

ROBOTIC RESEARCH IN SURGERY AND HEALTHCARE

Abdominal soft tissue modelling for surgical navigation

The aim of this project is to look at soft tissue modelling for image guidance of surgery in the pelvis. The two clinical applications are rectal cancer and prostate cancer surgery. There will be soft tissue motion in this region, but it is expected to be small compared to other regions of the abdomen since the anatomy is largely encased by the pelvis. We are examining how methods of statistical shape modelling can be used both to create the preoperative model and also to cope with tissue motion. We are also investigating how shape models of different structures can be correlated to enable us to infer the position of one part of the anatomy from knowledge of another using canonical correlation.

Affective Remote Presence Robot

With increasing pressure on the health care system in the United Kingdom due to a lack of health care personnel, there has been a call for health technology to improve the efficiency of care delivery. The aim of this project is to develop a telepresence robot that is capable of self-navigation within a defined environment and can understand simple human hand gestures and visual attention.

Autonomous Navigation for Remote Presence and Healthcare Robots

The day of healthcare robots helping and assisting patients is rapidly approaching. The first task for any autonomous robot is navigating through complex and dynamic environments safely and efficiently. A system using new technology is being developed to produce a reliable navigation system for use with healthcare robots.

BIOLOGICAL AND CLINICAL RESEARCH

Applying decision analysis techniques to validate checking procedures for nasogastric tubes

NG tubes are widely used in NHS. Misplacement of tubes may lead to serious consequences, especially for vulnerable patients. A variety of checking procedures are currently available, such as imaging (e.g. radiography, magnetic-detection), chemical (pH and bilirubin testing), clinical (e.g. auscultation), etc. The outcome of these tests however depends not only on the location of the tube, but also a variety of other variables, such as the age, the medication and the feeding condition of a patient. The research will apply decision analysis techniques, notably Bayesian Belief Networks and Influence Diagrams, to demystify the uncertainties.

Diagnostic, mechanistic and therapeutic role of “gasotransmitters” in upper GI cancer

On the basis of tremendous recent understanding of the novel roles of endogenous gaseous molecules (gasotransmitters) including nitric oxide (NO), carbon monoxide (CO), hydrogen sulphide (H₂S) and as part of our efforts to better understand molecular regulation of the development of upper GI cancers including oesophageal, gastroesophageal junction and gastric cancers, we aim to explore

- i) the role of oxidative and nitrosative stress and particularly the role of gasotransmitter pathways in various forms of these cancers and premalignant conditions
- ii) the influence of modulating these specific pathways on epithelial cell cycle progression, proliferation and apoptosis
- iii) predictive value of novel oxidative stress biomarkers in response to neoadjuvant therapy

These studies have potential for helping earlier diagnosis and better targeted therapeutic strategies.

Fibroblast growth factor-2 (FGF-2), chemo-resistance and colorectal cancer

Colorectal cancer is the second leading cause of cancer deaths in the UK and although modern combination chemotherapy has improved overall survival nearly 50% patients do not respond or have disease progression. FGF-2 is a cytokine known to be involved in tumour growth and spread. This study investigates the mechanisms by which FGF-2 mediates resistance to chemotherapy in colorectal cancer.

Colorectal cancer affects 35,000 people in the UK every year. Despite potentially curative surgery and the availability of effective chemotherapy, many patients will die due to resistance to chemotherapy. This project aims to elucidate the mechanisms by which Fibroblast growth factor-2 induces resistance to 5-fluorouracil and oxaliplatin in colorectal cancer cell lines.

Gaseous Markers of Oxidative Stress and Early Diagnosis of Gastro-Oesophageal Cancer

This research project addresses the challenge of timely diagnosis in gastro-oesophageal cancer. It aims to establish a reliable method for the clinical diagnosis of early gastro-oesophageal cancer with identification of trace gases as biomarkers of disease in exhaled breath. The concepts of oxidative and nitrosative inflammatory stress and carcinogenesis will be explored. Studies will focus on the role, diagnostic potential and therapeutic implications of specific aspects of the oxidative stress response.

