Previous medical theory suggested that AIS only affected the spine and the vertebrae that make it up. With advanced magnetic resonance imaging, the condition is also found to involve the brain, the semi-circular canals of the ear, and the spinal cord.

The spinal deformity associated with AIS is simply the most visible symptom of the disease. There are also numerous "hidden" features within the central nervous system that have yet to be fully explored. Findings from our research have given us a better understanding of the relevance of anatomical and functional changes in the central nervous system and their relationship to the etiopathogenesis of AIS and progression of the spinal deformity. This research could provide a new objective assessment for predicting the curve progression of AIS and the possibilities of future integrative treatment and rehabilitation in modulating curve progression clinically.

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MRI of Head & Neck Cancer

Head & neck cancer is a leading cause of cancer worldwide. Our group has been researching the role of MRI in cancer detection, prognostication, treatment planning and follow-up for over 20 years, resulting in multiple research articles, competitive grants and international lectures.

We have a special interest in nasopharyngeal carcinoma (NPC). Our group was among the first to document the MRI patterns of primary and nodal spread of this cancer, to compare MRI and FDG-PET, and to report a range of treatment-induced complications. In our current research, we include MRI for early NPC detection. Using our MRI grading system, we have shown that MRI detects the 10% of cancers that are endoscopically occult. We have also used MRI to detect early stage NPC in collaborative plasma EBV-DNA population screening studies. We are also a pioneering centre in functional MRI for head & neck cancer and for over 15 years we have been at the forefront of developing and evaluating DWI, MRS, DCE-MRI and CEST for tumour characterisation and prediction as well as monitoring treatment response.

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Chronic and Progressive Neurologic Disorders

While multiple sclerosis (MS) remains uncommon in Hong Kong, it has become increasingly prevalent in the last decade. We hold the largest database of high resolution MRI brain and spinal cord scans of Hong Kong Chinese people with MS. We have found that in two-thirds of our patients diagnosed within a year since presentation, brain volume loss is already present. Thus, we are working towards the technical validation and practical application of brain volumetry to assist prognostication and monitor progression.

Dementias, on the other hand, are common among Hong Kong's ageing population. We have completed the technical and clinical validation of automated hippocampal volumetry, which is now ready for clinical practice and translational research of its role in the work-up of patients with mild cognitive impairment. Validation on volumetry of white matter hyperintensities, a common substrate of small vessel disease, is also underway. Additionally, we are exploring advanced multimodal MRI techniques for potential biomarkers of early Alzheimer's disease.

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Medical Image Computing

Our research interests are mainly in the field of multimodal image quantification of brain and orthopaedic images to support clinical research and practice. Medical image computing plays an increasingly important role in the field of biomedical research and clinical applications. The Research Centre for Medical Image Computing (RC-MIC) focuses on the development of novel techniques for medical image computing and the promotion of the application of computational methods in clinical diagnosis and research.

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