PROCEEDINGS

ST VINCENT'S CLINIC, SYDNEY

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EDITORIAL

Dr John O'Neill MD, FRACP

CONSULTANT NEUROLOGIST

EDITOR, PROCEEDINGS

This Issue of Proceedings contains a disparate group of interesting topics.

The 10th Sandra David Memorial Lecture was delivered by Professor Rory Hume at the St Vincent's Clinic in October, 2003. His article provides a historical account of the development of Universities and, in so far as the medical field is concerned, he highlights the rapid advances which followed the amalgamation of academia, teaching and clinical research whereby "public benefit is the driver of research and teaching". St Vincent's Campus with its combined Garvan and Victor Chang Institutes, academic association with the University of New South Wales and large outpatient (Clinic) and in-patient clinical load is ideally suited to expand on this ideal of "teaching and research for public benefit".

On page 18 are listed the Research Grants which have been funded by the St Vincent's Clinic Foundation in 2004. It should be noted that of the $100,000 Sr Mary Bernice Grant, $85,000 was raised from the hard work of the Ladies' Committee of St Vincent's Private Hospital and St Vincent's Clinic. In addition to the listed grants, the Foundation has committed a minimum of $1 million over the next 3 years to fund adult stem cell research with specific grants to Professors Graham, Shine, Brew and Ma. Research work, therefore, is currently strong on St Vincent's Campus.

Dr Rajiv Shah wrote an excellent review on the important topic of glaucoma (especially primary open angle glaucoma) which, after age-related macular degeneration, is the second commonest cause of legal blindness in Australia.

Coronary artery stenting has revolutionised the management of coronary artery disease. There are currently major multi-centre trials to determine the effectiveness of stenting versus endarterectomy in patients who are at risk of stroke from carotid artery artherosclerotic disease. Dr Paul Roy, a pioneer of coronary artery stenting at St Vincent's Clinic, has now, in conjunction with Professor David Muller, performed over 140 stents in patients with both symptomatic and asymptomatic carotid artery stenosis. Their article details their experience and provides an overview of the subject, challenging their vascular surgical colleagues.

Associate Professor Michael Neil, Orthopaedic Surgeon, reviews his personal experience and the medical literature with respect to a new advance in knee surgery: the minimally-invasive unicompartmental knee replacement, delaying the need for total knee replacement in suitable (especially younger) patients.

These days many groups of surgeons have to become expert in laparoscopic surgery and Dr Vincent Lamaro, Gynaecologist and Endoscopic Surgeon, is one of the young leaders in this area. His article reviews the use of laparoscopy in the diagnosis and treatment of gynaecological pathology.

Professor Paul Fagan, ENT Surgeon and President Elect of the World Federation of Skull Base Surgical Societies, highlights some of the challenges imposed in dealing with tumours of the lateral skull base. Professor Fagan has been an international pioneer in skull base surgery.

Finally, the article by Drs Steven Liew (Plastic Surgeon) and Elias Moisidis provides an authoritative overview on the revolutionary advances in plastic (and cosmetic) surgery which have taken place as a consequence of the clinical utilisation of the tremendous technological and biomedical advances of recent times.

THE SANDRA DAVID ORATION

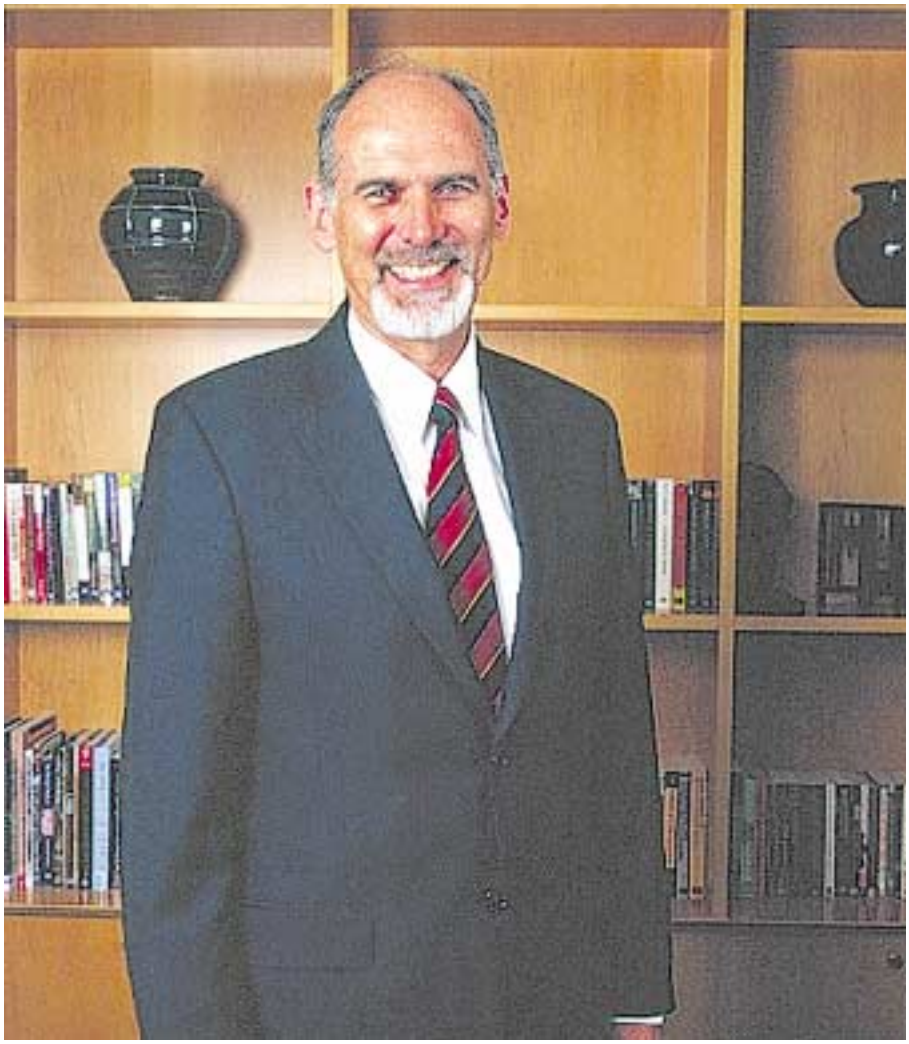
The nexus between teaching research and public benefit: the special case of the health sciences

Professor Rory Hume

Professor Hume was Vice-Chancellor and President of the University of New South Wales from 1 July 2002 to 30 June 2004. Prior to this appointment, Professor Hume was Executive Vice Chancellor of the University of California, Los Angeles (1998-2002). Professor Hume has also held the posts of Dean of the School of Dentistry at UCLA (1996-1998), Chair of Restorative Dentistry at the University of California, San Francisco (1991-1996), and Dean of the Faculty of Dentistry at the University of Sydney, Australia (1989-1991).

Professor Hume's academic qualifications include a Bachelor of Science in Dentistry and Bachelor of Dental Surgery, a PhD in Human Physiology and Pharmacology and a Doctor of Dental Science (for published work), all from the University of Adelaide.

Professor Hume is the author of more than 100 research papers and the recipient of numerous research grants from the NH&MRC of Australia and the US National Institutes of Health. He has been the recipient of numerous teaching awards, including consecutive Outstanding Instructor awards at UCLA and UCSF. He serves on the Board of the Garvan Institute of Medical Research, the Prince of Wales Medical Research Institute and the Australian Research Council.



I will speak about universities, and hospitals; about teaching, research and clinical care. In particular, I will highlight what I see as the very beneficial effects for society of the links between university teaching and research, focusing on the benefits that we can bring to society through the delivery of improvements in health care.

I will start, though, with universities as they have been and are the primary drivers of teaching and research.

Universities, as we know them in the European tradition, have been with us for a long time. The University of Bologna, in Italy, then the University of Paris began more than 800 years ago and we usually trace our origins to them. But we can, and we should, trace our origins further back, through the great Islamic centres of learning, the Islamic universities, through to ancient Greece.

Medieval universities were guilds of scholars – students and the teachers that they employed. They were, mostly, for the rich, and were watched over by the church. Like the Greek and Islamic universities they were primarily devoted to the seven 'liberal arts and sciences': grammar, logic, rhetoric (the first level, the trivium) and geometry, arithmetic,

astronomy and music (the quadrivium). These seven areas of study were seen as suitable for the development of intellectual and moral excellence, as distinct from the 'practical arts', which were thought to be merely useful.

Over the next 500 years universities multiplied and slowly evolved, mostly in Europe and then the American colonies, but they did not evolve greatly. They remained devoted to the liberal arts and sciences. Beyond the trivium and the quadrivium there were only three fields of higher study: theology, law and medicine. It was only in these fields that 'doctoral' degrees were awarded. I'll contrast education in the theory of medicine with practical training in surgery a little later.

Substantial change in the nature of universities started to happen in the 1700s, probably in response to the turbulent religious and political times in Europe and North America. Secularised and democratised universities started to develop. Thomas Jefferson established the University of Virginia just after the American Revolution, with the goal that it would be open to anyone, without religious tests, and independent of controlling church influence. Some European governments made similar changes. But the universities were still largely institutions devoted to the liberal arts and sciences, designed to educate the individual in the broadest sense.

This changed in the US because of the Federal Government's Morrill Act in 1862. The Act granted public lands to the states for the formation and support of what are now known as the land grant universities, on the understanding that the universities would, through their teaching, directly improve agriculture and manufacturing and consequently improve the economy as a whole. Universities therefore began to move into practical fields, and governments became involved in the support of universities.

Governments began investing in universities at around the same time in Germany, probably in response to defeats in the Franco-Prussian wars, and along what turned out to be very usefully different lines. German state governments provided direct financial support to universities to create professorial positions in new disciplines, resulting in a much finer-grained intellectual structure than the seven liberal arts – new fields like chemistry, physics, biology, engineering, history and sociology. The professors had great autonomy in their seminars, or what we would call departments or schools. They included research and research training for graduates in what they did, in part to replicate themselves.

This had a number of enormous benefits on the world subsequently – on science, on teaching, and on health care.

Young American bachelor degree graduates started to travel to Germany in large numbers to study at the graduate level, so US universities reacted by themselves establishing new disciplines of study focused around postgraduate programs.

Yale awarded the first American PhD, the degree that the Germans had started to use to recognise research-trained scholars in any field, in 1861. Harvard did so in 1873.

A new University, Johns Hopkins in Baltimore, was established in 1876 with the intention from its inception that it would give graduate research training fully comparable with the best German universities. The founding president of Johns Hopkins, Daniel Coit Gilman, wanted his university to, "...serve the practical needs of society through independent research on the nation's problems." We'll come back to Johns Hopkins twice this evening.

So a new concept was developing in the late 1800s of what a university could do – provide direct benefit to society through research outcomes. This was in addition to the benefits to individuals and therefore to society by improving people's skills and abilities through teaching.

When graduate research training was added to the large land grant universities, some became over time what we now call comprehensive research universities, covering many fields at the graduate research level.

At the same time, the late 1800s and early 1900s, Francis Bacon's 'scientific method' matured, principally in universities. From about the 1930s in most fields, up to now, the scientific method is considered to be, in broad principle, the objective analysis of a hypothesis, testing it against evidence, and then its acceptance, modification or rejection. In many fields this intellectual construct has added enormously to our ability to create new ideas and to test old ones effectively.

There were very positive effects on local economies from the research that flowed out of research universities, both in Germany, then in the US, then elsewhere as the model spread. The German chemical manufacturing industry, the dye industry – for colouring clothes and furniture – and then quite rapidly the pharmaceutical (drug) industry developed; so did precision engineering, and heavy engineering. All benefited from focused graduate-level teaching and research in the new fields.

Many rapid advances in the health sciences can be traced back to German scholars working in these new fields. I consider the most influential early advances to be in pharmacology, which derived from rapid improvements in the basic understanding of chemistry; and in microbiology, which was created as a field of knowledge because of focused research in biological sciences.

Both fields of research changed health care, very profoundly, in the decades that followed. The two fields came together later, in the 1940s and 1950s, with the development of antibiotics. This is the first example that I will use of the benefits of collision between disciplines.

So major effects on health care, and major effects on industry, began to happen because of the development of research-focused universities, first in Germany, then in the US, then in other parts of Europe and elsewhere. This rapid and profound effect on society is the unique feature of successful research universities, those which have substantial and focused graduate level research programs.

THE SANDRA DAVID ORATION

Hospitals, as centres of health care, have a similar history of development, one that has become increasingly interwoven with that of universities.

The earliest recorded form of hospitals also had their beginnings in Eastern Europe – Greek healing temples to Roman military hospitals.

Early Greek medical teachings were absorbed by the emerging Islamic empire. Medical theory and practice were assimilated and built on by both Muslim and then non-Muslim physicians.[1] The early Christian hospitals of Byzantium, the 4th Century, began to include concepts which would be familiar to tonight's audience. The spreading tenets of Christianity espoused the concept of welfare, supporting the care of the needy, the poor and the sick.[2]

After the fall of the Roman Empire, monasteries became one of the principal repositories for Greek medical texts along with many other forms of knowledge. They were also centres for the care of those in need.

During the 13th Century, universities began to replace former cathedral and monastic schools in providing medical education, teaching a wider range of subjects and establishing a standardised curriculum that culminated in a set of degrees. The two stories start to come together. Ratified by ecclesiastical authority, universities like Bologna and Paris became the main centres of study for academic medicine. Again, things didn't change much throughout the middle ages.

In the 1700s Britain, as often has been the case, began to follow a rather different path from other parts of Europe. The British voluntary hospital movement began without any government oversight, principally because of the concern of civic-minded businessmen who formed "alliances against misery", supporting medical and surgical groups. Between 1720 and 1745, eight voluntary hospitals were opened in Britain, including Guys Hospital and Middlesex, and the Edinburgh Infirmary and Bristol Infirmary.[3]

In London by about 1800, there was a strongly defined medical hierarchy, as there was elsewhere in Western Europe. The physicians were all university graduates, having studied at Oxford, Cambridge or other universities. They ruled. Beneath them were the two separate bodies of surgeons, who were rather despised, and apothecaries. Both learnt their trade as apprentices.[4] Dentists, you may not be surprised to learn, were an even more despised sub-set of surgeons, but were needed to deal with the new epidemic of tooth decay. I won't go into that tonight.

The introduction of the British Medical Act of 1858 regulated medical education and medical practice. Things started to improve for surgeons: they became included. Apothecaries – pharmacists – and dentists stayed separate, and they still are, but both later became university-linked as well.

The University of Edinburgh (established in 1582) had already gained a prominent reputation within Britain, Europe and North America. It was viewed as an alternative to the Oxbridge universities. When the Edinburgh Infirmary was created in 1729, it was linked to the university, an innovation, and "students of physick and surgery might hereby have ... a better and easier opportunity of experiences than they hitherto had by studying abroad."[5]

Very importantly, in the 17th century Edinburgh's Royal Colleges began to set the standards for qualification in medicine and surgery. Combining this oversight of standards with linked university and hospital education and clinical experience, with bedside teaching of physicians, was innovative and added great strength to medical education.

A similar strength developed in Dublin, with Trinity College linked to associated hospitals. Both the Scottish and the Irish strengths in university teaching and research, and the associated effects on health care, helped local populations and later became influential world-wide. They still are influential.

On the other side of the Atlantic, the founder of the first medical school in North America at the University of Pennsylvania, John Morgan, had earned his medical degree at the University of Edinburgh.

Here the two stories come together again. Johns Hopkins University in Baltimore was initiated in 1876 explicitly along German lines, and it included a teaching hospital and clinics.[6] It is, today, very probably the finest academic medical centre in the world, in large part because of the early and effective marriage of university-based teaching and graduate-level research, with training in and delivery of health care.

Medical education and health care service in America had, up to that time, been poor in relation to its European counterparts. Proprietary medical schools abounded. Virtually anyone could operate a medical school, and many people did. When universities started to gain strength and value through their research, the organised profession began to seriously question how medicine should best be taught in the US. This questioning culminated in the Flexner report on medical education in 1910. It had far-reaching impacts. The report called for all medical schools to be university-based, for faculty to be engaged in original research and for students to learn actively through laboratory study and clinical work in a research-centred environment.[7] Basically, the report effectively abolished by the 1930s any medical schools not linked to universities.

The US residency system then developed, which is again best exemplified through Johns Hopkins Hospital. Building, I think, on a combination of the Royal College oversight of standards in the British hospitals and the German university graduate training system, the Hopkins residency was designated as an academic experience for physicians who had already completed an internship and were continuing their hospital training to study a specific field of medicine. The most important objective of residency was the training of investigators and teachers. The residency system assumed many of the characteristics of a graduate school within a hospital.[8]

This emphasis on combining clinical study with research provided expert training in a clinical speciality, and it also prepared young physicians for a career in clinical investigation. This assisted in the development of clinical research in the United States. The mixture of clinical science, the clinical 'full-time' system and the residency system combined to make the US the leading nation in medical research in the world from the 1930s.[9]

The quality capstone in the US, as I see it, was the infusion over the last half-century of enormous amounts of competitive Federal research money for medical research, fully costed and fully supported, including salaries and full indirect costs. This led not only to great advances in health care, but also to the development of spin-off industries, particularly the pharmaceutical industry, which in turn now provides more research funds for the university-hospital research system. It works very well.

I'll speak only briefly about the unique circumstances of Australia, and then return to more general principles. Health care as we understand it in Australia began with European settlement. Our early physicians were the products of British medical schools, but many in the early medical work-force were surgeons who had been trained through apprenticeship. We did get one major thing right, in my view, right from the beginning. The Australian medical schools which were established, the first being in Melbourne in 1862, followed by Sydney in 1883 and Adelaide in 1885 were all university based and were linked with adjacent teaching hospitals, along Edinburgh lines.[10]

Hospitals in Sydney had been established in tandem with the arrival of the first settlers. The first hospital was established at the Rocks, and there were several versions of Sydney Hospital from 1812 with the final Macquarie Street Hospital site being established in the 1890s.[11] The Royal Prince Alfred Hospital was opened in 1882 from community funds raised as a memorial for Prince Alfred the Duke of Edinburgh after an assassination attempt while he was visiting New South Wales. This hospital would provide the clinical teaching to students of the medical school of the University of Sydney which opened in the following year.

Another private hospital was opened in 1857 by the Irish Sisters of Charity. They arrived in Sydney in 1838 and assisted many of the city's poor and disadvantaged: from convict women and children at Parramatta to caring for prisoners and their families at Darlinghurst Gaol. St Vincent's Hospital was first established in Potts Point with three of the Sisters having been professionally trained as Nurses in France. St Vincent's was established as a free hospital for all people and it moved to its current site in Darlinghurst in 1870. It had grown to become a leading medical, surgical and research facility, linked to a fine research university. It is an outstanding centre for research and is Australia's largest not-for-profit health provider.

As we look at universities and hospitals and health care today against the background of the very abridged history that I have just given you, we realise that the nexus between teaching, research and public benefit continues to roar on – that is the best phrase that I can use.

I will give some examples. I mentioned earlier the development of pharmacology, then microbiology, from the early discipline focussed work in new research intensive universities based on the German model, both in Germany and elsewhere. This work led to the development of new methods of care, but perhaps more importantly, new concepts of the nature of disease which then led to new concepts of care. Let's run through the simple example again. New understanding in chemistry led to the development of dyes, then drugs. New understanding in biology led to a basic understanding of microbiology. These two things in themselves changed the way we looked after people. Microbiology in particular brought us new concepts of the nature of disease and therefore new treatments. But the two fields later collided in the 1940s and 1950s with the development of antibiotics. That revolutionised health care, and also created new industries. That often seems to be the case with inventions coming out of universities.

In relation to surgery we could follow similar paths for anaesthesia, which also followed increases in the understanding of chemistry, or the development of surgical instruments, from metallurgy and fine engineering, or radiographic imaging from the understanding of electricity and physics. The examples of spin-offs from university research into health care are almost endless. University based research is almost always the driving force behind major advances in health care.

I would like to move now to the 1950s for the next big example, molecular biology. Genetics had told us what we were looking for, but chemistry, biochemistry and surprisingly crystallography were the fields of study which when they came together, led to the breakthrough in the understanding of the molecular structure of DNA. This was university based research, involving people trained in medicine as well as the basic sciences.

This understanding changed the world. I will move forward 40 years to the University of California, San Francisco, one of the major challengers to John Hopkins for eminence as a great research based, health sciences university, and a place where I worked for five wonderful years. Booming research in molecular biology led to new industries, to new treatments for disease and, as is always the case, to new understandings of the very basis of disease. The collision of the science of molecular biology with the new branch of engineering, computer science or information technology, led to the understanding of the genome and all of the other things that are flowing now from that.

Why does this sort of thing happen in research universities so effectively? In my view there is an extremely strong creative environment when you bring together research and teaching at the graduate level. Graduate students question their mentors. Sometimes the interactions are collegial and positive, and sometimes they are difficult. But

very often they are extremely creative. The second major reason today, is the collision between traditional disciplines when universities are able to sustain multiple areas of research strength. When people come together who have different backgrounds in science working on common problems, they very often come up with extremely creative ideas and new solutions.