Histopathological assessment and prediction of the Response to Neoadjuvant Therapy in Lower Oesophageal and Gastric cancer

Gastric cancer has poor prognosis, but there is some promise with the usage of neoadjuvant therapy to bring better results.

The aim of the project is to study the response to neoadjuvant chemotherapy, through assessing the currently used methods, in the form of Tumour Regression scales, and Image analysis. Also, to create a panel of tumour markers that, collectively, would give an idea about the extent of response to Neoadjuvant therapy.

Investigation of the bacterial pathogenesis of the ileal reservoir mucosa following restorative proctocolectomy for ulcerative colitis and familial adenomatous polyposis

Pouchitis is a form of inflammatory bowel disease which occurs in patients who have an ileo-anal pouch constructed for Ulcerative colitis or Familial polyposis. Its aetiology is unclear; however it is widely thought that a bacterial dysbiosis is responsible. We are studying pouch mucosal bacteria using 16s bacterial DNA sequencing technology to identify the bacterial differences between those with healthy pouches and those with pouchitis.

Metabonomics of acute pancreatitis

Intestinal ischaemia/Reperfusion is a significant cause of morbidity in patients undergoing major abdominal surgery. Metabolic profiling methods coupled with multivariate statistical analysis can provide a systems approach for studying in vivo metabolic profiles. ¹H nuclear magnetic resonance (NMR) spectroscopy can therefore be used to generate a metabolic 'fingerprint' of prognostic and diagnostic use from biological fluids or tissues in cases of intestinal ischaemia/reperfusion.

Metabonomic profiling of gastric and oesophageal cancer

¹H Nuclear Magnetic Resonance spectroscopy is used to analyse tissue and bio-fluid samples. A tissue bank has been established to collect and store samples. We aim to detect biomarker metabolites or metabolite patterns in spectra which are specific to those cancers. Pattern recognition techniques are used to analyse the data and correlate them with clinical characteristics of patients.

Molecular mechanisms in the development of peritoneal metastasis in gastric cancer

The peritoneum is a common site for recurrence following attempted curative gastric cancer surgery, and is associated significant morbidity and mortality. Our research is focused on the role of tumour-host interactions in promoting peritoneal metastasis, particularly via upregulating cytokines and matrix metalloproteinases. Further work will focus on the cellular signalling pathways and transcription factors responsible for these changes, and their effects.

Outcomes of ileoanal pouch surgery for familial adenomatous polyposis and metabonomic profiling of pouch pathologies

Familial adenomatous polyposis is a genetic condition that leads to the formation of hundreds of colonic polyps with inevitable progression to colorectal cancer. Ileoanal pouch surgery is a mainstay of surgical prophylaxis. Outcomes of surgery are measured and compared between different surgical techniques. Pouch polyposis and pouchitis, two important complications of pouch surgery, are examined with metabonomics, a novel technique that measures metabolite profiles.

The Visceral Hybrid Repair for Thoraco-abdominal Aortic Aneurysms

This operation was pioneered at St Mary's in 2003. This hybrid

Operation combines open and minimally invasive endovascular techniques and is an alternative to the traditional open operation that even in the best Centres in the world, is still associated with a high morbidity and mortality.

By studying the physiological effects of this new visceral hybrid procedure and comparing it to the same outcome measures in a control open repair population, we aim to prove that this new repair is not only an alternative but a better operative procedure for this complex patient population.

IMAGING RESEARCH IN SURGERY AND MEDICINE

A deformation tool for facial plastic surgery planning

The aim of this project is to develop an intuitive and easy to use three-dimensional facial surgery planning software system. Such a system will enhance the communication between surgeon and patient, helping to address the concerns and expectations of patients in a better way. By providing the possibility of studying outcome with respect to planning, as well as conducting follow-up analyses, it is expected that better planning and performance will be possible.

