WHETHER COMPLEX OR STRAIGHTFORWARD, LEADING-EDGE TECHNOLOGY AND NEW APPLICATIONS OF TRADITIONAL TECHNOLOGY ARE EMBRACED DAILY AT UT SOUTHWESTERN.

INCREDIBLE MEDICAL MACHINES

The tools of technology. At The University of Texas Southwestern Medical Center at Dallas, they're all around. Many may be stunningly high-tech; others less so; and some so deceptively simple one may muse, "Why didn't we think of this before?" Traditional technology often begets promising new uses, therapies and techniques.

But whether complex or straightforward, there remains a singular purpose to these tools. In skilled hands, they can discover and can heal.

Leading-edge technology and, or in some cases, new applications of traditional technology, are embraced daily at UT Southwestern.

BY MICHAEL BLACKMAN

On the left, Dr. Cole Giller and the Accuray. Right, Dr. Masahide Kikkawa.

for infants with brain tumors, a new chance at life

They were all very young, these children; one 3 years old, the other two less than a year. They all suffered from devastating and highly aggressive forms of brain cancer. Their prognosis was bleak.

Only rarely, said Dr. Cole Giller, associate professor of neurological surgery, does anyone with such cancers survive "more than two or three years."

But Giller and other doctors at the medical center are pioneering a therapy in which they use high-beam radiation via Accuray CyberKnife technology to treat young children with brain tumors.

"With every treatment we have a better feel for doses and plans," Giller said. "We are encouraged with the results; some but not all of the results have been superb."

Until now infants have not been able to undergo traditional radiation treatment because of the damage it causes their fragile brains. But the Accuray technology at Zale Lipshy University Hospital is able to precisely target cancerous cells, leaving healthy tissue unharmed.

The Accuray, installed at Zale Lipshy in 1997, moves robot-like around the patient, delivering its high-beam radiation from various angles. Because this treatment had previously only been used on older children and adults, radiation technicians had to design a special bed for their three smallest patients.

What also makes Accuray appropriate for treating infants is that, unlike the older "gamma knife" technology, it requires no frame bolted onto the child's head. "Their skulls are too pliant, are still developing, and that's too much for them," said Giller, who expects the Accuray therapy for infant brain tumors to become more widely used in the near future.

Giller credits the success of this groundbreaking therapy to UT Southwestern doctors throughout the medical center. "It's very much been a multidisciplinary effort."

THE ACCURAY, INSTALLED AT ZALE LIPSHY IN 1997, MOVES ROBOT-LIKE AROUND THE PATIENT, DELIVERING ITS HIGH-BEAM RADIATION FROM VARIOUS ANGLES.

The million-dollar microscope, and then some

Very few people can clearly see structures a mere one-billionth of a meter or less in size.

UT Southwestern scientists can.

That's because in fall 2002 UT Southwestern's new $1.6 million cryo-electron microscope — after nearly a year of undergoing custom design and construction — went into action.

Acquisition of the cryo-electron microscope is expected to elevate UT Southwestern's cell-research capabilities significantly, said Dr. Richard Anderson, chairman of cell biology. Only a handful of other universities utilize cryo-electron technology, he explained.

The new microscope is expected to lead to research breakthroughs in such areas as Alzheimer's disease, nerve regeneration, spinal-cord injuries, cell biology, cellular aging and death, cancer, diabetes, and cholesterol.

Already, UT Southwestern is reaping dividends with the acquisition, having recruited internationally prominent scientist Dr. Masahide Kikkawa from the University of Tokyo's Graduate School of Medicine. The new UT Southwestern assistant professor of cell biology is widely known for his use of cryo-EM technology.

The state-of-the-art microscope allows scientists to view, analyze and computer-simulate individual molecules, clusters of molecules and other sub-cell structures, Anderson explained. That resolution, he said, is more than three times the whole-cell magnification now possible with standard electron microscopes, which typically focus down to about three nanometers — three-billionths of a meter — and typically cost $200,000 to $400,000.

"It's a great leap forward to be able to use cell biology, genetics, biochemistry and other disciplines to reveal how the genes, proteins and other functional components interact," Anderson said. "But it's another major stride to be able to see the actual sub-nanometer-size structures and the functional organization of these structures at sites in the cell where these processes take place. That's the beauty of this cryo-electron microscope and related technology."

Cryo-EM uses an ultra-fast freezing technique coupled with high-powered energy filtration and a special prism and other computer enhancements to provide three-dimensional views of cell components with a resolution unequaled by standard electron microscopes.

These are promising days for all members of cell biology.

With the new microscope and the arrival of Kikkawa, "we'll have the instrumentation; we'll have the talent; and we'll attract and develop more talent," said Anderson, who holds the Cecil H. Green Distinguished Chair in Cellular and Molecular Biology.

A guru of gadgetry

As Skip Garner will tell you, "I do gadgets."

Does he ever. Wander through his melange of gadget-laden labs, all 5,000-square feet of leading-edge clutter galore, and one recognizes that Dr. Harold "Skip" Garner and his colleagues tinker their day away with considerable industry.

And with admirable success. But, then, no less is expected from the coterie of creative minds serving in the labs of the Eugene McDermott Center for Human Growth and Development and in the Center for Biomedical Inventions. That's because the professor of biochemistry and internal medicine and his 30 research colleagues create hardware and software as well as new methodology in their quest to exploit the massive amount of emerging sequence from the Human Genome Project and the Cancer Genome Anatomy Project, among others.