I would like to give a final example of collision between disciplines, the development of nanoscience. This is happening in different ways in different places where quite extraordinarily disparate disciplines come together. I took part, as an administrator, in an amazing development of new concepts and new technologies when people involved in molecular imaging, the science and practice of visualising levels of molecular activity, the creators of the PET scan, came together with synthetic chemists who were succeeding in creating molecular switches for a new basis for computing. The two groups realised that they had a lot to teach each other, and molecular imaging took a great leap forward. The group is now succeeding in imaging levels of gene activity within clusters of mammalian cells. This, again, will revolutionise medicine, create new cures and spawn new industries.

What is happening in universities in Australia? Generally speaking, there is now an effort to create strong research universities in a sector which for the last couple of decades has tended to become more homogenous and less focused. I believe that we need, as a nation, to come to terms with the competing social priorities of broad and low-cost access to higher education for much of the population, and the development and maintenance of research-intensive universities, ideally closely linked to teaching hospitals.

The University of New South Wales, for example, is working to bring together a unique mix of strong research disciplines in close alignment with clinical investigation and clinical care in our associated teaching hospitals. If we can do that, we will create new science, new technologies, and new clinical applications. Very importantly, we hope to enhance the clinical trials capabilities of our affiliated hospitals and clinics. Computer science has created great opportunities in care outcomes research, and to try and improve our understanding of the effectiveness of new technologies which are developed. UNSW's great information technology abilities should give us all the capacity to do this much better.

To do these things well we need substantially more funding for basic research, from competitive sources. If I have a single advocacy message, it's that we as a nation should invest more in the future well-being of Australians through increased competitive funding for all scientific research, including medical research. As we've seen many times in the last 150 years, research in virtually all scientific fields can improve health care.

I've been speaking enthusiastically about scientific research and its benefits, but as I draw to a close I'd like to acknowledge other important values.

Despite the developments in medical science, there is a persistent question as old as medical education itself. I quote Lisa Rosner: "Medical schools can teach basic sciences, anatomy, and pathology; but can they teach compassion, responsibility, flexibility, and problem-solving? They can teach the striking success of Western medicine in isolating and treating the disease – but can they teach how to understand and treat the whole patient" Are they – and should they be – providing the moral and intellectual discipline necessary for imparting values and building character, the original sense of medical education – that medicine is an art as well as science?[12]

There are many examples of how the health sciences have evolved to provide excellent medical care, and how research and teaching practice feed into that care. The work of the St Vincent's Clinic Foundation – and by extension the whole St Vincent's Hospital campus – follows in the best tradition of supporting medical research that impacts directly on clinical practice. For the health sciences to continue to thrive, public benefit must remain the driver of our research and teaching. Throughout the history of medicine, it has been the cure and prevention of disease, and therefore the best patient care, which have made advances through research worthwhile.

ACKNOWLEDGMENT

I acknowledge Morgan Stewart, a member of my staff, who has undertaken research for me on the history of hospitals as part of health care, in particular, and who has contributed substantially to writing this paper.

Material related to the history of university development was also used in a lecture by W. R. Hume to the UNSW community in November 2002.

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Dr Rajiv Shah

Primary Open Angle Glaucoma – an Overview of Diagnosis and Management

Introduction

The glaucomas represent a broad range of disorders that all have characteristic optic nerve head cupping and visual field loss in common.

Primary open angle glaucoma (POAG) is the second leading cause of irreversible legal blindness in Australia after age-related macular degeneration. It is generally an asymptomatic and progressive disease and has a prevalence that varies from approximately 2% up to 6% depending on the racial profile of the population studied. The Blue Mountains Eye Study gives a prevalence of 3% in a Caucasian population.[1] The higher prevalence's are in Afro-Caribbean populations.[2]

POAG is by far the most common type of glaucoma in our society. Primary angle closure ('acute glaucoma') will increase in Australia due to an increased population of Asian descent. The secondary and congenital/juvenile glaucoma's are less common and will not be discussed in this overview.

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Pathogenesis

Very little is known about the pathogenesis of POAG. Aqueous humour is produced by the ciliary body and is drained via the trabecular meshwork into the Canal of Schlemm (conventional outflow pathway) and then into the episcleral venous system (Figure 1). The primary site of increased resistance to flow is at the trabecular meshwork. It is generally believed that an increase in extracellular material in the trabecular meshwork creates this obstruction to flow resulting in increased intraocular pressure (IOP). In patients with normal pressure glaucoma the blood supply at the optic nerve head has also been implicated in the development of optic neuropathy.

Individual optic nerves have differing susceptibilities to levels of IOP. In most people the cause of the optic nerve damage is multifactorial. IOP is one of the only treatable risk factors. In some the disease is not responsive to a reduction in IOP and treatment for these people is limited.

Risk Factors

1. Raised Intraocular Pressure

Raised IOP is the major risk factor for the development of POAG. It was once considered part of the diagnostic criteria but normal pressure glaucoma is a well established and increasingly diagnosed entity. Intraocular pressure > 21mmHg is considered above normal. The risk of developing glaucoma increases as the IOP increases. Raised IOP without optic nerve head damage detectable by structural or functional means is called ocular hypertension.

Lowering IOP in glaucoma patients and in ocular hypertensive patients has been shown to slow down the rate of visual field loss or delay the onset of disease (Figure 2). Recent multi-centre randomised controlled trials[3-6] have all shown the importance of IOP lowering from the baseline (whether the baseline is in the normal range of IOP or not). Importantly, however, reducing IOP did not prevent the development of glaucoma.

2. Family History

A positive family history substantially increases the risk of disease. There are many genes now identified that are linked to differing subtypes of glaucoma but POAG had not been linked to any one particular gene. DNA screening will become more important in years to come in those considered to be at an increased risk of developing glaucoma.

3. Race

There is an increased prevalence in people of African (especially West African) and Afro-Caribbean descent. The disease often presents at a younger age and is more aggressive and more difficult to treat.

4. Central Corneal Thickness

This risk factor has been found in a recent study (Ocular Hypertension Treatment Study) to be significant for the development of glaucoma in ocular hypertensive patients if the corneas were less than 500 microns thick centrally.[7]

5. Other

Age, myopia, peri-papillary atrophy, diabetes mellitus, systemic hypertension and nocturnal hypotension (implicated in normal pressure glaucoma).

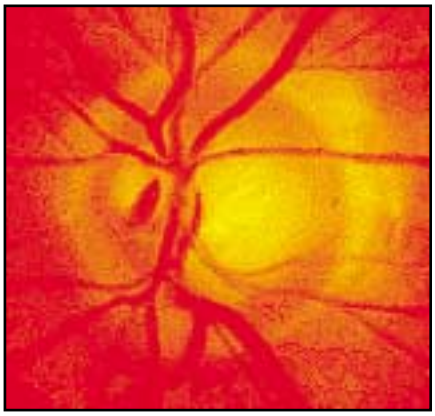

Figure 3: Glaucomatous optic disc showing cupping and inferior rim notching. (Reproduced with permission from www.eyetext.net)

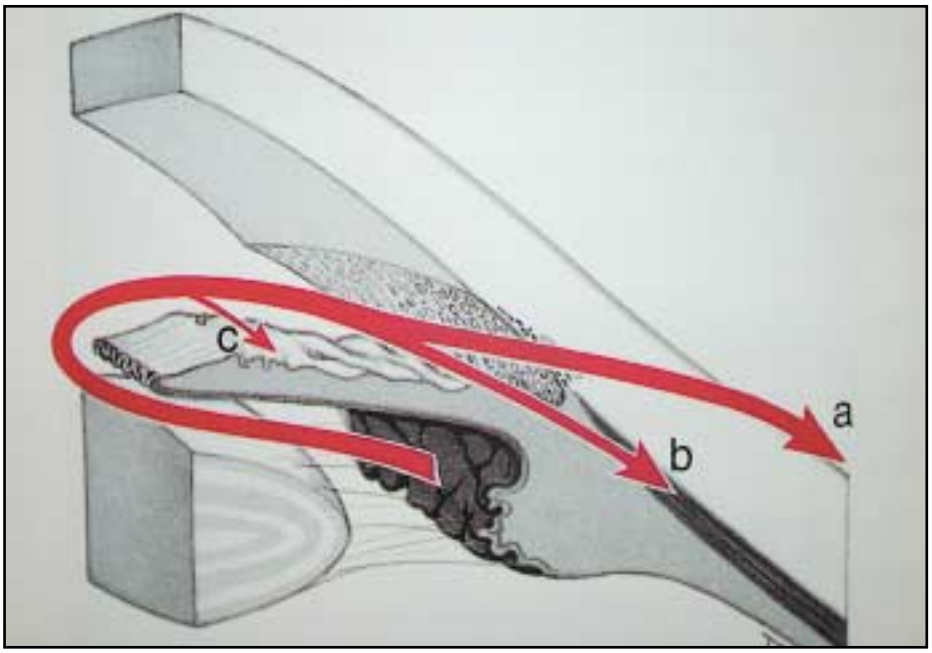

Figure 1: Normal Outflow of Aqueous Humour: (a) trabecular (conventional) route; (b) uveoscleral (unconventional) route; and (c) through the iris. (Reproduced from Kanski JJ: Clinical Ophthalmology. *Oxford, Butterworth-Heinemann, 1994, p234)*

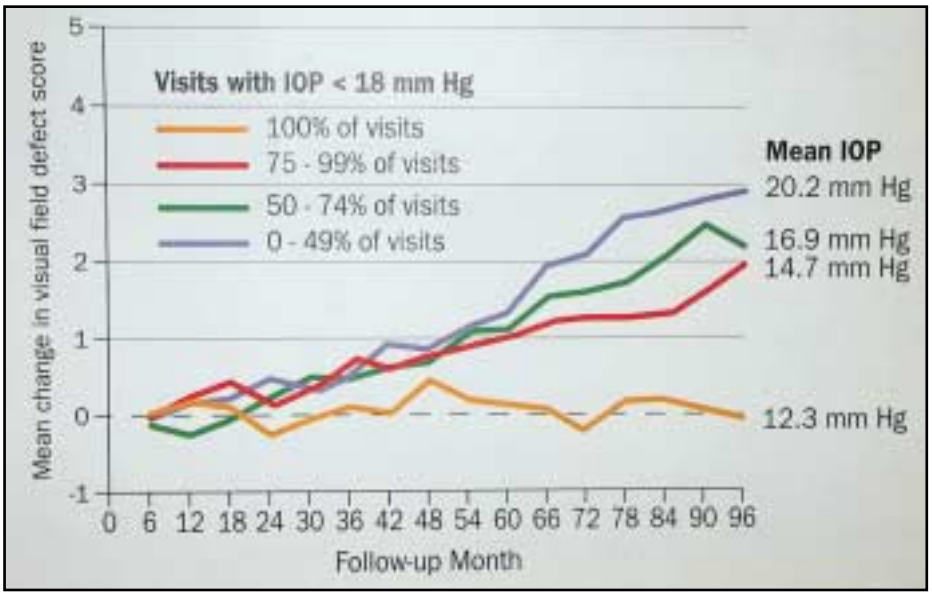

Figure 2: Effect of IOP control on visual defect. The Advanced Glaucoma Intervention Study, Am J Ophthalmol. *2000;130: 429-440.*

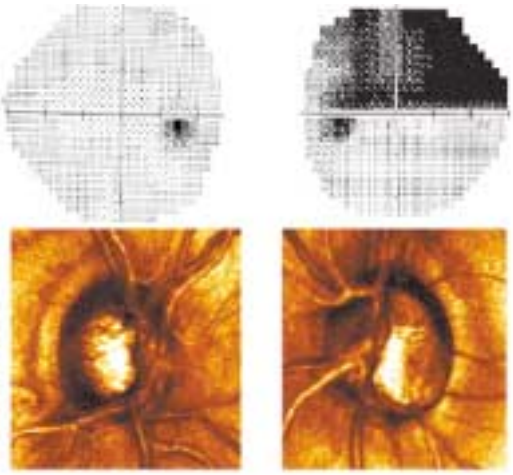

Figure 4: Normal optic nerve (scanning laser ophthalmoscopy image) and corresponding automated achromatic visual field on left. Glaucomatous optic nerve with inferior rim thinning and corresponding superior visual field defect on right. (Reproduced with permission from www.eyetext.net)

DIAGNOSIS

Glaucoma leads to very characteristic optic nerve head 'cupping' (Figure 3). A visual field defect is often found at diagnosis which corresponds to the area of optic nerve damage (Figure 4). Achromatic visual field ('white on white') defects are seen when 30-40% of the nerve fibre layer is already damaged. Disc damage is seen before development of a field defect as detected by white on white perimetry.

Other visual field techniques can be utilised which can detect field defects earlier. These involve targeting specific types of ganglion cells that are damaged earlier in the glaucomatous process (blue on yellow perimetry and frequency doubling technology). All these visual field tests are limited by their subjectivity, patient reliability and statistical analysis. Objective visual field testing involves stimulating different sectors of a patient's visual field with a checkerboard pattern and detecting multifocal visual evoked potentials in the occipital cortex.

Early diagnosis involves looking at the optic nerve head and surrounding nerve fibre layer (NFL) for nerve fibre layer defects. Optic nerve head analysis aims to detect the earliest possible structural changes. Scanning laser ophthalmoscopy (Figure 5), polarimetry and optical coherence tomography are all used. Reliability of the analysis of the images remains the main problem.

TREATMENT

The decision to treat glaucoma patients and how aggressively we treat these patients depends upon their age, life expectancy, general health, level of IOP and presence of other risk factors.

Treatment of ocular hypertensive patients (no structural or functionally detectable optic nerve damage) is often controversial and must be tailored to each individual patient. Their other risk factors must be taken into consideration. These patients are often younger and treatment is often life long.

When treating, a 'target pressure' is kept in mind. This is an IOP level that is tailored for each patient. It is a level that we think should be sufficient for stability

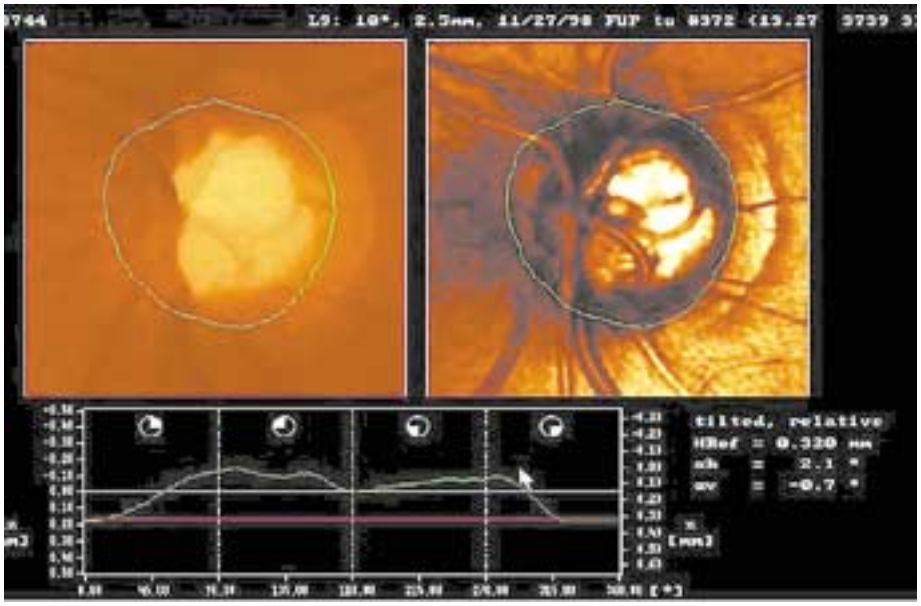

Figure 5: Scanning Laser Ophthalmoscopy images. (Reproduced with permission from www.eyetext.net)

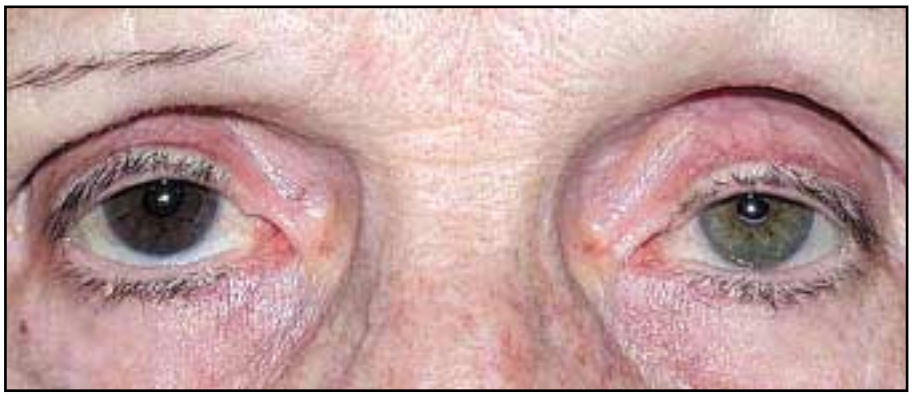

Figure 6a: Increased iris pigmentation in the right eye after use of prostaglandin analogue. (Reproduced with permission from www.eyetext.net)

Figure 6b: Increased lash growth on right eye after use of prostaglandin analogue.

of the patients optic nerve disease. Once the target pressure is achieved the patient is closely monitored for any signs of progression of disease (if detected then the target IOP is reassessed).

1. Medical Treatment

This is the mainstay of therapy for the vast majority of patients. Most patients now can be controlled on one or a combination of a number of topical medications.

Decisions as to which topical medication is used depends on the severity of the glaucoma, general health of the patient, specific contraindications, potential local and systemic side effects and predicted (and actual) IOP response. Compliance is a major reason why medications don't work as well as expected in some patients. A simple schedule as well as tolerable drops will improve compliance.

All current treatments for glaucoma are ocular hypotensive agents. There are some agents with proposed neuro-protective benefits but these are still the subject of constant debate. Neuro-protective agents aim to preserve the retinal ganglion cells and prevent surrounding neuronal death. Trials for such agents (e.g. memantine) are currently underway.

Traditionally, cholinergic agents such as Pilocarpine have been used to lower IOP by increasing the outflow of aqueous. Now they have been replaced by newer agents which are more effective and more tolerable. Pilocarpine does still have a role in certain types of glaucoma (Plateau iris, angle closure).

Beta blockers have been the main form of therapy for much of the last 25 years. They still are used very frequently but are slowly being replaced by prostaglandin analogues. Timolol is the most widely prescribed beta blocker. It acts by reducing aqueous production. The main problem with this class of drug is the systemic side effects, especially in the elderly. There can be significant systemic absorption resulting in bradycardia, hypotension, exacerbation of asthma/CAL, impotence and depression. They are, however, well tolerated topically.

Adrenergic agents such as brimonidine and apraclonidine are very effective in lowering IOP. Brimonidine may also have potential neuro-protective benefits. It lowers IOP by reducing aqueous production as well as increasing outflow. The main problem is a higher incidence of ocular allergy with long term use.

Carbonic anhydrase inhibitors can be used topically (dorzolamide and brinzolamide) or via the oral/parenteral route (acetazolamide). They reduce aqueous production. The topical forms are most often used as second line agents in combination with other agents. Orally they are used short term to achieve reductions in IOP that would be difficult to attain with topical medications alone. Unfortunately side effects prevent long term use in most people.