Development and validation of a virtual reality simulator for training in interventional radiological visceral needle puncture procedures (HTD – DoH)

The goal of this project is to develop and validate an accurate visual-haptic simulation of visceral needle puncture procedures in patient specific datasets for training in interventional radiology. The project end point of a pre-market, validated, authentic simulation of IR needle access procedures will remove much basic skills training from patients, improve safety and efficiency in the NHS and reduce the time to attain and maintain higher levels of competence.

Image registration for interventional radiology procedures (CRaIVE Consortium)

The aim of this project is to co-register 3D CT/MRI data sets with images produced by a magnetically localised 3D ultrasound probe. The results of this work will act as a platform for future developments in AR which will increase accuracy and speed of interventions in difficult anatomy, while reducing radiation in x-ray based guidance methods and extending considerably the range and type of interventions possible.

Integrity of the Repaired Rotator Cuff: A Roentgen stereophotogrammetric analysis with Ultrasound comparison.

Rotator cuff tears of the shoulder have a high incidence. They are often repaired surgically which unfortunately has a high failure rate. I am developing a new technique in Roentgen Stereophotogrammetric Analysis to monitor rotator cuff repairs. We have experimented and validated this technique on cadaveric models and we are now in the process of collecting in vivo data. The results will inform us as to the natural history of repair failure and should influence how we manage affected patients.

Model-based 2D-3D registration and tracking of deformable objects for image-guided minimally invasive cardiac interventions (EPSRC)

In this project we aim to develop techniques for the model-based registration of 3D deformable objects to one or more 2D views of the scene. We believe that any successful 2D/3D registration requires a-priori knowledge about biomechanically plausible types of deformation as well as a-priori knowledge about statistically likely types of deformation. We therefore propose the development of statistical and biomechanical models that will enable us to learn and predict the types of deformations more likely to occur.

Model-based 2D-3D registration and tracking of deformable objects for image-guided minimally invasive cardiac interventions

The ultimate aim of this project is to provide image guidance for robot-assisted coronary artery bypass. This requires a dynamic model of the beating heart to be constructed from preoperative imaging data and for this to be aligned to the patient on the operating table. The model is constructed from coronary CT, alignment achieved both spatially and temporally using the stereoscopic endoscope video. We are also investigating whether we can compensate for tissue-tool interactions using finite element techniques.

Physics-based virtual environment for training in vascular interventional radiological procedures (EPSRC)

The aim of this project is to develop and validate a complete VE for training in vascular interventional radiology, encompassing needle puncture as well as guidewire and catheter insertion and manipulation. We will use variable virtual anatomy, in which the appearance, 'feel' and human factors of invasive radiological procedures in patients can be reproduced and assessed.

Remote feedback and assessment for assessing clinical procedural skills (DoH)

As part of this project we have developed the Imperial College Feedback and Assessment System (ICFAS). ICFAS uses networked webcams, standard computer equipment and database facilities, and a proprietary content management software system (Librios – www.librios.com) modified for this purpose. It offers a unique integrated infrastructure for observing and recording multiple encounters, assessing them in real time from several simultaneous perspectives, integrating disparate data streams and presenting them in a structured format for secure web access.

The development of real time endoscopic compliance mapping system

Diminished tactile feedback in endoscopic surgery degrades the ability of the surgeon to identify the nature of examined tissues and may lead to tissue damage. We are developing a system which uses statistical algorithms to analyse force-displacement data acquired by high precision sensors mounted on conventional laparoscopic instruments, and adopts innovative usability techniques for routine use in theatre. Evaluation of the system's reliability will be followed by measuring the compliance of living human tissue in theatre. Based on these measurements the compliance mapping system will then be clinically validated.