"These new technologies are then applied to problems in biomedicine to validate their efficacy and to develop new knowledge in human genetics as well as all areas of biomedical research," said Garner, who holds the Philip O'Bryan Montgomery Jr., M.D., Distinguished Chair in Developmental Biology.

From idea to design and building, testing, and deploying, Garner and his team nurture their "gadgets" to maximum potential. Some will debut in the marketplace at other medical centers and research labs across the country. Sometimes an invention may even serve as a catalyst for a startup company.

Garner is no stranger to achievement. The 48-year-old scientist chose his career in the sixth grade, when, inspired by two engineer uncles, he built his first nuclear reactor — "out of cardboard." Garner holds 15 patents and has another dozen pending. His team's projects have been instrumental in helping bring more than $50 million in research grants to UT Southwestern.

Currently, Garner and his colleagues have more than 50 projects under way. Among the most prominent is a second-generation Digital Optical Chemistry program, a system developed with Texas Instruments and Affymetrix that analyzes gene components through custom DNA microarrays. It is, said Garner, a process considerably faster, more efficient and less expensive than others, and one that can significantly aid research in such areas as cancer, cardiac disease and "even bio-threat/infectious agents." A related area of exploration for Garner's lab is computational biology/informatics — in effect, making further sense and good use of the massive information gathered from gene study: sequence annotation/visualization, microarray analysis and text-data mining, for example. Garner and his researchers have created programs that facilitate the use of this information.

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— DR. HAROLD "SKIP" GARNER

Dr. Harold "Skip" Garner, reflected on a section of the holographic 3-D image projection system, one of his latest inventions.

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Dr. Dana Mathews with the PET-CT scanner.

In computational biology, there is now more raw and processed data available for biomedical researchers than they can ever comprehend," said Garner. "So we have developed tools that enable researchers to exploit all this data for their own purpose. Computational biology — you don't know what you've missed until you experience what it can do for you."

HDTV that's easy on the brain

At Zale Lipshy University Hospital, there's a new way of looking at television, and it doesn't have a thing to do with channel-surfing. The little screen's gone big in a high-definition, state-of-the-art way in one of the Zale Lipshy neurological surgery operating rooms.

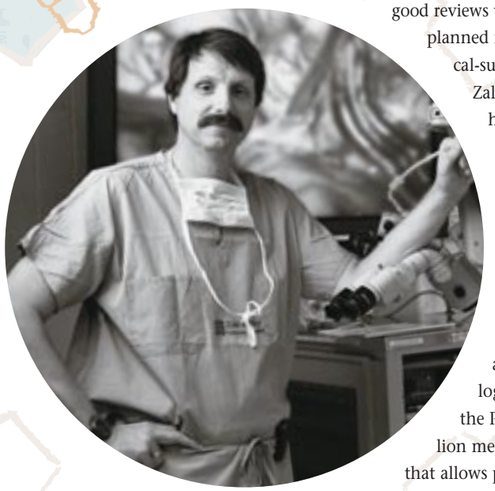
What it means is an up-close and uncommonly detailed view of brain surgery, allowing everyone in the room to see the same clear view surgeons see through their microscope when, for instance, they're looking at the brain's tiny vascular structures, where aneurysms occur.

Same clear view. Only larger. Much larger — a plasma screen 50 inches wide hanging on the wall. So significant is the HDTV's impact, surgeons say, that it's affecting their surgical technique.

"This system is primarily for the benefit of staff involved with the specific operation," said Dr. Thomas Kopitnik, professor of neurological surgery and holder of the Birsner Family Professorship in Neurological Surgery. "Now the entire operating room can see the minute details of the surgery and follow closely along."

The system, installed in 2002, was the first of its kind in the Southwest and is getting such good reviews that additional HDTVs are planned for two more neurological-surgery operating rooms at Zale Lipshy, an adult referral hospital for UT Southwestern physicians.

Dr. Thomas Kopitnik with the HDTV.



PET-CT scanner, a two-for-one bargain

UT Southwestern is among the leaders in acquiring another technological system. It's called the PET-CT scanner, a $2 million medical-imaging machine that allows physicians to simultaneously perform a positron emission tomography (PET) scan and computerized tomography (CT) scan.

PET scanners and CT scanners are not new, but performing them dually is. And that ability enables doctors to locate tumors and other abnormalities with greater precision.

The advantage of accurately comparing the two images, said Dr. Dana Mathews, associate professor of radiology and medical director of the PET facility at UT Southwestern, is that it could possibly prevent having to do more invasive and potentially painful procedures.

It also means faster diagnoses for patients.

"A PET scan analyzes metabolic changes in the body, while a CT scan shows anatomic detail," she explained. "When we have to do the scans at different times, the patient can move or be in a slightly different position and make the results harder to compare."

PET scans are traditionally used to diagnose or monitor cancer, cardiovascular disease, epilepsy and Alzheimer's disease, among other afflictions.

Tools of Technology

But for the imagination of the mind, nothing else so engages or accelerates scientific discovery and all that flows from it. Ask the parents of the babies treated by Cyberknife technology. Listen to the excitement in the voice of the scientist talking about his lab's discoveries, how they may aid in fighting cancer and heart disease. Think of the sheer marvel of a machine that under the eye of a master can break down the nanometer mysteries of matter.

These tools, be they fixtures of lab, clinic or surgical suite, may in some cases be as high-dollar as they are high-tech. But their return on investment is undeniable in their contribution to UT Southwestern's mission and the relentless pursuit of medical research, new clinical therapies and the education of young physicians and scientists — those who, with the tools of their own generation's technology, will not just embrace but extend the quest of medical science. To discover and heal. ✣