The newest and most potent class of medications available are the prostaglandin analogues. These act by increasing outflow via an alternate pathway (uveoscleral pathway). They

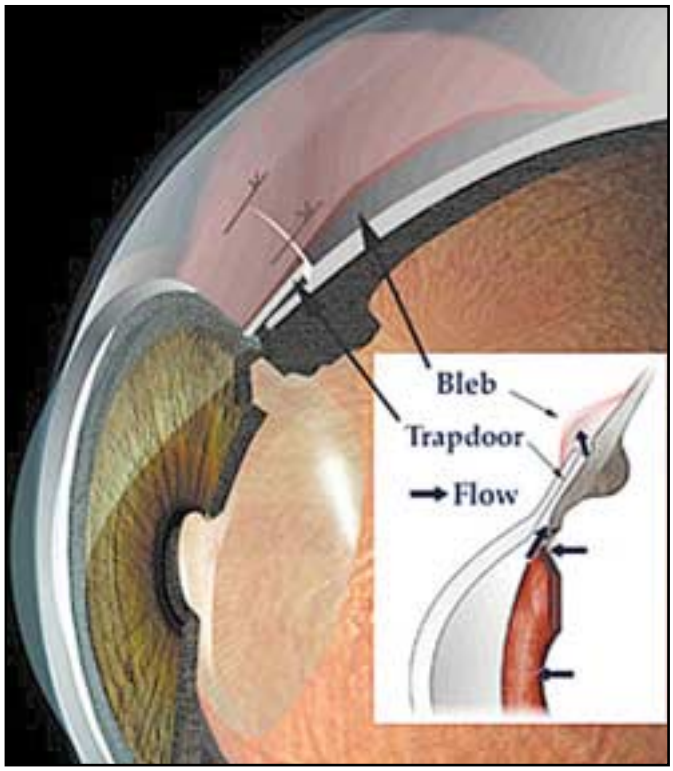

Figure 7a: 3-dimensional diagram of trabeculectomy flap and resulting subconjunctival bleb. (Reproduced with permission from www.eyetext.net)

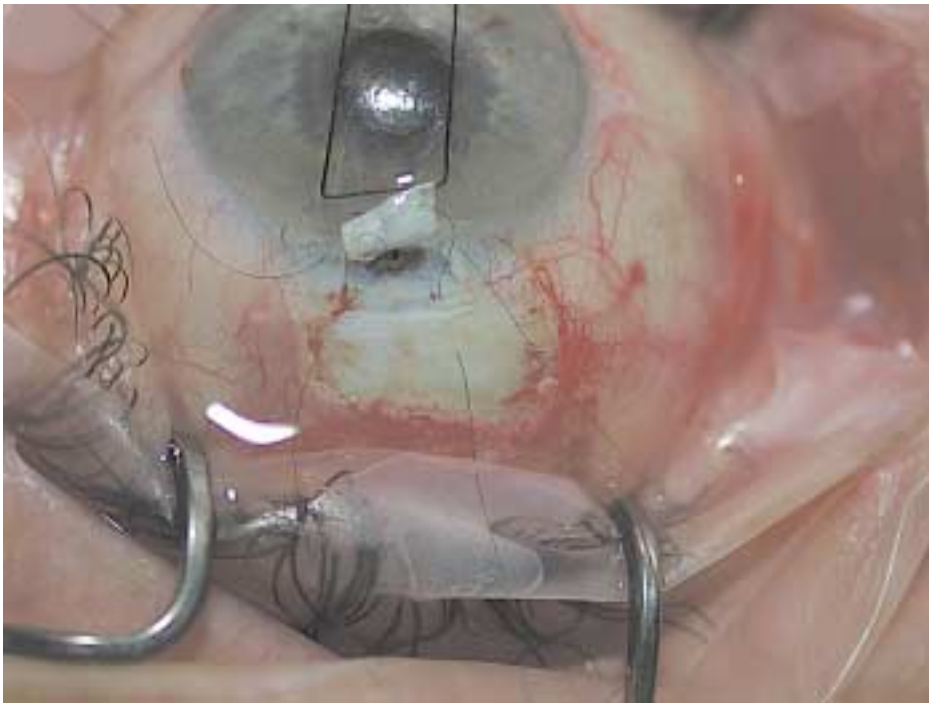

Figure 7b: Intraoperative image of scleral flap folded back over the cornea and sclerostomy cut prior to iridectomy. Note corneal traction suture and preplaced 10-0 Nylon releasable sutures in scleral flap.

are systemically very safe. They are a once daily dosage and give better 24 hour control of IOP. All these factors improve compliance and make the prostaglandin analogues the most prescribed class of ocular hypotensive. There are three main agents: Latanoprost, Travoprost and Bimatoprost. They are all equally potent. The main side effects seen are increased iris pigmentation (Figure 6a), increased lash growth (Figure 6b), conjunctival hyperaemia, itching and ocular surface irritation.

Combination therapies will become more frequently used to improve compliance. A combination of timolol and pilocarpine has been and still is used widely. Dorzolamide and timolol fixed combination is being used more frequently and provides good IOP reduction. Combinations of beta blockers and prostaglandin analogues are available and are in trial but are not widely used yet in Australia.

2. Laser Treatment

Lasers can be used in POAG to try and increase outflow of aqueous. Argon Laser Trabeculoplasty (ALT) or Selective Laser Trabeculoplasty (SLT) involve applications of numerous small burns to the trabecular meshwork in order to stimulate increased outflow. The precise mechanism of action is not clearly understood. These procedures are generally used when medications are not effective, patients are not compliant or when surgery may be considered too risky. Unfortunately the effect of ALT over time decreases and it is not a procedure that can be repeated in the same area. SLT is a newer technique which appears as effective as ALT but has the potential for repeated treatments.

3. Surgical Treatment

Surgery is considered when IOP is not controlled, target pressure is not achieved or when the disease is progressive despite apparently adequate IOP.

The procedure is called a trabeculectomy. This involves fashioning a partial thickness superior scleral 'trapdoor' or flap which covers a full thickness sclerostomy (i.e. a guarded sclerostomy). Aqueous flows out the sclerostomy and under the flap into a subconjunctival 'bleb'. The scleral flap is held partially closed with the aid of sutures which can be released or cut to improve aqueous outflow and further lower IOP. The aqueous then returns to the blood stream via the conjunctival vasculature (Figure 7a, 7b).

The success of this type of surgery depends upon the healing response of the patient. Young patients, Africans and Asians, patients who have had intraocular inflammation or previous surgery and those on numerous eye drops tend to have an exaggerated healing response. Increased episcleral fibrosis can cause progressive closure of the flap and subsequent failure of the trabeculectomy. Anti-fibrotic agents are commonly used now intra-operatively and postoperatively to try and modify the healing response. 5- Fluorouracil (5-FU) and Mitomycin C (MMC) are used commonly. MMC is a much stronger anti-fibrotic agent and is used with caution. Hypotony (too low pressure) and blebitis (infection of the bleb related to thin walled, avascular blebs) are seen in increased frequency with the use of MMC and can result in irreversible visual loss. Bleb-related infection can lead to endophthalmitis and subsequent blindness. Other complications of trabeculectomy include increased cataract formation, upper lid ptosis and bleb dysesthesia.

Glaucoma drainage implants are artificial devices that drain aqueous via a silicone tube in the anterior chamber to a plate situated subconjunctivally in the superior fornix. These are not commonly used for POAG except when repeated trabeculectomies fail. They are more commonly used in secondary glaucomas.

Conclusion

POAG is a common and blinding disease. It is asymptomatic and incurable.

The main challenge in glaucoma prevention is to educate the population to be screened for glaucoma (especially those people with risk factors for glaucoma).

A family history of glaucoma and raised IOP are the two strongest risk factors for the development of POAG. POAG is controlled in the majority of cases by lowering the IOP and should not lead to blindness if detected early.

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Carotid Stenting 2004

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Carotid Stenting will be the primary method of treating carotid atherosclerotic narrowing within five years. Carotid endarterectomy will be reserved for the few selective cases that are unsuitable for stenting methods.

Carotid artery occlusive disease accounts for one third of all strokes. Many patients with carotid disease also have coronary and other vascular disease. Coronary disease accounts for much of the mortality following carotid artery stenting or surgery. Carotid endarterectomy (CEA) was first performed for carotid occlusive disease in 1954. Between 1974 and 1985 there were more than one million carotid endarterectomies performed worldwide on the basis of anecdotal evidence without any trial at that stage showing the benefits of this procedure over medical treatment.

Subsequently there have been several large randomized trials. The most important of these were the NASCET[1] and ACAS[2] trials in the early 1990s which demonstrated the superiority of surgical treatment over medical treatment for high grade carotid stenoses (Table 1). At two years there was a clear benefit in terms of stroke incidence with nine per cent of the surgical group having a stroke compared with 26% of the medical group. The surgical group did have other complications including 7.6% cranial nerve injury (Table 2). It should be noted also from Table 1 that many patients that we are now asked to treat with carotid stenting were excluded from the NASCET trial because of the severity of their illness and particularly because of their age.

The ACAS trial involved asymptomatic patients with greater than 60% carotid stenoses (Table 3). In this trial there was a low perioperative morbidity and mortality rate of only three per cent with a stroke and death rate of five per cent at five years, compared with 11% in the medically treated group. These results do however include patients with 60% lesions on doppler and no symptoms. These are lesions which we would regard as very low risk in today's stenting environment.

At the same time as these two studies were done, a Veteran Affairs Study[3], thought by many to represent a more real world group of patients, showed a surgical death or stroke rate of 7.1% (Table 4).

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History Of Stenting At St Vincent's

In 1994 John Crozier, who was then a vascular surgeon here at St Vincent's, together with Ian Benn and myself performed a carotid angioplasty in a patient who had had previous restenosis on two occasions following carotid endarterectomy. The patient had a good result, but at that time for various logistic reasons we didn't go on with further carotid work until 1998.

Shortly before 1998 other groups in the world began producing good results with carotid stents. One of the principle initiators of this program was Gary Roubin, an Australian working in New York. Mathar and Roubin[5] described a high risk group of patients who had carotid stenting with a minor stroke rate of 6.2% and a major stroke rate of 0.7% (Table 5). The risk of stroke or death in the NASCET eligible patients was only 2.7%.

As can be seen from Table 5 the patients that were stented in Mathar and Roubin's Series were a high risk group with considerable more co-morbidities than the patients in the NASCET trial with only 14% of the patients stented being considered NASCET eligible.

This led me to attend Gary Roubin's unit in New York and observe carotid stenting first hand. I subsequently scrubbed with Gary on several occasions in various parts of the world while learning the technique.

We did not have an easy start to carotid stenting. The first patient that I was asked to stent was a 78-year-old lady who came to the catheter lab with unstable angina and had her coronaries stented first. She was due to have a carotid endarterectomy later, as she had a totally occluded right carotid and a 95% stenosis on the left side, which was quite calcified. To his surprise the surgeon involved found that he was unable to extend her neck because of severe cervical spondylosis and she ended up coming back to the catheter lab for a carotid stent, which was fortunately uneventful.

It would of course have been preferable to begin with cases such as many of the cases in the ACAS trial with 60% straightforward doppler lesions. In this day and age it is hard to imagine that a new vascular surgeon would have been given cases such as the first ones we were asked to stent.

Table 1

SYMPTOMATIC PATIENTS (RECENT TIA)	EXCLUSIONS
Reported Stroke & Mortality for Entry Surgeons (50 Centres) <6%	• Severe Hypertension, Diabetes • Recent Infarct • Cardiac Source of Emboli
Angiographic Lesion 70-99%	• Impairment of Major Organs • Serious Illness that reduced life expectancy of <50 in 5 yrs • 80 Years

NASCET TRIAL– Beneficial Effect of CEA in Symptomatic Patients with high grade carotid Stenosis

Table 2

OUTCOME	MEDICAL (N331)	SURGICAL (N328)
Procedural Stroke or Death	0%	5.8%
At Two Years	26%	9% (P<0.001)
Ipsilateral Stroke	18%	10%

Other Surgical Complications			Anaesthetic Complications
Cranial Nerve Injury	7.6%	11	• Oedema, Reintubation in 6
Wound Haematoma	5.5%	2	• Pneumothorax
Wound Infection	3.4%	2	• Brachial Plexus Injury
Myocardial Infarction	0.9%	1	• Upper Limb Ischaemia
Other CVS	3.0%	1	• Corneal Abrasion

NASCET TRIAL

Table 3

1662 Patients	Asymptomatic
Perioperative Morbidity & Mortality	3%

Five Year Results for those with >60% stenosis

CEA	5.1%	Stroke and Death
Medical Treatment	11.0%	Stroke and Death

ACAS TRIAL

Table 4

V.E.T AFFAIRS STUDY – 444 PATIENTS

Carotid Endarterectomy and Prevention of Cerebral Ischaemia in Symptomatic Carotid Stenosis

50-70% stenosis	Death or Stroke
Medical	6.7%
Surgical	7.1%

Table 5

PROFILE OF PATIENTS IN THE MATHAR & ROUBIN SERIES

231 Patients

Symptomatic	60%
HIGH RISK GROUP	
With CAD	70%
Bilateral Disease	39%
Contralateral Occlusion	12%
Prior CEA	22%
Ulcerated Plaques	24%
Calcified Plaques	32%
Therefore Only 14%	Eligible for NASCET
RESULTS	
Minor Stroke	6.2%
Major Stroke	0.7%

Assessment Of Patients For Carotid Stenting

Careful assessment of the patients before stenting is essential. It is our belief that angiography is important before stenting as dopplers can sometimes overestimate or underestimate problems. It's also important to determine whether there is other disease further up the carotids, or whether there is some unusual anatomy that might make the stenting procedure difficult or dangerous. The performance of a carotid angiogram will often give you some idea of cross circulation and in these days of angiography the risk of having a carotid angiogram is extremely low and certainly much less than the risk of having an unnecessary carotid stent or endarterectomy for a lesion which turns out on angiography not to warrant any intervention.

It is also important that the patients are carefully selected in terms of their medical management. They must all be able to take both Aspirin and Clopidogrel which is needed for the first three months following stenting. Generally when there is any interference with the baroreceptors in the carotids, blood pressure can become quite variable and we generally stop anti-hypertensives on the morning of the procedure. The patients are kept well hydrated and if there are any doubts about the patients' suitability or anticipated post-op management problems we frequently involve a neurological colleague in their management.

Not all patients are suitable for carotid stenting and there are some definite contraindications. They are listed in Table 6. Most important of these are the presence of visible thrombus and extreme anatomy which may make approach to the carotid difficult and dangerous.

On the other hand there are some lesions that should be treated by stenting and these are listed in Table 7.

Stenting Outcome

The occasional elderly patient does have labile blood pressure for a day or two following the procedure, particularly when the stent involves the bifurcation or the very proximal internal carotid. The majority of patients are

Table 6

CONTRAINDICATIONS FOR CAROTID STENTING

1. Multiple tortuosity with calcification in the approach vessel
2. Coiling and kinking in the Internal Carotid – juxta lesion
3. Visible thrombus
4. Stable catheterization of Common Carotid Artery not possible
5. Intolerance to antiplatelet drugs

Table 7

LESIONS BEST TREATED BY CAROTID STENTING

1. High or tandem lesions	
2. Multiple brachiocephalic lesions	
3. Previous radiotherapy	28% Nerve damage
4. Restenosis after endarterectomy	
5. Contralateral occlusion	(NASCET 14.3% Complication)
6. Comorbidity –	
CAG's + CEA	5 – 15% MORTALITY
CAG's + Separate stent	2.6%

SHAWL A.H.A 1998

Table 8

ST VINCENT'S HOSPITAL – 140 PATIENTS

Death	0.7%
Major Stroke	2.1%
Minor Stroke	5%
Cranial Nerve Palsy	0%
TIA (<4hours)	2.8%

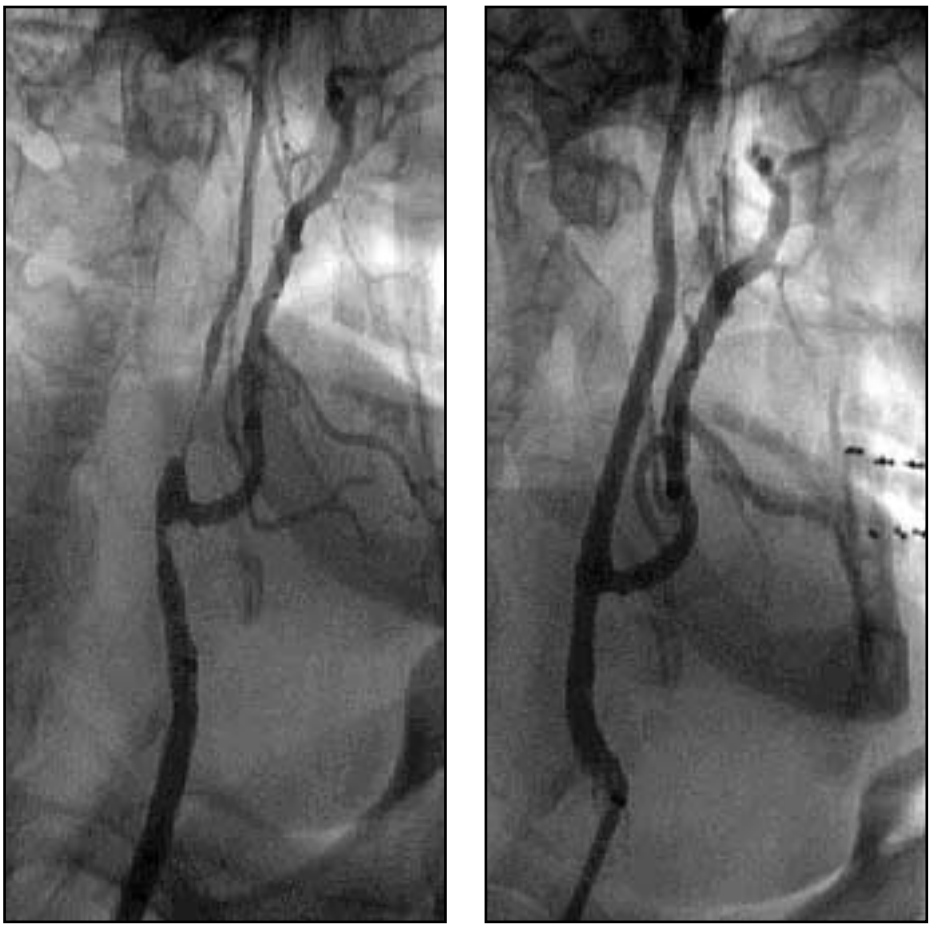

Figure 1: 1a – Left Carotid Prior to Stenting. 1b – Left Carotid Post Stenting

labile for only minutes after the procedure and generally are able to go home the following day.

In reported series so far, the restenosis of carotid stenting has been <5% which is in keeping with the restenosis rates following carotid endarterectomy.

Our own results of carotid stenting are shown in table Table 8. We have now done 140 patients. Thirty of these patients were high risk candidates who would not have been eligible for the NASCET carotid endarterectomy trial. There was one death included in a major stroke rate of 2.1%. The minor stroke rate was 5%, cranial nerve palsy 0% and TIA <4 hours 2.8%. Note a comparison of a 7.6% incidence of cranial nerve injury in the surgical arm of the NASCET trial.

Figure 1 is an example of a patient who had had carotid endarterectomy on two occasions with restenosis within six months both times. This patient has had a successful carotid stent procedure more than 12 months ago.

Protective Devices For Distal Embolization

One of the risks of carotid endarterectomy and stenting is the risk of distal emboli. If trans-cranial doppler is used when the patient is having either a stent or endarterectomy it becomes clear that all patients have distal emboli. The emboli which cause problems are those over 100 microns in diametre and there have been great advances in techniques to prevent distal emboli. This distal protection has largely reduced the major stroke rate to very low levels and has converged the high risk carotid patient into a much lower risk group.

We did not have distal protection available for the first seventy five patients. The distal protection devices take the form either of a balloon, which is passed on a wire beyond the lesion or an umbrella device. The balloon prevents any material travelling up the carotid artery but of course the balloon itself (Figure 2a and 2b) does limit blood flow into the brain while the procedure is being done. This can take as long as five to six minutes of ischaemic brain time which is similar to the ischaemic brain time it takes to insert a surgical shunt.

Figure 2a: Demonstrates the action of the Distal Balloon in Preventing Embolization During a Stent Procedure

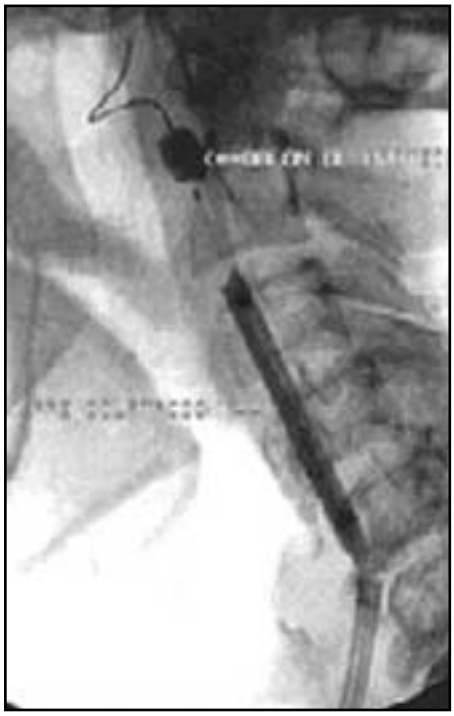

Figure 2b:

Table 9

ST VINCENT'S GENERAL HOSPITAL MORTALITY FOR COMBINED CORONARY GRAFTING & CAROTID ENDARTERECTOMY

	Death Cardiac /	Resp	Death CVA	Non Fatal CVA
1994	17	1	0	2
1995	10	0	0	0
1996	14	1	1	0
1997	13	0	1	0
1998	11	0	1	1

Mortality due to Cardiac / Resp	3.1%
Mortality due to CVA	4.0%
Permanent CVA not resulting in Death	4.6%
Overall CVA Rate	9.2%
Overall Mortality	7.7%

Worries about this period of cerebral ischaemia during balloon inflation led to the development of various other umbrella devices, (Figure 3a, 3b, 3c). We now use umbrella devices for most cases and these allow blood to pass through, but will not allow large atheromatous particles to pass. The ischaemic time using the umbrella device is limited to the few seconds when the balloon and/or stent is being inflated.

We used the first distal protection device here at St Vincent's in August 2000 and protection devices are now mandatory for carotid stenting. It is law in the USA and Europe to use these devices.

In one of the first studies using Distal Embolization Procetion, Henry Armor from France described one hundred carotid stenting procedures with only a one per cent stroke rate. In our own series there were three major strokes and two of these occurred before we had the benefit of distal protection devices.