INNOVATIONS IN SURGICAL TOOLS AND DEVICES

Developing a pervasive body sensor network for post-operative monitoring of surgical patients

Wireless Body Sensor Networks (BSN) is a new and evolving technology that for the first time offers the prospect of completely pervasive monitoring of patients in any environment. Advances in minimally invasive surgery, goal-directed recovery, and patient preference have meant that patients are being discharged from hospital earlier than ever. As a result, the need for post-operative home monitoring is increasing yet existing systems to achieve this remain labour-intensive and intrusive. The development of a pervasive body sensor network to monitor post-operative recovery is the focus of this research and represents the first step towards developing a ubiquitous monitoring system for patients undergoing a range of surgical procedures.

i-Snake: The Development of a Snake Robot for Minimally Invasive Surgical Applications

The aim of this project is to provide a sensorised, intelligent snake robot for minimally invasive surgical procedures. Such a device will enhance a surgeon's ability to operate through small incisions by providing novel intra-operative imaging, sensory feedback for tissue-instrument interaction and navigation guidance.

Terahertz imaging of Colonic tissue

Recent advances in ultrafast technologies have led to the development of efficient sources and detectors in the THz range of the electromagnetic spectrum. (THz = 10^{12} Hz). In theory organic and biological materials have distinct signatures in the THz frequency range. We are conducting a collaborative study to compare THz measurements with gross pathology and histopathology in order to determine the attenuation characteristics of normal colonic tissue, inflammatory bowel disease and colonic adenocarcinomas.

NEMO - Nano-based capsule-Endoscopy with Molecular Imaging and Optical biopsy

The objective of the NEMO project is to develop an advanced cancer screening system that is patient-friendly, highly sensitive and specific for early detection of gastrointestinal cancer. The NEMO project will adopt converging technologies combining optical imaging technologies with novel nano-technologies for biosensing, maneuvering and ultra low power miniaturization to create a unique wireless capsule endoscope including an array of immunoassay methods for the detection of surface and deeper tissue pathology, especially cancer.

Optical monitoring of radiofrequency tissue fusion

Radiofrequency tissue fusion is a novel technique of tissue approximation that has been successfully applied by Valleylab-Tyco Healthcare to the sealing of blood vessel and artery. Our project consists in transferring this technology to other tissue type

(e.g. bowel). More specifically, we investigate the possibility of using near infrared spectroscopy as a method for assessing tissue transformation due to heating and as feedback to generate optimal tissue seal.

Optimal Parameters in Tissue Fusion

Radiofrequency energy has traditionally been used to destroy tissue in medicine. However, using a combination of mechanical pressure and a lower frequency of radiofrequency energy, tissue fusion can be achieved. This project aims to investigate electrical and mechanical parameters essential for successful tissue fusion, as well as the effects of this energy on biological tissues.

The ergonomics of the paediatric endoscopic field

Minimal access surgery in children, particularly in infants, has additional ergonomic constraints compared to adult practice due to their small size. We investigated the influence of instrument size on the task performance within a small simulator (constructed based on neonatal anthropometric measurements). The smaller space on the other hand allows the use of less powerful illumination sources. We developed alternate illumination sources using solid-state semiconductor lighting technologies and their characteristics were evaluated. In addition, the perception of shadows within the endoscopic field and the effect of distortion using the paediatric endoscope on performance were investigated.

EDUCATION

An induction to the operating theatre for novice medical students

HEFCE Capital Grant for E-Learning

This project seeks to develop an online induction programme for novice medical students entering the operating theatre (OT). The OT can be an alien environment for novices. The resource introduces students to theatre protocols, equipment, teams etc.

Enhancing medical students' skills at performing gynaecological examinations

This project explores the feasibility of using hybrid simulations to support students in learning vaginal examination. Actresses (simulated patients) are linked with a female pelvic model to provide students with an opportunity to perform smear test and bimanual digital examination. The project is evaluated from the perspectives of student, faculty and simulated patients.

Integrated Procedural Performance Instrument (IPPI)

IPPI is a sequence of clinical procedure scenarios, each using an inanimate model in conjunction with a Simulated Patient. The scenarios build a composite picture of technical skills, communication skills and professional behaviours across a range of challenging clinical situations. Networked video technology allows participants to be assessed remotely, and detailed confidential feedback is provided via the web.

Involving patients in medical education: Developing patient-focused resources for learning about technical skills

This project aims to review our existing simulated patient roles and develop new ones based on interviews with real patients. That is, simulated patient roles will reflect real patients' experiences rather than interpretative accounts of our multidisciplinary team. We are also establishing a database of accessible patient-focused materials. That is, materials that have real patients as the starting point.

Multiple External Representations

Medical students have expressed difficulty correlating illustrations with real life human anatomy and related pathology. Modern curricula and textbooks emphasise the importance of teaching clinically oriented anatomy but it is unclear what contribution multimedia technologies have to offer. I am researching the use of multi-representational learning environments to teach pathophysiology using a combination of 2D and 3D representations

The Enhancement of Surgical Performance

My project involves studying different methods for improving the acquisition, retention and performance of technical and non-technical surgical skills. Different methods being studied involve Mental Imagery Rehearsal (MIR) (the symbolic practice of physical actions in the absence of any gross muscular movement), pre-operative viewing of procedural videos, and pre-operative preparation under the guidance of non-surgical executive coaches. The role of mentoring in the personal and professional development of trainees is also being investigated.

The use of case records in teaching quality and care in hospital medicine to senior medical students and Foundation Year trainees

Selected segments of anonymised case records will be copied onto the intranet and integrated into a teaching programme for senior medical students and Foundation Year trainees. Participants will be required to recognise and document issues related to quality and safety in hospital care. Trainees will be assessed at the end of the academic year to determine whether or not completing the programme has had an effect on their knowledge and attitudes.

HEALTHCARE OUTCOME, QUALITY AND SAFETY

Analysis of patients' recognition of incidents of inadequate care matched against assessments of case records.

A researcher will telephone patients one week after discharge from hospital to determine whether or not they have any complaints regarding their clinical care. The patients will be required to answer a number of pre-set questions (based on current knowledge of common defects in care) and will be offered time for free comments. Completely separately, an experienced assessor will review the patients' case records and note any recorded problems in care. The researcher will then collate and compare the two sources of information.

An Investigation of the Patients' Role in Improving Quality and Safety in Healthcare

An important context in which patient involvement has been largely ignored is that of patient participation in patient safety. Patients themselves could play a salient role in the reduction or prevention of medical errors and adverse events in healthcare. However, the extent to which patients are able and willing to take on such an active role remains to be elucidated. This research will attempt to address this question.

This research programme is funded by the Health Foundation. It aims to investigate the potential role of patients or their carers in improving the quality and safety of patients' care. This is an area that very little empirical research has been conducted to date, despite its potential benefits for patients and the NHS. The research aims to address: a) the extent to which patients or their carers are able and willing to take on such an active role and factors that affect their involvement in clinical safety; b) the role of the health care professionals in facilitating this; c) the development and piloting of interventions aimed at encouraging patient involvement in safety in specific clinical settings.

Clinical Decision-Making

The cognitive processes involved in surgical judgement and decision-making are still considered a “black box” – hardly any research has been done on the topic. The aim of the research that we are conducting in the CSRU on surgical decision-making is to elucidate how surgeons arrive at judgements (e.g., risk estimates) and what factors affect their decisions at various stages of the care of the surgical patient (i.e., pre-, intra-, and post-operatively). To date, we have completed a systematic review and a number of studies using junior and senior surgeons as participants and common surgical conditions as stimuli. Moreover, we have examined sub-optimal decision-making in the form of diagnostic errors reported to the UK’s National Reporting and Learning System, hosted by the national Patient Safety Agency. Research plans for the immediate future include application of quantitative modelling techniques to surgical decisions (prioritisation for surgery and cardiac surgery) and investigation of patients’ decision-making process regarding treatments.