There are many patients who have associated co-morbidities, particularly coronary artery disease. These patients do not do well with combined carotid and coronary surgery at the same time. Recent trials have shown significant rates of myocardial infarction following carotid endarterectomy particularly with a combined procedure.[4] Our own cardiac surgeons have for several years preferred not to do combined carotid

Figure 3a:

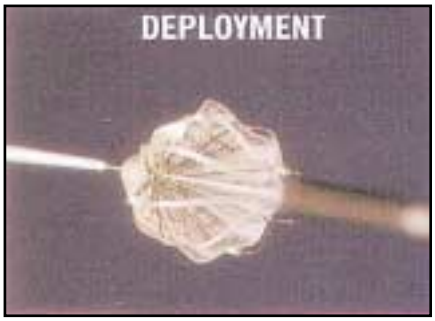

Figure 3b:

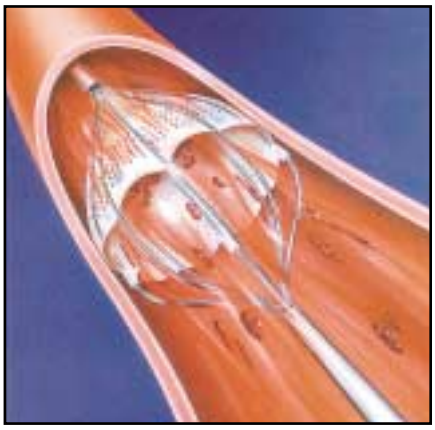

Figure 3c:

endarterectomy and bypass surgery. The results of these combined procedures have shown a mortality of three per cent from cardiac causes, four per cent from CVA and an overall mortality of 7.7% (Table 9).

Carotid Stenting Versus Carotid Endarterectomy Trials

There are now several trials being undertaken, one of which was completed last year. The SAPPHIRE trial was presented at the American College Meeting[4] in November last year, (Table 10 & 11). The inclusion criteria included co-morbidities that placed the patient at a higher than normal risk. The death and stroke rate was 5.8% in the stented group versus 12.6% in the surgical group with most of the problems relating to myocardial infarcts in the surgical group. There were 7.3% of patients with carotid endarterectomy having an infarct compared to 2.6% in the stented group. I think this only emphasizes the fact that many of the patients with carotid disease have associated vascular co-morbidities and that these co-morbidities often determine the patients outcome. Of note also the randomized patients who had surgery had a 5.3% cranial nerve injury.

Table 10

SAPPHIRE

> 50% Stenosis Sx
> 80% Stenosis Asx
One or more Comorbidity Criteria
Physician Team : Neurologist, Surgeon, Inverventionalist

CONSENSUS

SURGICAL REFUSAL		INTERVENTIONAL REFUSAL
↓	↓	↓
STENT REGISTRY	RANDOMIZED	SURGICAL REGISTRY
409	307	7
	Stenting = 156 CEA = 151	

Table 11

RANDOMIZED PATIENTS 30-day EVENTS

EVENTS	STENT (156pts) (95% CI)	CEA (151pts) (95% CI)	pVALUE
Death	0.6% (-0.6%, 1.9%)	2.0% (-0.2%, 4.2%)	0.36
Stroke	3.08% (0.8%, 6.9%)	5.3% (1.7%, 8.9%)	0.59
Major Ipsilateral	0.0%	1.3%	0.24
Major Non-Ipsilateral	0.6%	0.7%	>0.99
Minor Ipsilateral	3.2%	3.3%	>0.99
Minor Non-Ipsilateral	0.6%	0.0%	>0.99
MI (Q or NQ)	2.6% (0.1%, 5.0%)	7.3% (3.1%, 11.4%)	0.07
Q-Wave MI	0.0%	1.3%	0.24
Non Q-Wave MI	2.6%	6.0%	0.16
Death / Stroke	4.5% (1.2%, 7.7%)	6.6% (2.7%, 10.6%)	0.46
Death / Stroke / MI	5.8% (2.1%, 9.4%)	12.6% (7.3%, 17.9%)	0.047

Conclusion

It is my prediction that with continually improving technology and results to go with this technological improvement that it will not be long before stenting is done for the majority of carotid atherosclerotic lesions with surgery reserved for the select few who are unsuitable for stenting.

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St Vincent's Clinic Foundation

Research Grants 2004

LADIES' COMMITTEE SR MARY BERNICE
AWARD 1 – $100,000
Professor Michael Feneley
Mechanisms of induction of hypertrophy in left ventricular pressure overload.

K+A COLLINS CANCER RESEARCH GRANT – $50,000
Dr Bryce Vissel
Identifying new molecular targets for treating brain tumours

DI BOYD CANCER RESEARCH GRANT – $20,000
Dr Ian Cole
Identification of novel genes of disease progression in head and neck squamous cell carcinoma"

ANNUAL GRANT – 1
Dr Diane Fatkin $20,000
Molecular Genetic Evaluation of Familial Atrial Fibrillation.

ANNUAL GRANT – 2
Professor Peter McCluskey/Professor Denis Wakefield $20,000
The role of iris pigment epithelium in the pathogenesis of anterior uveitis.

ANNUAL GRANT – 3
Professor Terence Campbell $20,000
Drug binding to HERG K+ channels.

ANNUAL GRANT – 4
Dr Phillip Stricker $20,000
Investigation of the role of wnt signalling pathway in prostate cancer – is secreted Frizzled-related protein 4 (sFRP4) an inhibitor of prostate cancer growth?

ANNUAL GRANT – 5
Dr John Moore $20,000
In-vitro studies of the haemopoietic stem cell in rheumatoid arthritis

TRAVELLING FELLOWSHIP GRANT –
Dr Kris Rasiah $10,000
Clinical Fellowship in Uro-Oncology with the Department of Urology Addenbrooks Hospital in Cambridge working with Professor D.E.Neal.

STUDENT RESEARCH GRANT – $3,000
David Skalicky
New developments in the molecular pathology of pancreatic cancer.

Associate Professor Michael Neil

Minimally Invasive Unicompartmental Knee Replacement

Introduction

Osteoarthritis (OA) is the most common form of arthritis and is a leading cause of disability in older adults in Europe, Canada, Australia, the United Kingdom, and the United States. The economic and social costs of OA are substantial. On average, a person with OA makes nine visits to a physician each year and has 0.2 to 0.3 hospitalizations each year lasting 7 to 8 days each.[8]

UKR (Unicomparmental Knee Replacement) has been well established in the treatment of OA of the knee over the past 20 years, with the potential advantages being preservation of bone stock, preservation of cruciate ligaments and normal knee kinematics.[4,6,7]

Nevertheless, UKR has not generally been performed in large numbers compared with TKR (Total Knee Replacement: Figure1). In spite of being more bone conserving, the procedure was traditionally carried out through the same approach as TKR, with the same risks and complications, and because of the long list of contraindications[11], surgeons have generally opted for TKR in the management of patients who would be suitable for UKR.

Furthermore, UKR's have generally resected more bone than a standard TKR, making salvage surgery eventually for failure much more difficult (Figure2).

Over the last 2-3 years, several developments have prompted a resurgence in interest in UKR, specifically:

1. long term studies on the natural history of Unicompartmental OA
2. long term results of UKR
3. minimally invasive surgical approach with bone preserving implants (Repicci)

Associate Professor Michael Neil, FRACS, Orthopaedic Surgeon, St. Vincent's Clinic

The Natural History Of Unicompartmental OA

A study by the University Department of Orthopaedics in Lund, Sweden,was presented as a poster presentation at the annual meeting of the American Academy of Orthopaedic Surgeons in 1987.In this study,370 knees were classified by X-Ray methods described by Ahlback,[1] with only 2% showing involvement of both the medial and lateral compartments of the knee joint.

Disease progresses in one compartment over 13 years to produce tibiofemoral subluxation, or lack of knee alignment.

The conclusions of this study can be summarised as follows:

- Primary OA is focal, either medial or lateral
- Primary OA is rare before age 55 years.
- In younger men,OA is usually secondary to trauma(sports).

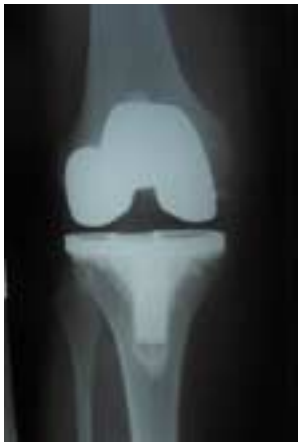

Figure 1: *Conventional cemented total knee replacement (TKR)*

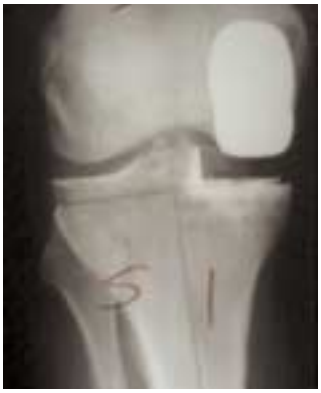

Figure 2: Excessive tibial bone resection in older style UKR

- Medial and lateral cartilage loss is suspect of rheumatoid arthritis (RA)
- The prognosis for OA in the knee is worse than the hip.

The conclusions from the natural history data is that there is the need for a pre-total knee replacement procedure that may last long term, and that Unicompartmental OA knee should not be overtreated with a total knee replacement.

Long Term Results Of UKR

- Various publications have presented excellent survivability for patients treated with TKR, approaching 95% at 10-15 years.[2] However, this is only for patients treated age 75 or older. Patients treated with TKR at age 65 or younger resulted in prosthetic survival rates in the low 80% range.[3,4,6] If the statistics are valid, one can anticipate generating one TKR revision for every five primary TKR's over a 10 year period when working with patients 65 or younger.
- The Swedish National joint repalcement registry, which records every joint prosthesis used in that country, indicates in follow-up of over 2000 UKR's by the Marmoor technique, a ten year survival rate in the low 90% range. The revision rate of UKR's at 10 years was twice that of TKR. [5]
- UKR has reasonable intermediate survival capabilities, but longer term (>10 years) is unpredictable and not comparable to TKR.

Minimally Invasive Surgical Approach With Bone Preserving Implant (Repicci)

By the early 1990s, TKR was well accepted as the ultimate knee salvage procedure in the United States.

During this time, Repicci recognised that knee arthritis occurs in two common formats, tricompartmental and unicompartmental, each with a distinct clinical presentation (Figure 3).

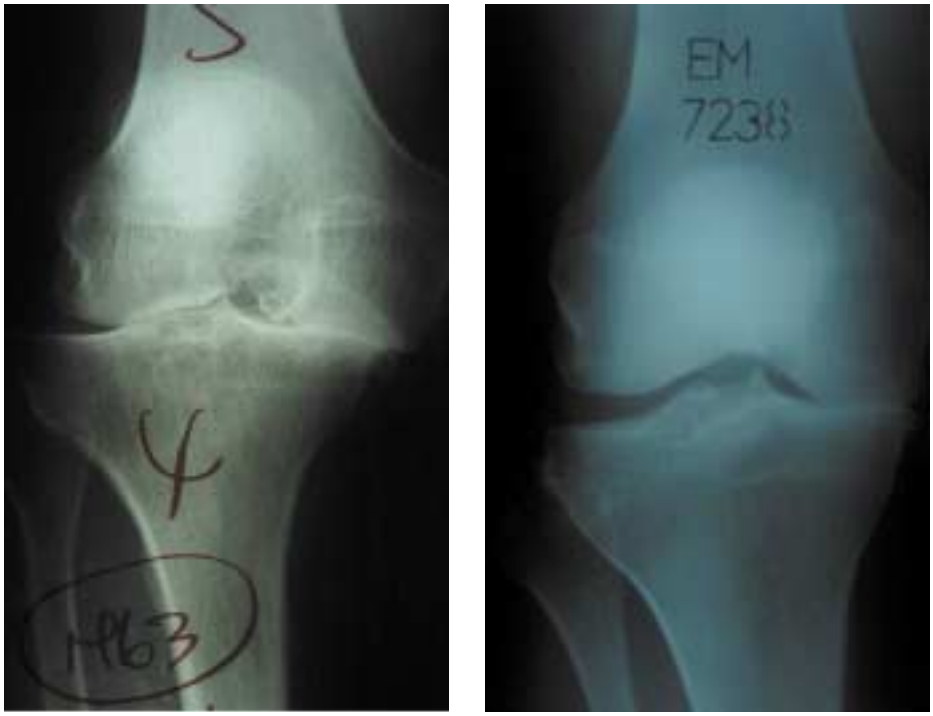

Figure 3: AP radiographs showing unicompartmental and tricompartmental OA.
Left, Tricompartmental OA with loss of both medial and lateral joint space, resulting in subluxation of the tibia relative to the femur.
Right, medial compartmental OA showing isolated loss of medial joint space with good preservation of lateral joint space.

In tricompartmental OA, pain is often so debilitating that activities of daily living are severely restricted, making TKR the procedure of choice.

In Unicompartmental OA, pain typically is inconvenient but not disabling. Because the disease is not as severe, these patients are often far more active, and generally will not be satisfied with simple pain relief, but may desire restored function and return to activities of daily living. Such patients are good candidates for UKR, particularly through a less invasive procedure (Figure 4).

Minimally invasive UKR is highly advantageous because it avoids disturbing knee physiology, interfering with lifestyle and compromising future treatment options.

The recognised benefits to the patient include:

- Less blood loss
- Less infection, bleeding or wound problems
- Rapid return to normal knee function
- Shorter hospital stay, potentially as a day only procedure.
- Less bone removed (3mm) making salvage surgery simpler.

The preservation of soft tissues and the avoidance of patella dislocation are almost certainly responsible for the diminished postoperative pain and decreased rehabilitation time associated with minimally invasive UKR. When it is presented as an arthritic bypass option with morbidity similar to arthroscopic procedures, patients with Unicompartmental OA consistently choose minimally invasive UKR over TKR, preferring to delay a potential TKR for eight to 10 years.

Repicci describes his procedure as a "patch and repair" operation to buy time before the need for TKR if necessary. He likens it to a dentist filling a tooth, hopefully to delay the need for an extraction. [9]

Personal Experience With Minimally Invasive UKR

I began doing UKR's through a minimally invasive approach using the Repicci technique in August 1998, having worked with Dr John Repicci in Buffalo, New York, and learnt the procedure with him.

Between September 1998 and April 2004, 508 knees in 490 patients have been operated upon by me personally using this method. All patients have been admitted the day of surgery, and mobilised as rapidly as their own physical factors would allow. The average age is 66 years, with 97% medial and 3% lateral UKR. There have been eight failures to my knowledge (two osteoporosis related, two over-correction of deformity with progression of disease on the lateral side, and four subsidence of tibial baseplate possibly due to stress fractures). All cases have been successfully revised to a standard TKR.

In this series of 508 knees, there has been only one readmission to hospital (for pain relief), and one superficial wound infection. There have been three deep vein thromboses treated with prolonged anticoagulation. The average length of stay is **1.57 days**, with 41% of patients returning home the same day (Figure 5).

Successful rapid discharge and mobilisation requires intensive pre-operative education about the procedure and what to expect after it. Patients are educated as a group the day before surgery, by the senior nurse educators, as well as the physiotherapists and occupational therapist. Post-operative pain control utilises regular oral analgesia and anti-inflammatory medication, but without injectable narcotics. Patients are taught how to change the dressing at day three, and to mobilise as they tolerate. First follow-up is at two weeks.

Patient satisfaction with this procedure is extremely high, around 98%, probably because recovery is rapid and the knee often feels and functions quite normally once swelling settles in around six to eight weeks.Patients frequently regain motion rapidly postoperatively, compared with TKR, because there is less trauma to the knee with the minimally invasive approach.

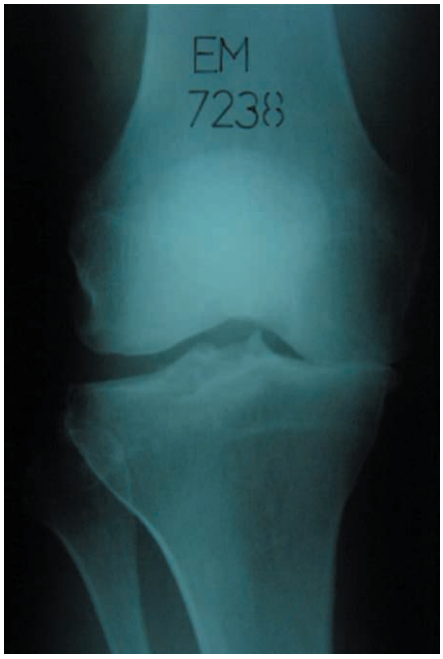

Figure 4(a): *Ideal patient for minimally invasive UKR using the Repicci technique.*

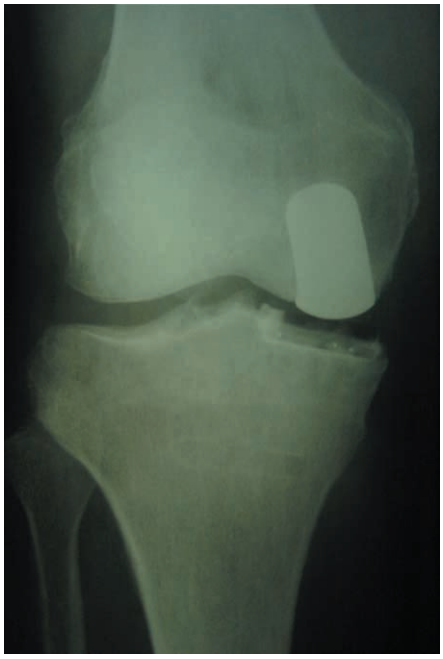

Figure 4(b): *Post operative radiograph of Repicci UKR of the medial compartment.*

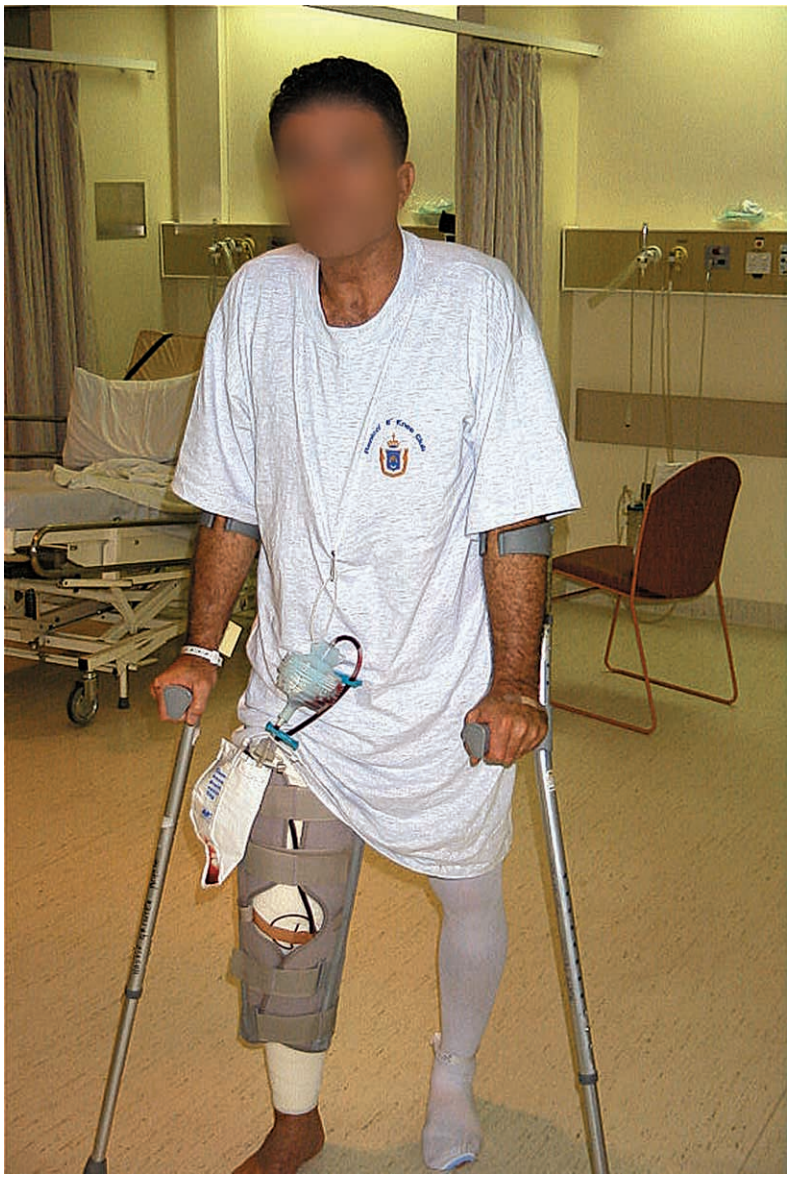

Figure 5: *Patient walking 2 hours after Repicci procedure in the recovery ward of St. Vincent's Clinic Day Surgery Unit. Patient was discharged directly home shortly thereafter.*

SUMMARY

The renewed interest in UKA on the part of both orthopaedic surgeons and patients, coincides not only with improvement in surgical technique and design but also with the introduction of minimally invasive UKR. This approach is highly advantageous because it does not interfere with physiology, lifestyle, and future treatment options. Avoiding patella dislocation and nonessential tissue dissection results in lower morbidity and rapid rehabilitation. Because minimally invasive UKR may be performed on an outpatient basis, with full independence achieved by four hours postoperatively, rapid rehabilitation, and return to activities of daily living, it addresses patient satisfaction issues regarding lifestyle. Pain is managed through preoperative patient education, controlled anaesthesia, local anaesthetic infiltration of all incisional areas, as well as slow release infusion devices ("pain buster"). Parenteral narcotics are avoided at all costs, with oral analgesia and anti-inflammatories only used.

UKR continues to improve. The prosthesis should function well for between eight to 10 years, afterwhich revision of the tibial baseplate may be necessary, or possible conversion to a primary type of TKR.Patients can return to full active lifestyle, but avoiding repetitive impact, such as running.