Communication and patient safety within the core competency programme

This project will result in the development and evaluation of audiovisual resources for undergraduate students learning clinical procedural skills. The aim of the materials is to provide a conduit for students to integrate different sets of skills – technical, communication and safety skills as they perform procedures.

Distraction and interruption in the operating theatre

The aim here is to characterise the team environment in operating theatres, overlapping with theme 1. One goal is to measure distraction and its effect on performance. (Healey AN; Sevdalis N; Vincent CA. (2006) Measuring intra-operative interference from distraction and interruption observed in the operating theatre. *Ergonomics*, 49: 589-604).

High-reliability surgery – Health foundation

The aim of this research is to transfer the principles of the high-reliability developed in other high-risk domains to the surgical system, with a view of characterising levels of system reliability with strategic measurement.

Identifying and reducing risk to elderly patients: A scoping exercise of the healthcare literature

The purpose of this research is to scope the patient safety issues in the elderly with a view to identify interventions that can be used to reduce risk in this population. The review will consist of: a general scope of risk and safety issues in the care of elderly patients, with a specific focus on risks in surgery. In addition to the review we will conduct a scoping exercise to identify a practical intervention to reduce surgical risks in elderly patients.

Inflammatory Bowel Disease and Female Reproductive Health

Inflammatory bowel disease (IBD) is the collective name for ulcerative colitis and Crohn's disease; chronic conditions that commonly affect women of childbearing age. Restorative proctocolectomy (RPC) is the surgical procedure of choice for patients requiring excision of the large bowel for chronic ulcerative colitis. The aim of this project is to assess the impact of IBD and Restorative proctocolectomy on female reproductive ability and health. There have been a limited numbers of studies looking at the implications of RPC for women in terms of sexual and urinary function, fertility, pregnancy and delivery. It will be an important facet of management of the IBD, prior to and after surgery, in advising women on their reproductive ability and when is best to conceive.

Quality of Life and Function Following Restorative Proctocolectomy

Outcomes following restorative proctocolectomy (RPC) are varied, with the majority of patients achieving a good functional result and quality of life. There are many factors that can influence the future course following RPC, and the primary aim of

this work is to determine those factors which may influence patient quality of life and functional outcome. Using the ileal pouch registries of St Mark's Hospital, Harrow and the Association of Coloproctology of Great Britain and Ireland's National Ileal Pouch Database, together with the ileal pouch registry of the Cleveland Clinic Foundation, Ohio, USA we have compiled a dataset comprising over 4,000 patients. Using logistic and linear regression techniques we hope to identify those factors that can be used to predict future functional outcome and quality of life following this complex surgery.

Integrating human and technological systems in the operating theatre - EPSRC

The broad aim of this research is to delineate surgery as an information processing system. Methods of research include literature review and survey of staff, but more heavily involves observation and the development of relevant measures. Healey & Vincent. (in press) *The Systems of Surgery, Theoretical Issues in Ergonomic Science*.

Integrating human and technological systems in the operating theatre: a multi-method study of information processing in surgical teams

This 3 year research programme is funded by the Engineering and Physical Sciences Research Council (EPSRC). The research aims to identify the challenges faced by operating theatre staff in relation to the transfer and use of surgical procedure-related information. Specifically we aim to: 1) identify information needs, weaknesses and effective practices in communication, processing and integration of information in current Operating Theatre (OT) systems, comparing different types of surgery; 2) define criteria for what information, when and how it should be transmitted, transferred and presented effectively in the OT for each type of operation; prioritise identified areas for intervention; 3) develop and pilot appropriate technological and human factors solutions to systematically address information needs, identified weaknesses and promote good communication practices in the OT.