However the single most important factor affecting survival of all UKRs, regardless of design or use of minimally invasive approach, is proper surgical technique. Therefore, it is critical that surgeons who choose to pursue UKR receive proper training to ensure the surgical expertise required to successfully perform this type of surgery.

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Dr Vincent P. Lamaro

Gynaecological Endoscopic Surgery – Past, Present and Future

Introduction

Gynaecological endoscopy is the use of laparoscopic (trans-abdominal access) and hysteroscopic (transvaginal uterine access) surgery for diagnosis and treatment of gynaecologic pathology.

Operative endoscopic surgery for gynaecologic conditions has been steadily evolving for the past 25 years. Over the past five years there have been major advances in miniaturisation of fiberoptics, camera systems, articulated operative equipment, as well as great progress in safety (design, training, anaesthetic and procedural). This quantum evolution allows us to constantly develop advanced endoscopic techniques that now make it possible for many patients to have their procedure performed by "keyhole" surgery.

At St Vincent's Private, extensive technology trials for state-of-the-art endoscopic equipment took place in late 2003. This has resulted in St Vincent's Campus operating theatres being equipped with the nations most advanced optical and operative environment for the endoscopic surgeon. Thanks are largely owed to the financial and philosophical support of the Clinic Foundation and the Ladies Committee without whose support this would not have been possible.

Dr Vincent P Lamaro
B Med FRANZCOG
Gynaecologist
Endoscopic Surgeon
St Vincent's Clinic

History and Evolution of Endoscopy

It is only by understanding our past that we may continue to improve on our future. The early history of laparoscopy is unknown to many surgeons, but endoscopy was first described by Hippocrates in Greece (460-375 BC). He made reference to a rectal speculum. A three-bladed vaginal speculum was found in Pompeii's ruins (70 AD).

The credit for modern endoscopy design belongs to Philipp Bozzini (1773-1809). He developed the first "reflected light" design called "Lichtleiter" (Figure 1).

Antoine Jean Desormeaux is, by many, considered the "Father of Endoscopy." His further design of the Lichtleiter in 1853 had a system of mirrors and lenses, with a lamp flame as the light source. The endoscope burned a mixture of alcohol and turpentine (Figure 2). Burns, as might be imagined, was the major complication of these procedures. Interestingly, he thought of using electricity but felt it unsafe.

The development of the incandescent lamp by Thomas Edison in 1880 and miniaturization of the bulb into a low-amperage mignon bulb allowed instrument makers to produce simple, inexpensive and easily manageable endoscopes, illuminated with bright, burn-sparing light.

Harold Hopkins was responsible for the two most important inventions in endoscopy after World War II: the rod-lens system and fiberoptics. Transfer of cold light source into a body cavity, with visualization via a rod-lens system created the foundation for current day endoscopy.

Philosophy and Evolution of Operative Endoscopy

The next major development which continues today was design of instruments that would allow "operative" endoscopic surgery. This evolved due to a philosophical change in the way patient care was to be delivered. In the 1960's, a doctor in Trinidad called Courtenay Clarke set out to design operative instruments that could be used via mini-laparotomy incisions. His

Figure 1. Bozzini's "Lichtleiter"

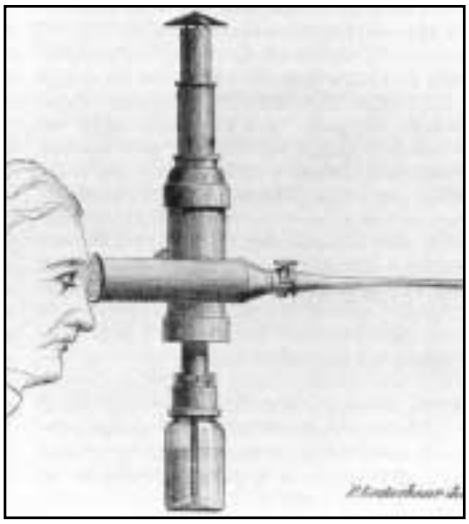


Figure 2. The Desormeaux endoscope.

Table 1 – Origin of chronic pelvic pain in the female.

70% – gynaecological cause
10% – gastrointestinal
8% – musculoskeletal/neurological
7% – myofascial syndrome
5% – urologic

56% of ALL cases are due to endometriosis

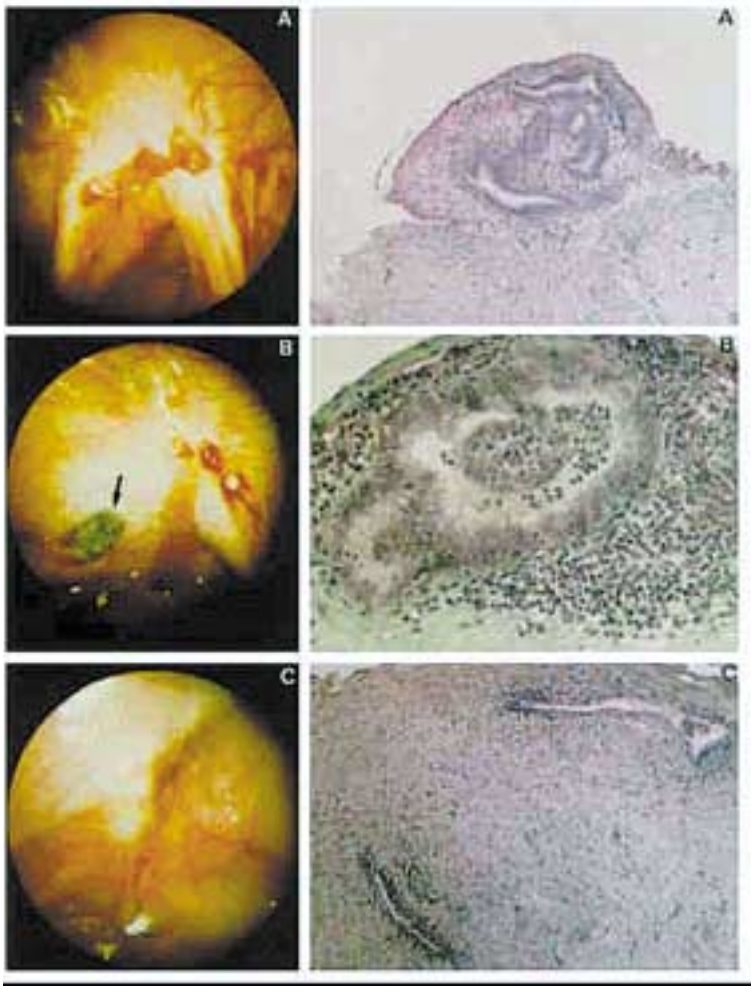


Figure 3. Inflammatory lifecycle of peritoneal disease. (A) shows acute inflammatory reaction with neovascularisation. (B) shows neutrophil and macrophage involvement with necrotic cellular debris and development of chronic inflammatory reaction. (C) shows the "quiescent" state of inactive peritoneal disease.

patients were poor (20 US cents per 8 hour shift) so it was essential that they could recover rapidly to keep earning for their families. He went on to develop the first operative laparoscopic equipment that allowed cheap access to reusable technology.

In endoscopic surgery, our philosophy and drive relate to the original objectives for which operative endoscopy developed:

1. A commitment to continually decreasing the surgical insult on tissues: by modification of CO_2 gas; continuous tissue irrigation; specific tissue designed operating instruments; "intelligent" energy sources; refined anaesthetic protocols; and advanced operative training.
2. Improving tissue visualisation and recognition for better reconstruction. Constantly evolving miniaturisation of optics, camera chip technology and operative instrumentation now allow 5mm and even 2mm operative surgery.

   "Live" endoscopic surgery has redefined many "cadaver" anatomical misconceptions. An example is better understanding of fascial planes and their biomechanics which have revolutionised reconstructive pelvic floor surgery.

3. Minimise access trauma for decreased pain and optimised recovery time.
   2mm, 5mm and 10mm ports allow access to all anatomical locations. The design of internal "bags" and internal tissue "morcellation" devices allow removal of structures such as fibroids that would often not be accessible via transverse laparotomy.

Across all surgical specialties, St Vincent's Hospital has strived to become a leader in minimal access surgery. Over the last 4 years, we have been able to put in place a variety a structures that we continue to develop to achieve that goal. Several of these include:

1. Establishment of the first laparoscopic perioperative training course for nursing in Australia.
   In order to perform complex endoscopic surgery, the role of

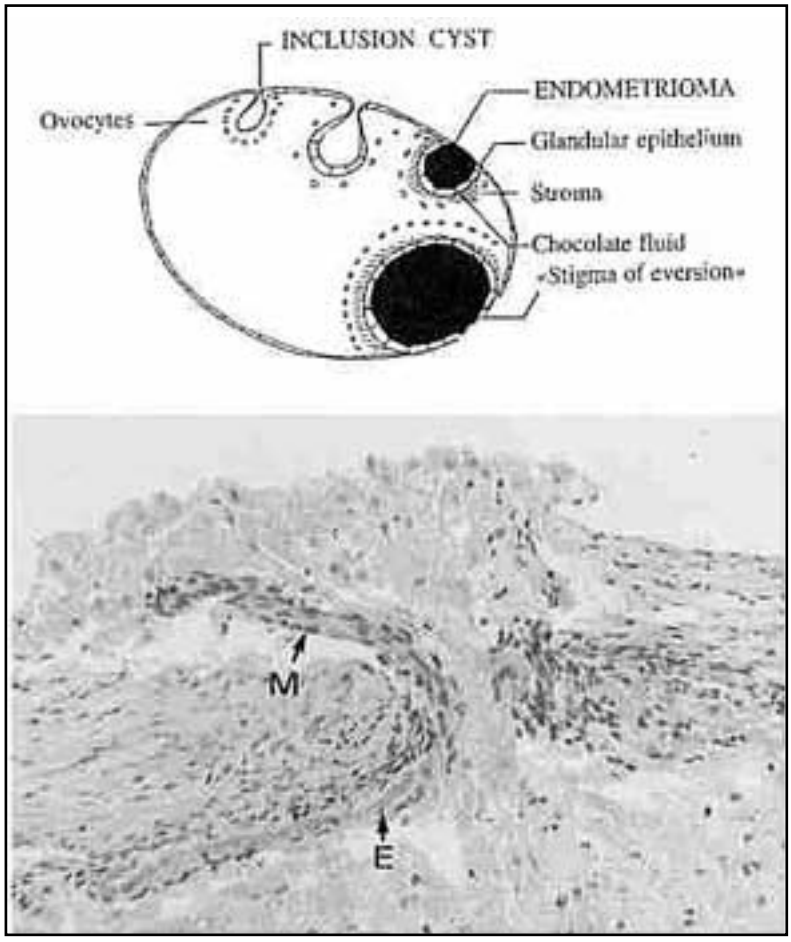


Figure 4. Development of ovarian disease. Mesothelial invagination followed by metaplasia create the "Chocolate Cysts" of ovarian endometriosis.

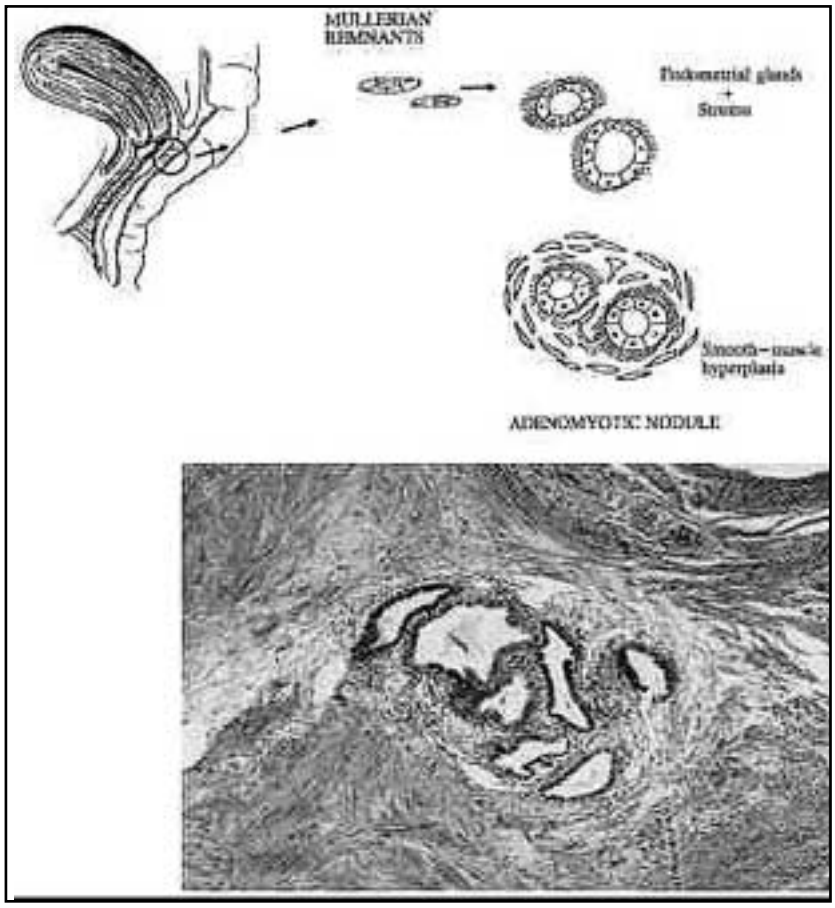


Figure 5. Deep disease of the Recto-vaginal septum- the "Adenomyotic Nodule"

perioperative nursing in the team is integral. A thorough curriculum jointly developed with the University of New South Wales has enabled structured, focussed endoscopic perioperative training for nursing staff.

2. Establishment of the St Vincent's endoscopic training center.
   This was initially housed at the Garvan Institute, then at St Vincent's General and later this year, a second site at St Vincent's Clinic will be established for simulated training and new instrumentation assessment. Importantly, this structure allows higher levels of surgical training and new technologies to be assessed and developed in an inanimate or animal setting.

3. Recent renewal of St Vincent's operative endoscopic equipment.
   As previously mentioned, the very latest robust technologies in camera systems, scope optics and operative instrumentation have provided this campus's surgeons, nurses and patients with an uncompromised and world class operating environment.

What does Gynaecological Endoscopy offer our patients currently at St Vincent's? Listed here are some of the more complex gynaecological procedures performed and in some cases, developed at St Vincent's campus.

Endometriosis and Chronic Pelvic Pain

Between 12-25% of females will present with an acute on chronic history of pelvic pain at some stage in their reproductive years. 56% of cases will be due to endometriosis (Table 1).

The exact aetiology of endometriosis remains uncertain, however the current research supports three different site specific entities. The theory put forward by Nisolle and Donnez is probably the most contemporary accepted hypothesis.[1]

It is in the understanding of these origins that we may direct our treatments – surgical, medical and physiotherapy – towards patient care. Figure 3, 4 and 5 show the three tissue specific aetiologies of the disease.

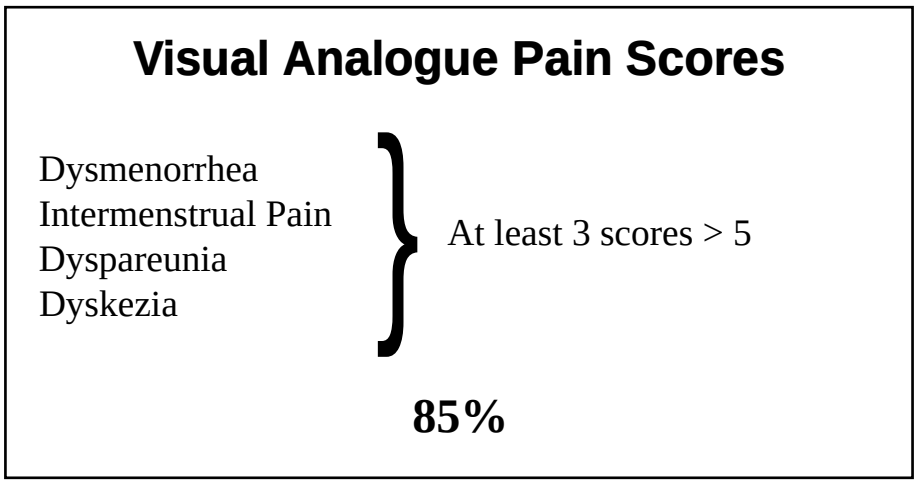


Figure 6. VAS pain scores for prediction of endometriosis.

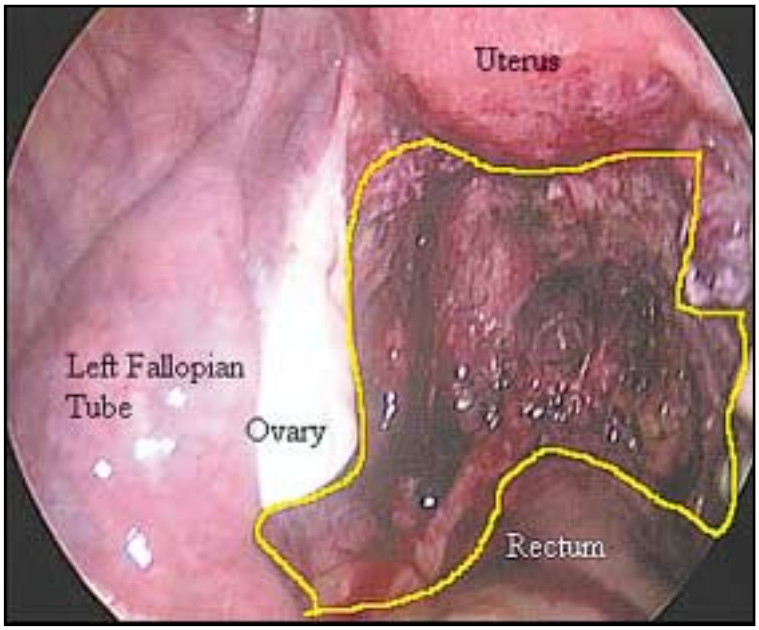


Figure 7. Rectovaginal excisional surgery. A large endometriotic nodule obliterating the Pouch of Douglas has been removed. Yellow line shows excision margin.

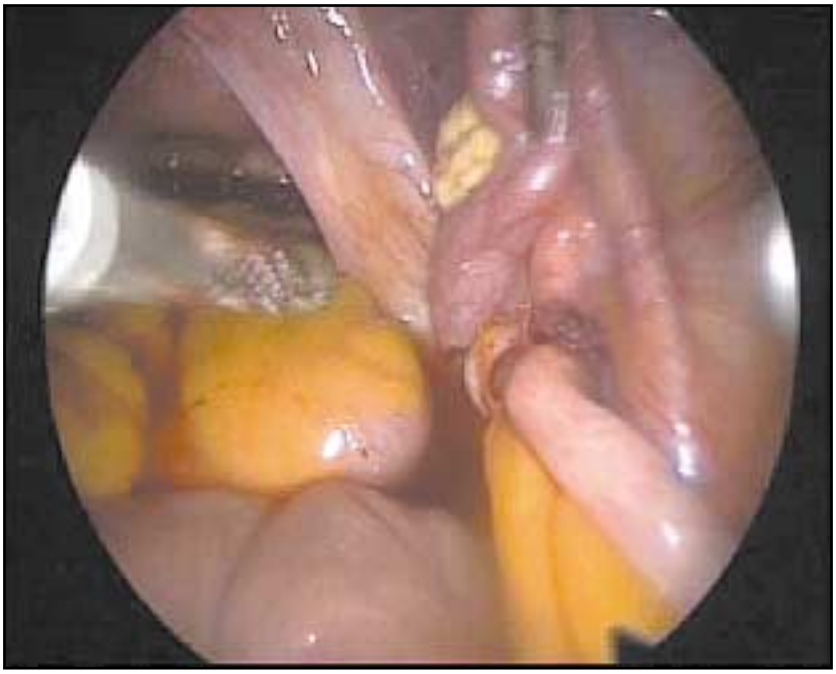


Figure 8. Endometriosis of the appendix. 30% of stage 4 endometriosis patients will have involvement of the appendix requiring its removal.

Diagnosis: Review of five year pain score data in our department has shown an important symptom pattern that allows accurate prediction of active endometriosis on history alone (Figure 6).

Surgical Management and Outcome.

The optimal surgical management of endometriosis is laparoscopic resection of superficial or deep disease. For complete excision, this involves identification of the plane and depth of disease (Figure 7). Monopolar electrosurgery is the most efficient energy source for this dissection. Recto-sigmoid serosa and muscularis involvement occur in upto 50% of stage three and four endometriosis cases. Skimming excision or disc excision will be required. 2-5% of these patients will require low or ultra-low anterior resection due to lesion size > 3cm and mucosal involvement. Appendix and terminal ileum disease is not infrequent (Figure 8).

In most series where resective surgery is carried out by an experienced unit, pain scores return to normal population scores in 80% of patients with 3-5 year follow-up.

Prolapse and Incontinence

The challenging task of management of complete pelvic floor prolapse has always been how to obtain a durable functional long-term repair often working with poor connective tissues. Laparo-vaginal surgery now gives us an ability to define fascial structures and safely dissect anatomical locations previously only possible at best in a cadaver setting (Figure 9). In addition to this, functional "live" pelvic floor anatomy responds very differently to our previous post mortem dissection studies. The understanding of these fascial support relationships and access to them for reconstruction has allowed the development of a laparo-vaginal procedure for complete pelvic floor prolapse (Figure 10).

This procedure has been under constant development at St Vincent's Hospital over the last 3 years (Figures 11 & 12).

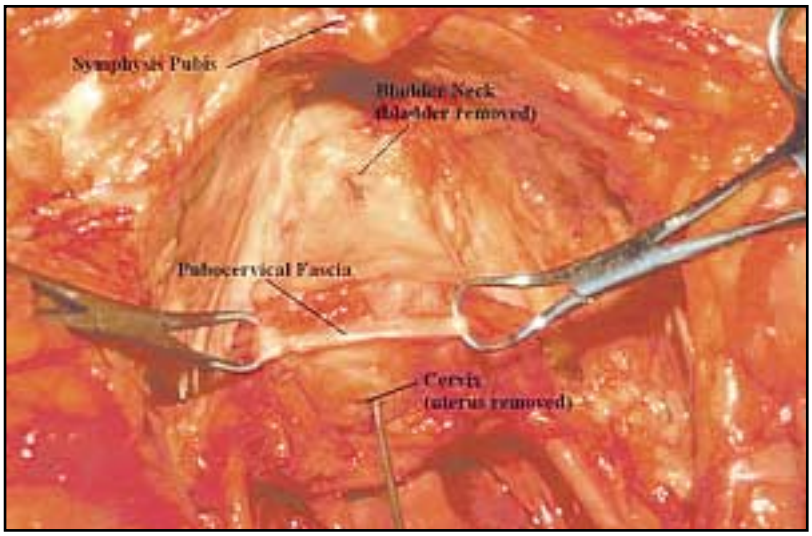
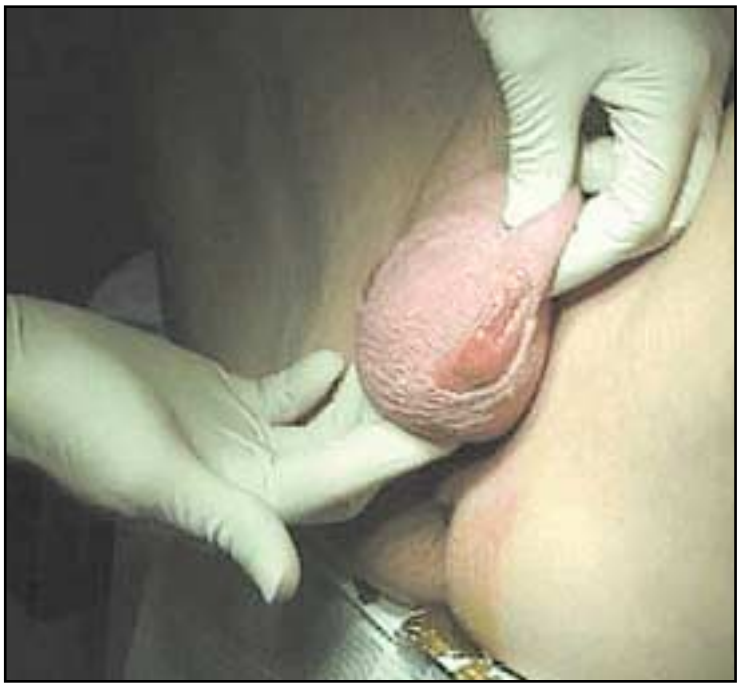


Figure 9. "Fresh" cadaveric dissection – demonstrating the location of the Often disputed "Pubocervical Fascia". This structure, once identified and dissected, may be utilized in laparoscopic surgery for prolapse or incontinence.



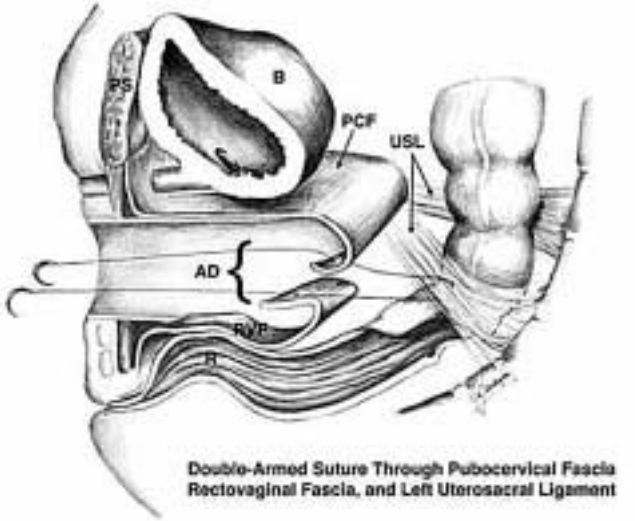


Figure 10. The Problem. Complete pelvic floor prolapse. This vaginal mass contains small bowel, recto-sigmoid and bladder.

Reproductive Surgery

Reproductive tubal and uterine surgery is made possible by improved optics, magnification and miniaturisation.

Laparoscopic procedures such as tubal re-anastomosis, ovarian adhesiolysis and laparoscopic or hysteroscopic uterine reconstruction have essentially replaced reproductive microsurgery via laparotomy.

A single (muscularis) or double layer (serosa/muscularis) closure may be used, with increasing support in the literature favouring single layer closure – with respect to pregnancy rates and ectopic gestations.

Uterine Bleeding Disorders

The development of operative hysteroscopic equipment including safer energy sources, further miniaturised optics and scopes and resection instruments now allow a range of surgeries to be carried out within the uterus. These include reproductive procedures for uterine anomalies, as well as resective and ablative procedures for uterine bleeding.

This often allows a minimally invasive procedure which can preserve fertility in a woman who wishes to do so, or avoid hysterectomy in an older patient with a condition such as a vascular sub-mucous fibroid (Figure 13). These structures can cause massive acute uterine blood loss and may be hysteroscopically managed in an acute or elective setting.

Development and miniaturisation of laparoscopic morcellation devices have also allowed us to treat and remove exceptionally large structures such as serosal fibroids and uteri. Laparoscopic hysterectomy and laparoscopic myomectomy for large pathologies are made quicker and simpler with these technologies. Once dissection and suture haemostasis is carried out, these structures may be removed via a 10mm port (Figure 14).

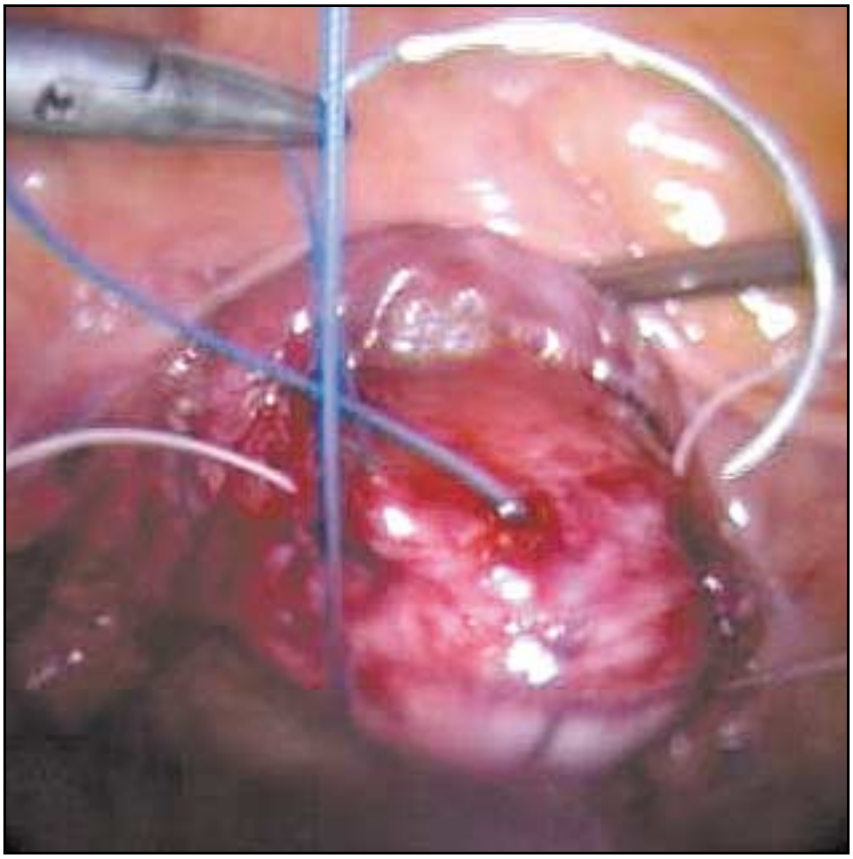


Figure 11. The Procedure. Location, dissection, reconstruction and suspension of fascial structures between vagina and bladder (pubocervical fascia) and vagina and rectum (rectovaginal fascia).

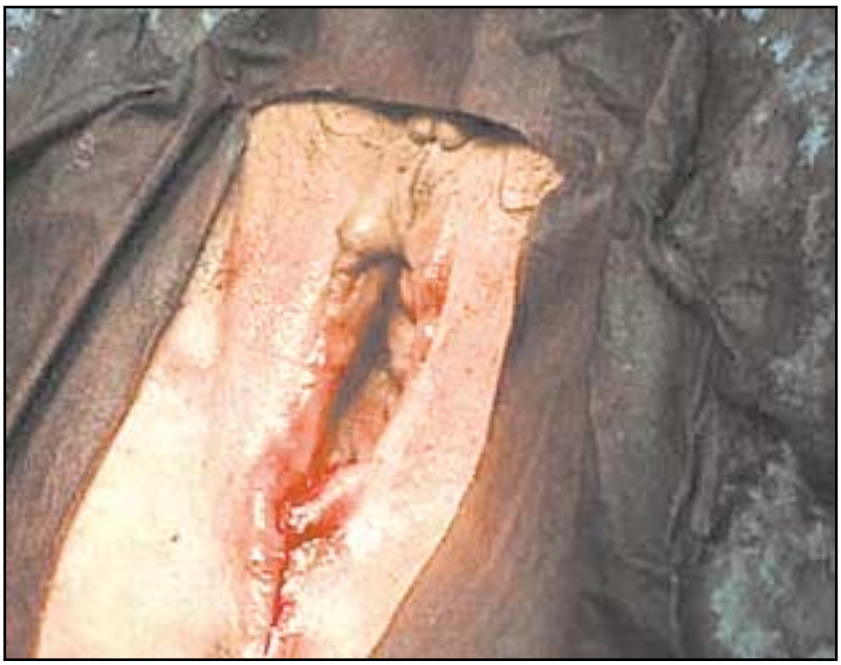


Figure 12. The Result. Laparo-Vaginal Reconstruction. The anterior, posterior and apical supports have been united and re-attached to their fascial origins in the parasacral fascia.

The Future

The above procedures serve as a guide to what is currently possible in endoscopic gynaecology and performed on our campus. As one can see from the historical account, rapid advances in all aspects of endoscopic technology continue at an increasing pace. 2mm endoscopic foetal surgery and Da Vinci robotic surgery (recently on campus) are two examples of high end technology currently in use.

Future developments in remote robotic surgery and telesurgery may offer a wider group of patients the benefits of this tertiary service at St Vincent's.

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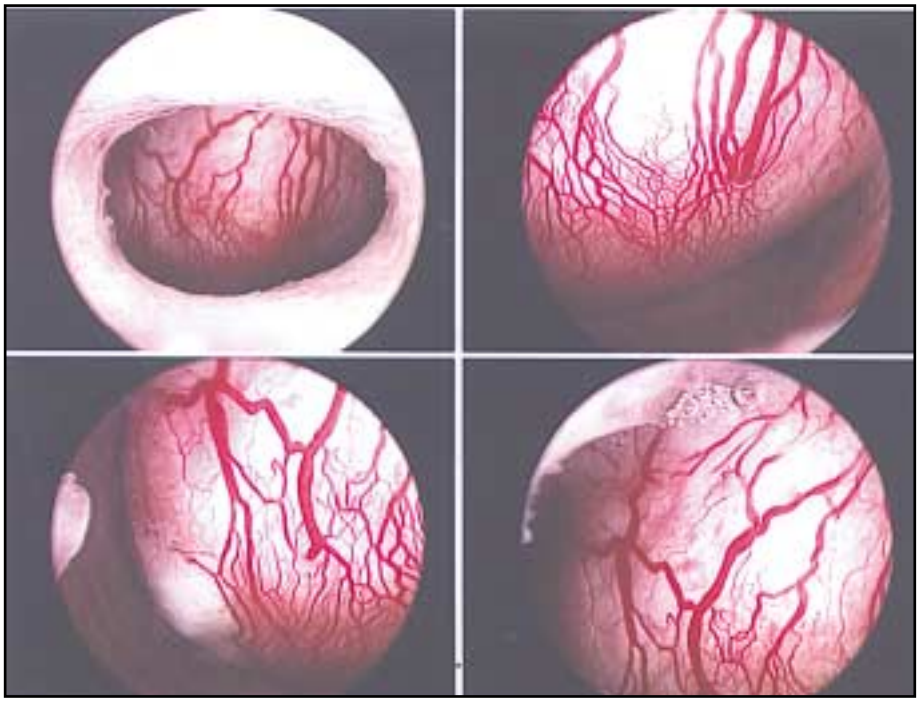


Figure 13. Vascular Submucous Fibroid Within the Uterine Cavity.

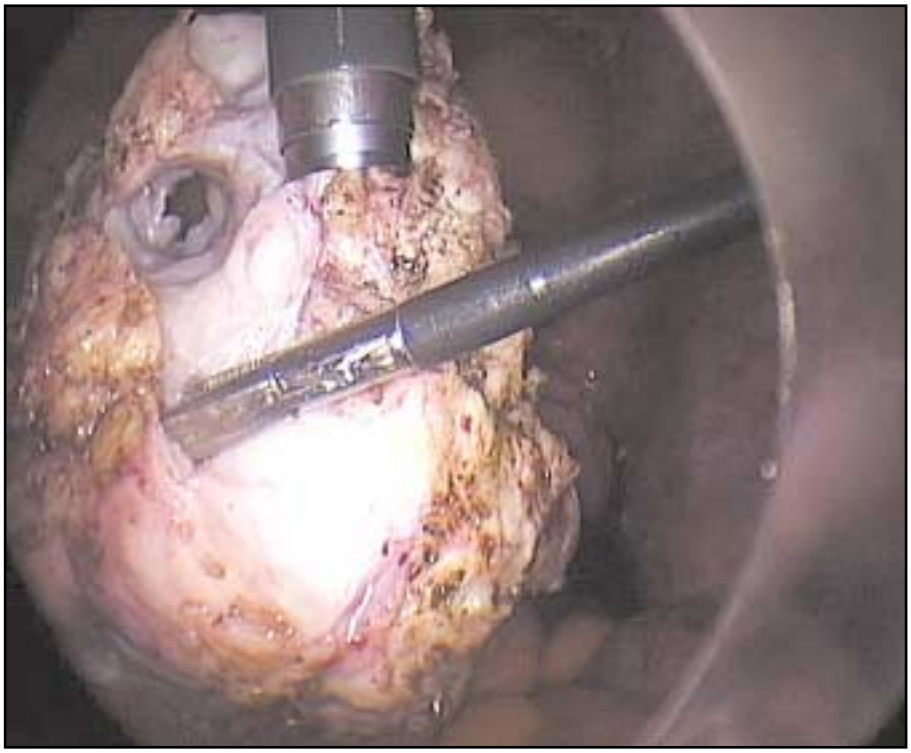
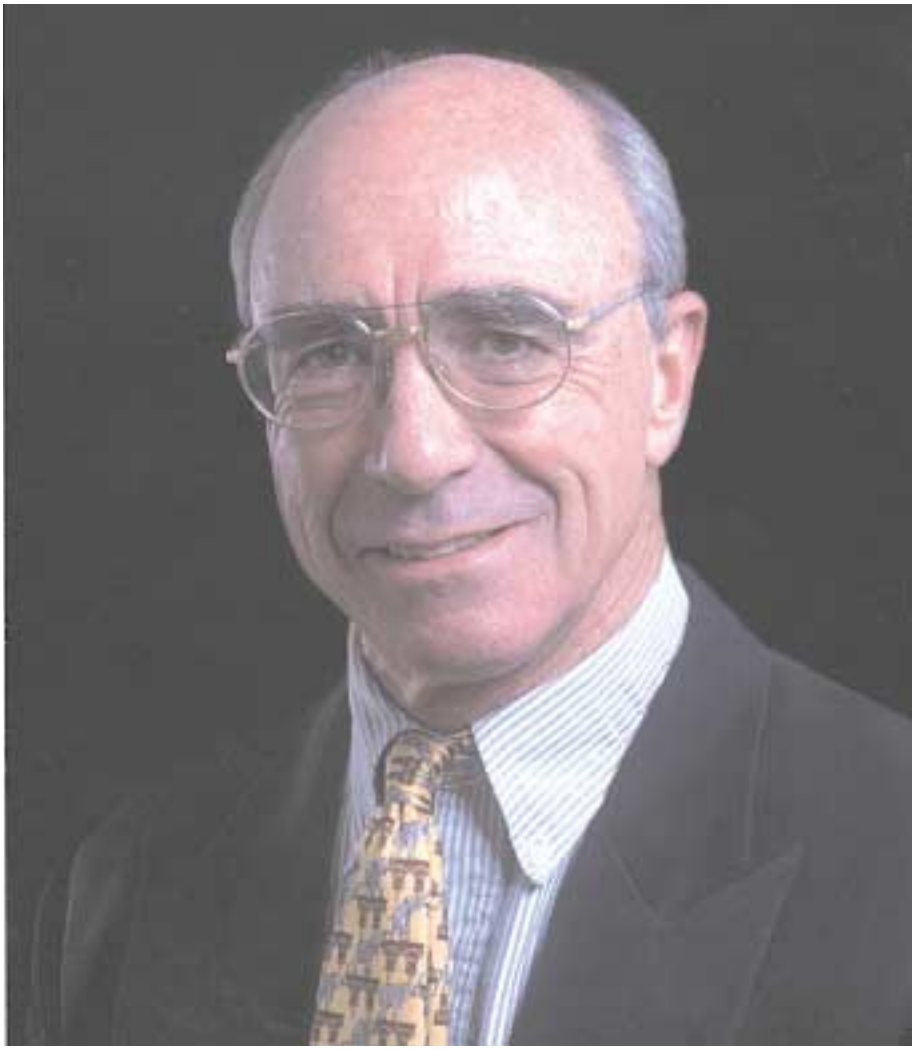


Figure 14. Laparoscopic Myomectomy and Morcellation.

Professor Paul Fagan

Background to Surgery of the Lateral Skull Base



Professor Paul Fagan,
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St Vincent's Hospital, Sydney
President-Elect of the World Federation of Skull Base Surgical Societies

Surgery of the skull base has become a well recognised field and many skull base units have been established, usually on a fairly informal basis, in teaching hospitals. The growth of interest in skull base surgery over the past 25 years has been exponential and indeed, most countries now have a national skull base society. There are four regional skull base societies (North American, South American, European and Asian-Oceanic) and in addition, there is the World Federation of Skull Base Surgical Societies. Skull Base meetings are held on a regular basis and indeed, probably too regularly. After an initial extraordinary expansion of the field, there has been little new in the past ten years and the Scientific Programmes of all these skull base meetings tend to be pretty much the same.

One might think there is little difference between skull base surgery and neurosurgery given that there is a significant overlap between the two and that most skull base meetings now include vascular neurosurgery, the surgery of the pituitary fossa and many other purely neurosurgical fields. As skull base surgery now includes in its orbit, surgery of the cerebello-pontine angle, it is worth recording that Dr John Tonkin (Figure 1) of St Vincent's Hospital,

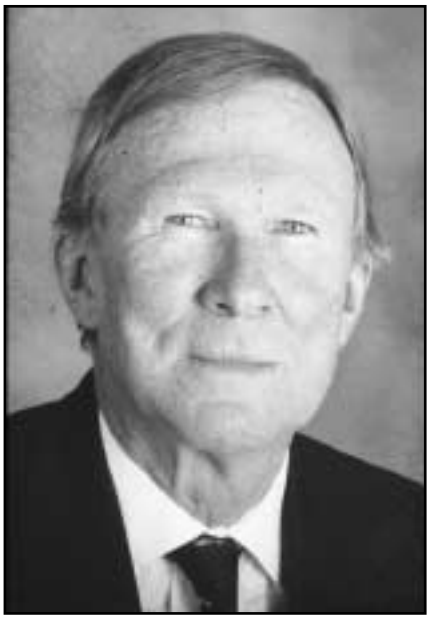


Figure 1: Dr John Tonkin

following the lead of Dr William House of the House Institute in Los Angeles, was the first man in this country to use an operating microscope, now considered standard of care, to remove a tumour of the cerebello-pontine angle. This was carried out in 1963 and published in 1964.[1]

However, most of skull base surgery involves those tumours which cross the base of the skull. The three cranial fossae lend themselves readily into a division of skull base surgery namely the anterior (involving the anterior cranial fossa) and the lateral (involving the middle and posterior cranial fossae). This article will deal with the lateral skull base.

This author first developed an interest in this field in the late seventies, when a 16 year old female came to St Vincent's with what proved to be an enormous glomus jugulare tumour. It was obvious to the author that the treatment of such a lesion was totally beyond his expertise and even that of his senior colleagues in all fields. This was in the early days of CT, well before MRI, so that the true extent of the tumour was hard to comprehend. However, CTs of this patient (Figure 2), taken some years after diagnosis, show a truly significant tumour mass.