Longitudinal outcomes and modelling of survival and Quality of Life in upper gastrointestinal cancers

This project aims to assess quality of life and calculate quality adjusted survival in all patients diagnosed with gastric, oesophageal and pancreatic cancer at St Mary's, The Royal Marsden and Hammersmith hospitals using validated QOL questionnaires. Novel statistical modelling will be used to calculate quality adjusted survival with the aim of changing the current primary outcome measure of surgery from survival alone to quality adjusted survival in addition to changing prediction modelling and ultimately to effect service provision within cancer services

Long-term outcomes of abdominoperineal excision for rectal cancer

To assess the long-term effects of permanent stoma formation following rectal cancer surgery, we have performed a meta-analysis to compare quality of life following anterior resection and APER. Following collaboration with the Cleveland Clinic, Ohio USA, we have been able to assess long-term outcomes from a large single unit series, comparing local recurrence, survival and quality of life between the two major approaches to low rectal cancer.

Minimally invasive approaches to colorectal surgery

We have participated in a variety of separate studies examining the risks and benefits of minimally invasive approaches to colorectal surgery. Internationally presented and published studies have examined areas including laparoscopic versus open approaches to subtotal colectomy, ileocaecal resection and ileal pouch surgery, as well as outcomes following colonic stenting for malignant colonic obstruction.

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National Bowel Cancer Audit

A substantial part of the research period has been spent working on the National Bowel Cancer Audit, run under the auspices of the Association of Coloproctology of Great Britain and Ireland. As well as data analysis and contribution to the ACP Bowel Cancer Annual Report, the researcher has worked on studies examining the influence of social deprivation on colorectal cancer outcomes, predictive models for the length of postoperative stay following surgery, and the impact of metastatic disease on short-term outcomes following colorectal cancer surgery.

Reliability and resilience in healthcare systems

Improve the quality and safety of care delivered to patients through developing reliability and resilience in healthcare systems initially at the clinical unit level for Upper-Gastrointestinal Services. Reliability refers to the capacity for continuous failure free operation of routine, standardized care delivery processes. Resilience refers to the capacity of an individual, team or organisational system to adapt to

complexity and unexpected variations arising from interactions between the patient's condition, care delivery process, clinical system and other uncontrolled factors.

Safety Skills

The pace of work in healthcare and the lack of opportunity for reflection often make it difficult for healthcare staff to develop and maintain awareness of the hazards and problems in their workplace. We believe that it may be possible to train people in foresight, anticipation of error and error recovery techniques. Furthermore patients could enhance the safety of the health care delivery system in many ways, but the extent to which this is possible and the impact on patients and families, both positive and negative, is currently unknown, therefore we aim to evaluate the use of a patient safety video.

Strategies for faecal and urinary incontinence

An examination of diagnostic modality and criteria for incontinence of various, review and meta-analysis of literature pertaining to treatment strategies, and decision-analysis to determine optimal strategic planning.

Surgical stress management training using high fidelity surgical simulation

We have developed simulations using complex surgery scenarios that enable us to assess surgeons' intraoperative stress levels and surgical performance in a safe environment. We are evaluating a surgical stress management training consisting of a combination of simulation training and evidence-based educational modules on stress and coping in surgery. This is a collaborative study of psychologists and surgeons.

Surrogate Measures of Surgical Quality: Circumferential Resection Margin Status

The potential for circumferential resection margin rates following rectal cancer excision to be used as a surrogate marker of surgical quality, which can be used to compare the quality of care between units through the framework of National Audit, has been investigated using ACPGBI audit data. To confirm the link between short and long-term outcomes, we have collaborated with St Marks Hospital, examining their rectal cancer database.

Surrogate Measures of Surgical Quality: Permanent Stoma Rates

Based on advice from the NICE Colorectal Cancer guidelines we have examined the impact of patient factors on national rates of Abdominoperineal excision (APER) for rectal cancer. Using hospital episode statistics (HES) we examined general trends over time, and the influence of social deprivation. These trends, and the influence of tumour and patient factors on permanent stoma rates were confirmed using ACPGBI data.