It was this experience which lead the author to seek further training in the field and which took him to Zurich in 1982 with his family. There, under the tutelage of Professor Ugo Fisch, formal training in skull base surgery was undertaken. [2]

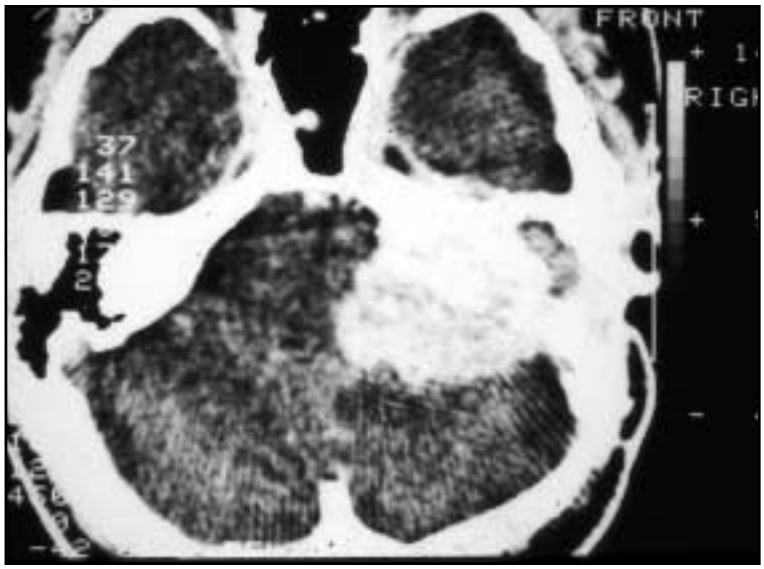


Figure 2: Glomus jugulare tumour (left) with gross intracranial extension

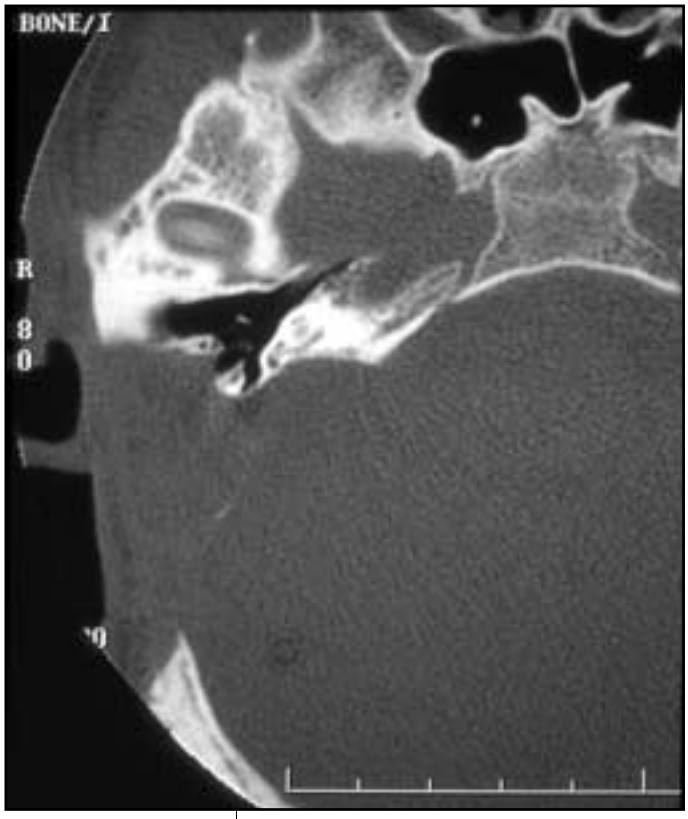


Figure 3: This illustrates the amount of temporal bone that is removed in a lateral skull bone procedure

ANATOMY

The lateral skull base can be conveniently divided into two areas related to the middle cranial fossa and the posterior fossa. The former lies lateral and anterior to the intrapetrous portion of the internal carotid artery.

In the middle cranial fossa, tumours will involve the temporal lobe and cavernous sinus above, the greater wing of the sphenoid in the base of the skull and below, the infratemporal fossa. Medially is the sphenoid sinus and the nasopharynx and anteriorly is the orbit and the maxillary sinus. Laterally is the temporal squama, the zygomatic arch, the temporal muscle and temporo-mandibular joint, which latter structures need to be removed or mobilised to grant surgical access .

Most tumours involving the posterior skull base arise in the jugular foramen. Tumours arising here will extend superiorly and posteriorly into the posterior cranial fossa (see Figure 2), medially along the internal carotid artery to the petrous apex and inferiorly into the neck and internal jugular vein. The sigmoid sinus itself can often be involved.

Skull base surgery by definition, requires bone removal. Figure 3 indicates the amount of the bone that is removed in a standard translabyrinthine approach

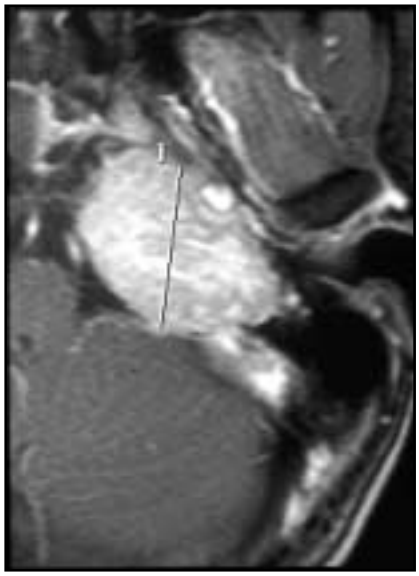
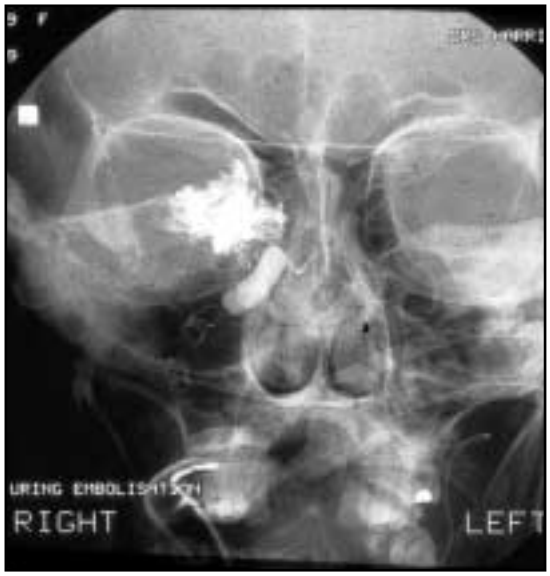


Figure 4 (Left): The entire intra-petrous internal carotid artery has been engulfed by the tumour

Figure 5 (Right): The occluding balloon is lodged in the internal carotid artery just proximal to the ophthalmic artery



to tumours of the cerebello-pontine angle, giving access to the tumour and complete preservation of vital structures.

Tumours of the jugular foramen, their presentation and management

Tumours of the jugular foramen are commonly chemodectomas, arising in the chemoreceptor cells of the jugular bulb. Less common is schwannoma arising in the lower cranial nerves and meningioma. Occasionally a chondrosarcoma can arise here and there has been one plasmocytoma in the St Vincent's series. Morbidity is caused by involvement of the lower cranial nerves or by extension into the posterior cranial fossa involving the cerebellum and brainstem.

Paradoxically, patients with lower cranial nerve lesions do well if it is the slow progression of the tumour that causes the nerves to lose function. Those patients who suffer an acute loss of function by surgery or by rapid tumour progression (e.g., a bleed), have significant problems in adapting, particularly to swallowing. Dysphagia may require nasogastric feeding or even on occasion a percutaneous enterostomy (PEG). However, this period of incapacity can be significantly shortened by pre-operative tutoring by a skilled Speech Pathologist. [3]

All patients undergoing surgery in this area lose the middle ear resulting in a significant conductive hearing loss. If involvement of the internal carotid artery is significant, the inner ear needs to be excised to gain access to the artery, resulting in a total hearing loss.

Tumour involvement of the internal carotid artery can be extreme (Figure 4). Occasionally the artery can be engulfed by tumour and the only way to effect a cure is to resect both tumour and artery after balloon occlusion of the artery under EEG control (Figure 5). There have been no strokes in the St Vincent's experience even though the internal carotid artery has been inadvertently ruptured (three cases) and resected, after balloon occlusion, in three cases.

Apart from lesions of the lower cranial nerves, CSF leak occurs in 7% of cases, generally through the wound as the Eustachian tube is occluded under vision as part of the operative procedure. Prolonged dysphagia requiring lifelong PEG feeding has been present in two cases and one patient, who had undergone radiotherapy and embolisation, had an ischaemic necrosis of the pinna and skin flap requiring secondary free flap repair.

As nearly all tumours involving the jugular foramen are benign, an expectant policy with serial imaging can be justified in many patients, particularly in older patients with intercurrent illness.

Radiotherapy for chemodectomy has a place, again in older patients but there is a reluctance to use radiotherapy in young patients with benign disease, particularly as subsequent surgery is made significantly more difficult if tumour progression is recorded.

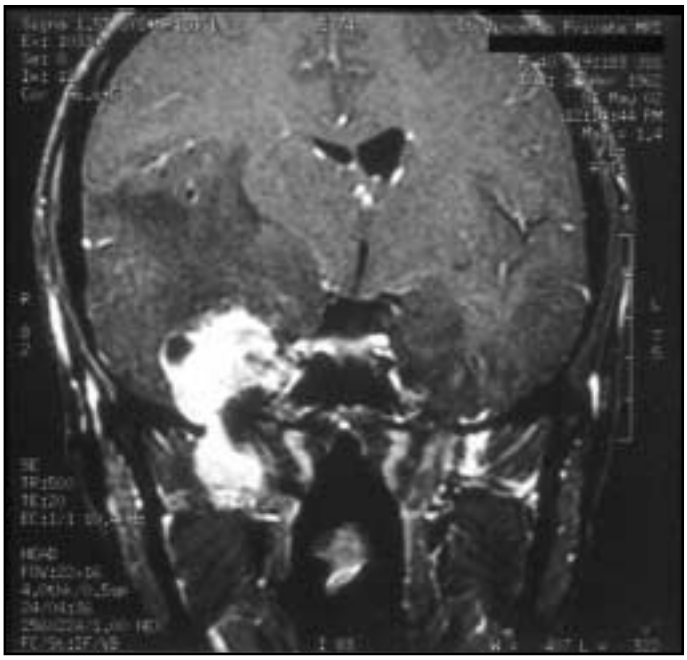
There is no place for radiotherapy in schwannoma or meningioma of the posterior cranial fossa, surgical excision being required if the tumour is producing symptoms by virtue of its mass.

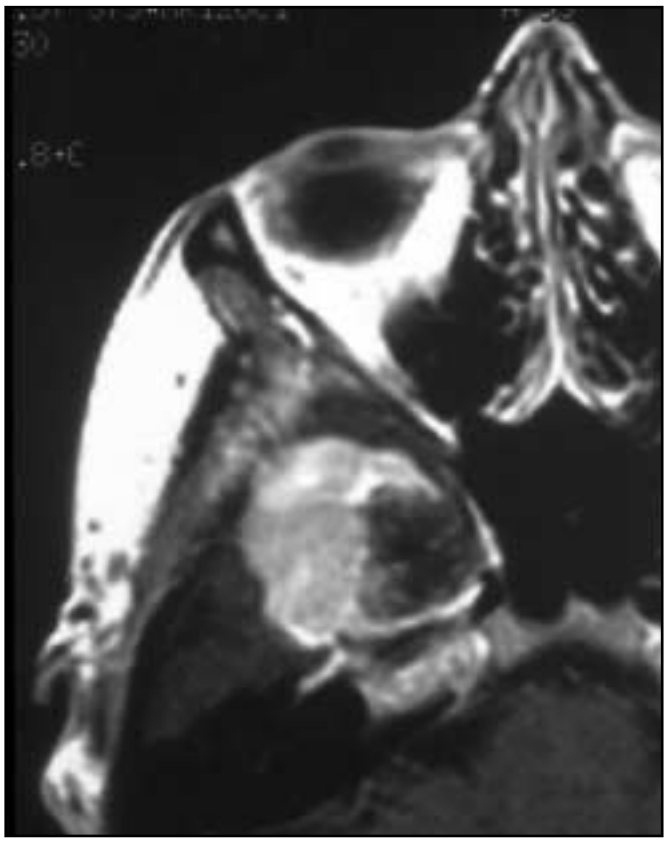
In the past, surgery lead to inevitable facial nerve damage with its severe cosmetic and functional impairment. The facial nerve lies directly laterally to the jugular bulb and any tumour contained therein. However, trans-position of the facial nerve first described by Fisch[2] leaves the patient with normal facial function in 52% of cases (St Vincent's figures).

Tumours of the middle cranial fossa and their management

Tumours involving the middle skull base, i.e., those in front of and lateral to the horizontal internal carotid artery, are generally meningioma (Figure 6a and 6b) with the rest being schwannoma, related to the fifth cranial nerve. Unusual tumours such as fibrous tumour of the meninges and malignant schwannoma complete the series.

A complete conductive hearing loss was common after the treatment of such tumours. This has been reduced by the introduction of the orbito-zygomatic approach.[4] Prior to this and the advent of mini-plates, a cosmetic deformity due to an inability to stabilise the zygomatic arch was common.





Figures 6a (coronal) and 6b (axial) views of meningioma which extends from the temporal lobe of the brain above into the infra-temporal fossa

The facial nerve does not require transposition but there is often a temporary paresis of the upper branches of the facial, resulting in a flat, expressionless forehead for a limited period of time. Anaesthesia in the distribution of the mandibular and (less frequently) the maxillary nerve occurs.

The Special Case of Petrous Apex and Clivus Tumours

The internal carotid artery is the key to tumours of the skull base. As discussed above, jugular foramen tumours are generally bounded by the carotid artery in the front while those in the middle cranial fossa, have the carotid artery behind. The tumours of the petrous apex and the clivus, require bone removal from both in front of and behind the internal carotid artery to give access to the tumour.

Conclusion

Modern techniques of skull base surgery allow even the largest tumours to be removed without unacceptable neurological deficit. The indications for surgery are constantly being refined. While modern imaging facilitates early diagnosis, it has also given us the ability to monitor slow-growing tumours which in some cases avoids surgery altogether.

Acknowledgement

Skull base surgery is a multi-disciplinary specialty. The author is particularly indebted to the skills of the anaesthetists with whom he has worked over the years, particularly: Ben Barrie, Brad Smith, Greg Deacon, Michelle Joseph, Greg O'Sullivan and others. Skull base surgery would be impossible without the knowledge, skill and enthusiasm of the St Vincent's Radiological team, lead by Professor Bruce Doust and we are also very grateful to Professor Jim Roche from North Shore and Dr Julian Adler from St George who have played a major role. No skull base surgery could be carried out unless an extremely skilled Intensive Care Unit was available and we are indebted to Dr Robert Wright and his team in this regard. Radiotherapy is an essential adjunct in this field. Dr Peter Duval's advice is always exemplary. I would like to acknowledge the pioneering work of Dr John Tonkin. Lastly, and perhaps most importantly, I would like to pay tribute to Dr John Sheehy, Neurosurgeon, who has worked with me tirelessly and on many of the major cases that have been dealt with over the years, teaching me constructive approaches to problems outside my own training and experience.

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Dr Steven Liew and
Dr Elias Moisidis

Milestones in Plastic Surgery

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Introduction

The field of plastic surgery has evolved significantly since the birth of "modern plastic surgery" with the treatment of burn victims during the Second World War. Reviewing the plastic surgical literature, the major milestones can be summarized chronologically.

- In the 1970s: An improved understanding of local, regional and vascular anatomy of soft tissue has seen a rapid expansion in the number of reliable soft tissue flaps being described (both muscle, skin and combinations). Many of these flaps continue to be used in current plastic surgical practice .
- In the 1980s: The introduction of microsurgery revolutionalised the management of complex clinical problems particularly in the area of head and neck surgery, breast reconstruction and lower limb trauma. Further technical advances in microsurgical techniques resulted in significant improvements in reliability, functional and aesthetic outcomes. Microsurgery has become an established technique and no longer are patients subjected to multiple staged reconstruction (tubed pedicles), prolonged hospitalization and increased morbidities. Today, one stage free vascularised transfer of tissue ranging from skin only, skin and

muscle (myocutaneous) or skin, muscle and bone (osteomyocutaneous) has become the standard reconstructive option in most patients undergoing major head and neck resection.

- In the 1990s: Advances in the field of genetics have led to the identification of specific gene anomalies which are associated with particular clinical conditions such as Apert and Crouzon syndrome. The improved understanding of bone regeneration has seen the revival of bone regeneration by gradual distraction, a technique that was utilized by Ilizarov over half a century ago on lower limb fracture and which was subsequently adopted by modern orthopaedic surgery. This new bone transport technique has been modified and adopted by plastic surgeons and has revolutionised the management of craniofacial surgery. Patients with severe midfacial retrusion, mandibular hypoplasia can now be treated early with the use of miniaturised distraction device that allow a surrounding bony defect to be corrected by gradual stretching.

- In the 2000s: In the current era, plastic surgery will continue to interact with other surgical specialties, to solve major clinical problems related to healing, infection, repair, regeneration and reconstruction. We are now entering an era where progress in biotechnology engineering has seen the introduction of state of the art devices and products that allow refinement in wound healing (VAC, C- Spray), facial reconstruction (bio-absorbable plate, facial prostheses) and breast reconstruction (anatomical shape cohesive gel breast implant).

The advancement in tissue engineering has also seen the development of cultured epithelial autograft spray suspension, which in early studies has shown improvement in the management of burn victims. Acellular human dermis widely used in USA and currently being trialed in Australia, may further improve the management of patients with extensive full-thickness burns. It achieves this by providing a structural scaffolding for the overlying epidermal cell thus preventing secondary scarring to a large degree.

Whilst the basic reconstruction principles and techniques remain the same in most areas of the body, refinement in the surgical equipment and the further understanding in blood supply has seen a number of new developments that have improved flap harvest and minimized donor site morbidity (perforator flap in breast reconstruction).

Concurrently, the developments in aesthetic surgery (major subset of plastic surgery) have mirrored the parent field of plastic surgery. In fact, the recent advancement in tissue and biogenetic engineering has seen the cross utilisation of products in both fields. The recent surge in popularity of botulinum toxin in facial rejuvenation has seen the application of its benefits in patients with migraine and tension headache.[1] Other areas of application include hyperhydrosis and more recently, lower facial contouring. The influx of various dermal fillers for aesthetic surgery patients in the market has seen its application extended to medical fields eg patients with HIV-lipoatrophy due to protease-inhibitor usage and indentations of facial scarring from previous medically related surgery. Improvement in the design and quality of silicone gel implants used in cosmetic surgical patients has benefited those mastectomy patients undergoing expander/breast implant reconstruction.

Detailed description of all recent progress is obviously beyond the scope of this article and hence we have focused our attention on what is available at St Vincent's Campus.

Recent Progress in Wound Healing

(a) Vacuum Assisted Closure – KCI Medical Australia

VAC is the most recent technological advance for complex non-healing acute or chronic wounds. It utilises the application of controlled localised negative pressure to help uniformly draw the wound closed. This is achieved by positioning a foam dressing into the wound. The foam has an embedded suction tubing which is connected to a pump which delivers the suction pressure. The foam is then occluded with a semipermeable film dressing. The therapeutic benefits of VAC include reduced oedema, accelerated healthy granulation tissue and angiogenesis thereby promoting wound healing in poorly vascularised tissue such as diabetic feet, pressure ulcers and radiation induced ulcers.

Indications for VAC dressings in our current practice are:

- Acute wound: (Limb trauma, wound dehiscence) (Figures 1-3)
- Chronic Wound (Pressure sores, leg ulcers)
- Adjunct to surgery (improve the wound bed for skin grafting)

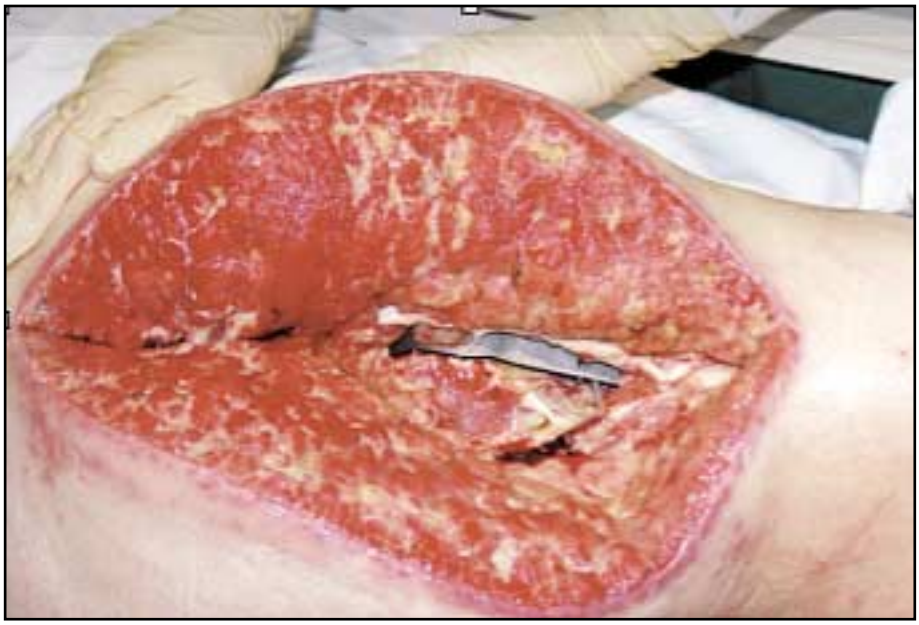

Figure 1: Dehisced orthopaedic wound of the hip

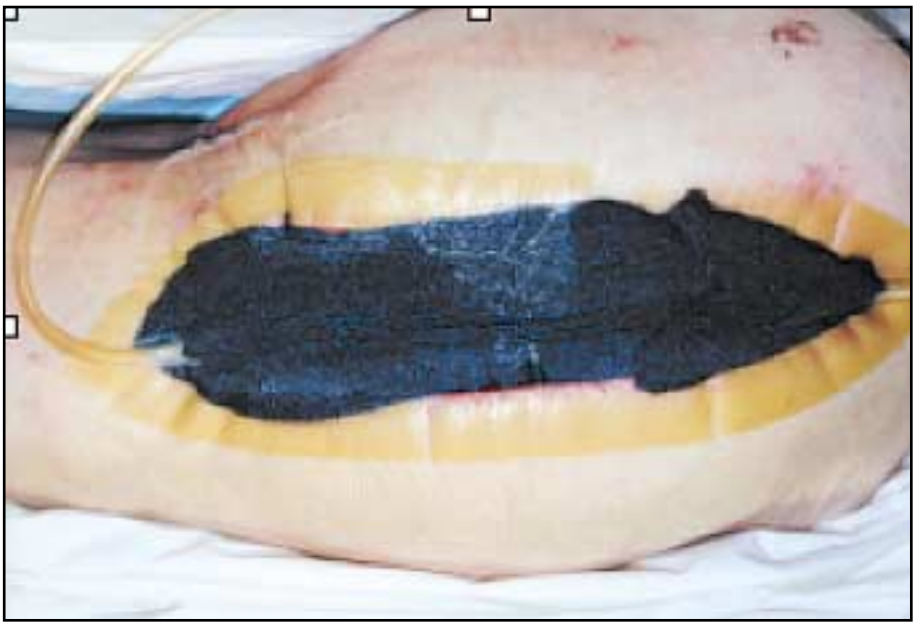

Figure 2: VAC dressing

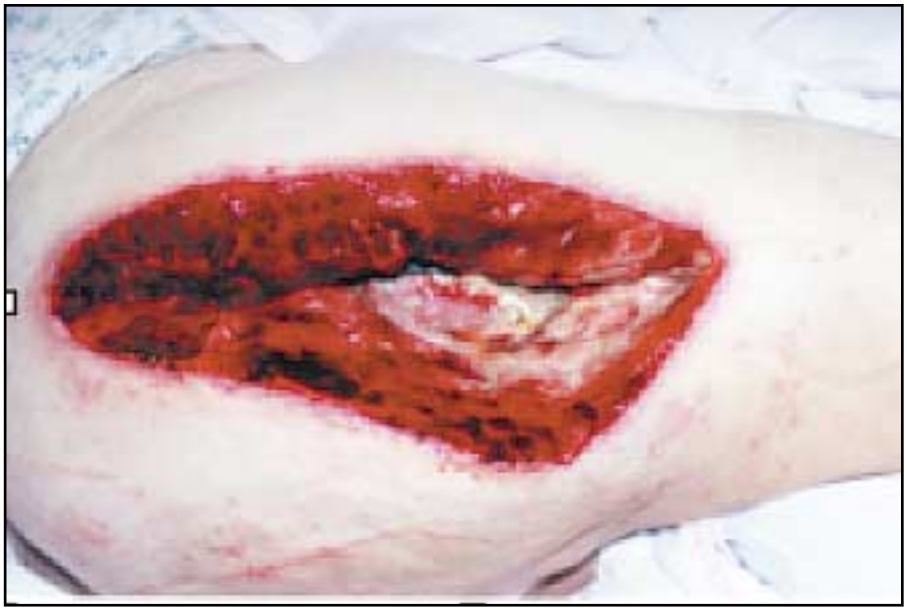

Figure 3: One week after VAC therapy, reduction of surface area of defect and abundance of healthy granulation tissue

- Salvage (recalcitrant wounds, found predominantly in the elderly, which would otherwise require complex reconstruction)

The introduction of Mini-VAC means that some patients who would otherwise need to be hospitalised because of their complex wounds can now be treated in the community. This allows patients to return to more normal activities whilst receiving the therapy.

(b) Epithelial cell suspension

The concept of spraying a suspension of autologous epithelial cells was pioneered by Dr Fiona Wood, a plastic surgeon working in Perth. The application of this technology in patients with burns has improved healing and preserved the natural pigmentation in mid to deep dermal burn injury. Unlike conventional cultured epithelial sheets which are associated with various technical difficulties, the new technology involves harvesting the cultured epithelial cell at the preconfluent stage (before becoming a sheet) and preparing them into spray technology, hence " Spray on Skin". The cultured epithelium closes the wound by forming chemical bonds on the surface and then develops a basement membrane . This differs from a skin graft, which survives by initial adhesion and vascular ingrowth. The epithelial cell suspension also introduces melanocytes into the area which may positively improve the cosmetic outcome.

The epithelial cell suspension comes in two forms: Cell sprays which are mainly used in Burns Units and ReCell which is more widely applicable. Recell is a portable kit, allowing surgeons to prepare periopertively an autologous cell suspension within 30 minutes from a small piece of harvested skin (1cm). The suspension can than be sprayed on to a small area wound, either acute medium depth burns, hypopigmented scars, vitiligo or following laser resurfacing. From the clinical standpoint, early results have shown this technology to be beneficial to patients with debilitating scar and hypopigmentation problems such as vitiligo because the melanocytes in the suspension replaces some of the lost pigment. It also has the added benefit of increasing epithelialization of acute wounds.

Recent Progress in Implants and Plating Systems

(a) Cranio-Maxillo-Facial and Head and Neck Reconstruction

The advantage of accurate reduction and rigid fixation of bony fragments for primary bone healing either following osteotomy for elective cranio-maxillo-facial surgery or in the settings of facial trauma has naturally led to the development of and widesperead use of metallic screw and plate fixation systems composed of titanium in the late nineties. Further refinement in the products has seen the miniaturisation of such devices (1mm diameter screw and low profile plates) to ensure non-palpability in area with thin soft tissue covering such as the orbital rim.

In the paediatric population however, these devices still pose the potential problems of postoperative restriction of bone growth, imaging artefact as well as trans-cranial migration of hardware. This has led to the recent development of bio-absorbable fixation devices (composed of polymers of polylactic acid and polyglycolic acid) which have demonstrated sufficient biomechanical stability, no adverse tissue effects during biodegration and complete resorption within 15 months. Such products have now been gradually adopted in the adult setting where resorbable sheets have gradually replaced metallic mesh in the

management of orbital floor fractures. Such resorbable fixation devices have also been widely used in the cosmetic surgery setting for endoscopic brow and mid-face lift.

Autogenous bone graft has traditionally been the gold standard for replacing missing or damaged bone in facial surgery. It is however still associated with donor site morbidity. Today, with advances in biotechnology, there has been an explosion of alloplastic materials with unique mechanical properties and biocompatibility which have virtually replaced the use of autologous bone grafting. These materials have the added benefit of not being associated with any donor site problem, availability off the shelf, reduced operating time and some of the materials offer the added benefit of providing a scaffold for tissue ingrowth. "Medpor" is a good example of such a product. It is a polymer of polyethylene which is widely used in facial reconstruction following trauma, head and neck cancer resection and facial aesthetic surgery. It is extremely useful in orbital floor reconstruction, supporting the midface following maxillectomy and as a structural support in nasal reconstruction or cosmetic rhinoplasty.

Recent Progress in Breast Surgery

Whilst the basic techniques and options of reconstruction have remained the same in the last decade, there has been further refinement in the quality of reconstruction due to the progress in two major areas.

- Improved understanding of neurovascular anatomy
- Improvement in the quality and range of silicone gel breast implant.

(a) Autologous breast reconstruction

The TRAM (transverse rectus abdominus myo-cutaneous) flap has been the gold standard of autologous breast reconstruction since its introduction by Dr Hartrampf in 1981. It involves harvesting a large piece of lower abdominal skin and subcutaneous tissue together with the underlying rectus muscle. The composite piece of tissue is perfused by either the deep superior or inferior epigastric vessels. Since then there have been numerous modifications of the flap to improve its survival as well as its aesthetic outcome. Autogenous tissue reconstructions have the advantage of using the patient's own tissue from areas in which it is available, and usually in excess. The reconstruction once complete is extremely resilient and will change commensurate with the patient's body habitus.

One major morbidity of such surgery, however, has been the abdominal wall weakness following removal of either the whole or a portion of the rectus muscle. The recent improvement in understanding of the neurovascular supply of the flap has led to development of DIEP (deep inferior epigastric perforator) flap. This has allowed the same composite of skin and subcutaneous tissue to be harvested based on the perforators of the artery without removing the rectus muscle, thus preserving its integrity and function. The DIEP flap has been shown to be associated with reduced postoperative abdominal pain and weakness when compared with conventional TRAM flap.

(b Prosthetic /implant breast reconstruction

Whilst implant breast reconstruction has been around for decades, its long-term success is often limited by the development of capsular contracture which can lead to distortion of the reconstructed breast and increase the risk of implant rupture and associated silicone leakage. This, coupled with the " silicone-controversy" in 1992, led to the banning, by the United States Food and Drug Administration, of silicone breast implants for cosmetic augmentation surgery. This dampened its use in the ensuing years and many prostheses were replaced with saline-filled implants.

The justification for the moratorium was not that silicone breast implants were unsafe, but rather that they had not been shown to be safe. Multiple international multi-centre trials have since been conducted and these have demonstrated the safety of silicone gel implants. Studies have not demonstrated any link between silicone and breast cancer,[1] nor have they demonstrated any link between silicone and auto-immune disorders.[2]

The temporary world-wide restriction of silicon breast implant usage resulted in a massive investment in research and development with the beneficial outcome of improved implant design. The introduction of cohesive gel has replaced liquid silicone. Due to its cross link adhesiveness, the cohesive gel implants have a more gelatinous consistency and do not flow freely even if the outer shell is disrupted. Furthermore, improvements in the technology of texturing the surface of the implants has led to a significant reduction in the rate of severe capsular contracture ensuring that the augmented or the reconstructed breast remains soft and retains its shape for a longer period of time. Finally, the recent introduction of anatomically shaped (teardrop shape) implants which come in numerous sizes, permit individualization of implant choice and help attain a more natural breast shape in cases of reconstruction and cosmetic augmentation.

Whilst the use of silicone breast prostheses is still banned for cosmetic augmentation in USA, its application in breast reconstruction cases continues to be approved on a trial basis. In Australia, most European countries and Canada the new silicone gel implants have been approved by the governing bodies (TGA) and are widely used both for cosmetic and reconstructive purposes.

Today, the use of a tissue expander followed by an appropriately chosen teardrop-shape breast implant, in suitable patients, has allowed plastic surgeons to reconstruct an aesthetically pleasing, near natural breast far superior to what could be achieved a decade ago (Figure 4). The absence of additional donor site scarring and morbidity as well as the shorter operating time and recovery makes implant reconstruction appealing to a subgroup of mastectomy patients.

(c) Breast reduction surgery

"Large breasts", those that are considered to be out of proportion for a female's body shape and stature, can be a source of both functional and social embarrassment. Neck and back pain, grooving from the bra strap and skin rash are some of the usual complaints of this group of patients.

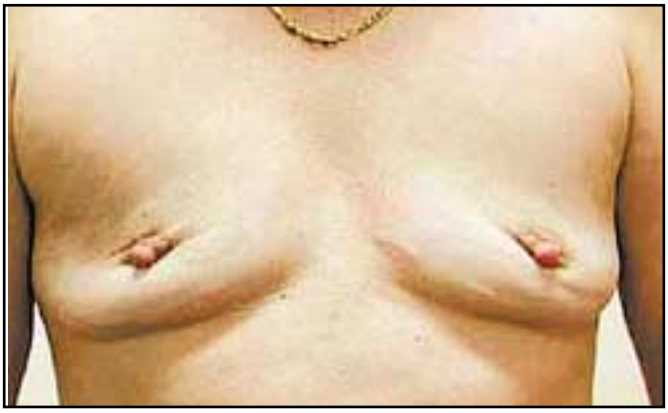

Figure 4a: Bilateral subcutaneous mastectomy for multiple suspicious breast lumps.

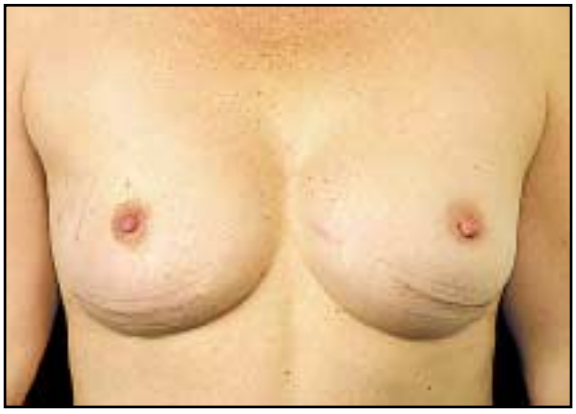

Figure 4b: 6 months following staged expander followed by anatomical-shaped silicone implants.

Breast reduction surgery not only reduces the volume to a size more in proportion to the patient's body but also aims to reshape them. It can also improve a patient's posture and very importantly, boost confidence and self-esteem.

The "inverted T" is probably the most widely used technique in breast reduction both in Australia and worldwide. Its major disadvantage is the degree of scarring associated with the operation. In addition, the shape of the breast is largely determined by the skin brassiere which in most cases of hypermastia has been excessively stretched by the volume and the weight of the breast. This, in turn, can lead to a deterioration in the shape of the reduced breast, a process known as "bottoming out".

Recent refinement in techniques as well as understanding of the blood supply of the breast has changed the thinking by stressing more the manipulation and suturing of the breast tissue to determine the final shape. The medium term follow-up of this technique has shown a more controlled and longer lasting final breast shape as well as a shorter scar.

Recent Progress in Non-Surgical Devices and Products

With increasing social acceptance of the importance of aesthetics, many patients are now seeking both surgical and non-surgical ways of achieving their aesthetic goals. The advancement of biotechnology has seen the influx of various products aiming to provide facial rejuvenation. Most of these products have since been used in patients seeking aesthetic improvement as well as those requiring reconstruction.

(a) Botulinum toxin type A

Botulinum toxin is an exotoxin produced from the bacteria Clostridium botulinum has essentially become a household name world-wide since it was approved by the US Food and Drug Administration and the Australian Therapeutic Goods Association (TGA) in 2002 for glabellar rhytides. Since then, botulinum toxin has been increasingly used and its number of applications has increased eg. the effacement of dynamic or hyperkinetic facial lines. Today, it has been used successfully as a potential method of nonsurgical treatment for patients with problems ranging from various spastic disorders, jaw pain and spasm, urinary dysfunction, vaginismus and dyspareunia, anal fissure, tension/ migraine headache, axillary and palm hyperhydrosis.

Headaches deserves a special mention. The unexpected reduction in the severity and frequency of tension and migraine headaches in patients who had received botulinum toxin as well as for those who had forehead rejuvenation surgery has generated great interest in the potential of surgical treatment for migraine headaches. Whilst the cause of migraine still remains to be established, there are some suggestions that inflammation of the peripheral branches of trigeminal nerves could potentially be the cause of pain. In the forehead region, most of the trigeminal nerve branches are passing through certain mimetic muscle. It has been postulated that the constant contraction of these muscles could be the cause of inflammation of the nerves, causing the headaches. The potential benefit of surgeries such as endoscopic browlift, septoplasty and turbinectomy and neurolysis of the great occipital nerve are currently being investigated.[3]

Hyperhydrosis also deserves a special mention. It is a pathological condition characterised by excessive sweating which often results in significant social and functional impairment. To date, the application of botulinum toxin has provided an effective non-surgical alternative in the management of this group of patients. It works by blocking the transmission of Acetylcholine to the offending sweat glands. It has in many cases replaced many of the established surgical therapies such as excision of axillary tissue and thoracoscopic symphathectomy. A total of 80 to 100 units of the toxin is normally injected in the offending site in both axillae following accurate location of the sweaty area with iodine-starch test. There is a significant decrease in sweating for up to 12 months.

(b) Newfill

This recently introduced filler is being used in aesthetic surgery for facial rejuvenation. It consists of a biodegradable chemical (polylactic acid) that has been used in surgical suture materials as well as other biomedical implants for decades. It works by gradual stimulation of new collagen formation in the dermis and with time creates a thicker and firmer skin. Like other fillers, its use in the aesthetic surgery field has been adopted for reconstructive purposes. Its role in the management of HIV patients with facial liproatrophy

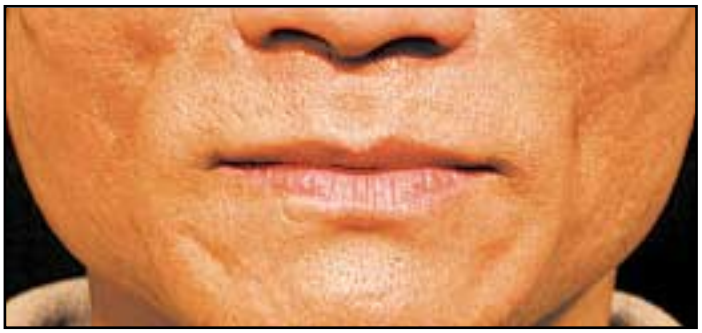

Figure 5a:Marked atrophy of sub-malar region (arrowed)

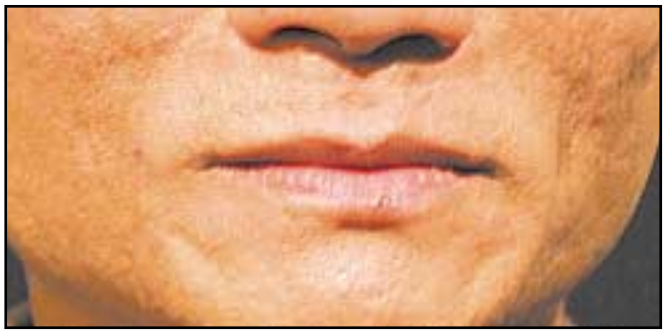

Figure 5b: Volumetric improvement 3 months after newfill

will be subjected to a propective randomized trial at St.Vincent Campus. Unlike other fillers, the full effect of Newfill is not seen at the time of injection but rather after a 6 week period when new collagen is being formed. (Figure 5)

(c) Isolagen

This is the latest technique of non-surgical rejuvenation available. Developed in 1995 by Dr W Boss, a plastic surgeon from the United States. The main application currently has been in the aesthetic surgery arena for filling wrinkles and fine lines on the face. It involves harvesting a tiny piece of skin from the back of the ear, which is then processed and cultured into millions of collagen forming cells (fibroblasts). The cultured fibroblasts are than delivered in an enriched medium using a syringe to inject specific areas. These fibroblasts, once they survive the initial trauma, should start functioning to produce collagen in the injected area and thus reduce lines, wrinkles and folds. The longest follow-up to date is about eight years, with patients continuing to show long-lasting results. Its application in the reconstructive field to date has been limited to patients with severe facial acne scarring.Other potential areas of application may include linear cutaneous scleroderma or contour irregularities due to Romberg's disease.

Conclusion

The new era of plastic surgery will be more of a refinement rather than development of new surgical techniques. These refinements will be accomplished through the development of various tools and products from the field of genetic engineering, biotechnological break-through , aesthetic surgical products as well as fine tuning of the existing established surgical principles and knowledge. Plastic surgeons in the future will not only be equipped with their surgical knowledge and craftsmanship but also the ability to choose the correct tools to optimise surgical outcome and patient satisfaction.

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THE ST VINCENT'S CLINIC FOUNDATION

Established in 1992, the St Vincent's Clinic Foundation has strengthened the research and educational aims of the Clinic. The Foundation provides funds and support for medical research into matters of clinical significance as well as providing support for public and medical education.

The Foundation has made a funding commitment of over $1million over a three year period for ADULT stem cell research on the Campus. Research in this area is cutting edge and has the potential to provide the basis for major scientific breakthroughs and the development of new treatments.

Since 1992, the Foundation has provided over $3.8 million in financial support for over 115 research projects. The Foundation has successfully supported vital research into disease and illness including:

- Heart disease
- Cancer (prostate, breast, colon and pancreas)
- Asthma
- Arthritis
- Deep vein thrombosis
- Diabetes
- Obesity
- Liver disease
- Pulmonary disease
- Pain
- Depression and suicide
- Alzheimers Disease
- Adult stem cell research

Additionally, the Foundation supports research into the function of genes and cellular activities in the development and progression of diseases or illness.

The Foundation is proud to be able to provide financial assistance to medical students who wish to undertake research whilst they are studying and to provide a travelling scholarship for recent graduates to travel for a period of time overseas whilst furthering their studies.

This research helps to develop the body of knowledge that underpins medical practice, which in turn means better patient care. The development of a strong research base helps in the practice of excellent patient care.