The design of a novel resus station

Recent evidence published by the National Patient Safety Association (NPSA) suggests that cardiac arrests trolleys are responsible for endangering patient safety. Current trolleys are based on tool trolleys, and were first described ten years before cardiorespiratory resuscitation was first described. This project is utilising a unique collaboration with the NPSA and the Helen Hamlyn institute to create a modern resuscitation platform.

The psychology of teleoperation in surgery

This peripheral project considers how the surgeon adapts to and operates through the teleoperative interface. This project reflects interest in visuospatial and sensory-motor learning in mediated environments. Healey AN. (in press) The neuropsychology of teleoperation: implications for presence research and minimally invasive surgery. Presence: teleoperators and virtual environments.

SURGICAL SKILLS TRAINING AND PERFORMANCE ASSESSMENT

Analysis of Perceptual Behaviour in Minimal Invasive Surgery

The skills required in MIS present unique challenges, particularly in establishing the appropriate perceptual-motor relationships. Thus far, there is little knowledge about the association between the visual information and the cognitive and perceptual functions particularly in surgery. The current research investigation is the first step towards providing a robust eye-tracking methodology for understanding the role of visual perception in MIS, which is a prerequisite for quantifying surgical performance and identifying the underlying idiosyncrasy of different operators to objectively assess surgical skills and setting standards for improved surgical safety.

Hand eye coordination in Surgery

This project aims to introduce the measurement of hand-eye coordination in surgery, using this as a novel method to assess intrinsic abilities of the surgeon. As the shortening of training in surgery is imminent, trainee selection should be focused not only on academic excellence and good clinical judgement, but also the potential to develop superior surgical skills.

Eye and hand tracking technologies are available and have been utilised in surgical assessment, however the relationship between the two have not been fully understood. It is the separation of motor and visual learning that may provide insight into surgical skills acquisition.

Pattern Recognition for NIRS (Near Infrared Spectroscopy)

There is a need of a technique for objectively assessing surgical skills capable of explaining learning curves in terms of brain activation reflected in the neuroplasticity. NIRS, as a neuroimaging technique, could prove itself to be suitable for this task, by indirectly measuring brain activation by means of the cerebral blood flow and blood oxygenation response. Data acquired from a NIRS apparatus needs to be analysed in order to search for patterns showing brain activations after a certain surgical task is performed. The challenge of this project is the application of existing machine learning techniques, and/or developing new algorithms if necessary, for proper classification of the NIRS data which helps in explaining the presence or absence of brain activation.

Peripheral Visual Fields in Laparoscopic Surgery

This project utilizes eye tracking technology in the laboratory and operating theatre to investigate the importance of peripheral visual fields to the laparoscopic surgeon. The ultimate aim is to develop systems to improve the visual feedback to the surgeon and surgical performance.

The role of functional neuroimaging in the objective assessment of technical skills in surgery

Methods to quantify technical skills fail to explain why some trainees rapidly acquire proficiency whilst others struggle in similar training environments. Our hypothesis is that differences in innate perceptual and motor learning capability are responsible for this diversity. Motor learning ability can be inferred from brain function, quantified using non-invasive technologies.

A feasibility study demonstrated a reliable and repeatability cortical response associated with surgical knot-tying. The results were presented to the Organisation for Human Brain Mapping (OHBM)2006 and Medical Imaging Augmented Reality 2006 and were published in Lecture Notes in Computer Science. A subsequent study involving 62 subjects demonstrated that surgical knot-tying evoked a lateralised prefrontal brain response in novices, a finding not mirrored in expert surgeons. These findings have been submitted for presentation to OHBM 2007.

We are currently evaluating neuroplasticity associated with protracted technical skills acquisition.