Presidential Address

Surgery is a great career

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Certainly one of the greatest honors that a surgeon can receive is to be elected President of the American College of Surgeons. I am truly grateful, and I accept this responsibility with the greatest enthusiasm.

This evening is a very special occasion for the Initiates of the College, and I extend my congratulations to you, your spouses, your families, and your friends. You have achieved an important milestone—full acceptance by your peers as an independent and respected surgeon.

I am reminded of another very special time in my life—1964, the year of my own initiation into the College—when a good many of you were still struggling with long division. I believe this occasion, when we welcome new members, ought to be a time for celebration. Thus, I hope you won't be too disappointed to hear that I'm not going to deliver a long lecture about the health care crisis in this country. Rather, I would like to share with you some of the fantastic achievements in patient care that have occurred between the time of my initiation and yours.

Nineteen hundred and sixty-four was an exciting time to be a young surgeon—especially in the fledgling field of cardiac surgery. There were many exhilarating moments, yet patient outcome was unpredictable. I remember a 70-year-old man with severe aortic stenosis upon whom I operated in February of 1965. At surgery, we removed his very calcified and stenotic aortic valve and inserted an early model 1000 Starr-Edwards valve in its place. Myocardial protection, which at that time was not well understood, was accomplished by ischemic arrest with moderate hypothermia. Although the valve procedure went smoothly, we ran into a great deal of difficulty in restoring effective cardiac function. We used almost every conceivable cardiotonic drug and, after two and one-half hours of resting the heart on cardiopulmonary bypass, we were finally able to come off bypass with very borderline cardiac function. The patient had an extremely stormy convalescence but was eventually discharged from the hospital on his 27th postoperative day. Eight months later, in spite of the usual anticoagulant therapy, he suffered a major stroke, almost certainly due to an embolus from the prosthetic valve. His days were further marked by recurrent pleural effusions and increasing congestive heart failure of which he died three years after the operation.

And do you know what? Everybody, including the patient's family, said that we had done a marvelous job. In retrospect, of course, it's clear that we have learned a great deal in cardiac surgery since 1964, so as I'll explain later, a patient with aortic stenosis can now look forward to a much brighter future with surgery.

Remembering this case made me pause and consider the magnitude of the advances in surgery since 1964, not just in my own field of cardiac surgery but also in the other specialties represented here today. I thought you might enjoy reviewing some of them with me—looking back not to the remote past, but just one generation. Because, after all, 28 years isn't a very long time. Even so, within those years, surgery has come a long way.

I hope you noticed that I said "advances in surgery" instead of "advances by surgeons," because, as you know, there's been a tremendous amount of productive dialogue and cooperation between disciplines, and many of the achievements in surgery have, of course, occurred through collaboration with basic scientists, engineers, and other physicians. Spectacular developments in diagnostics—especially in imaging technology, in anesthesiology, and in intensive care, have substantially enhanced our ability to care for our patients before, during, and after surgery.

Since I wanted to get the history straight, I asked some of my colleagues to lend me a hand. They were very generous and supplied me with many of the examples I'm going to use. I'm tremendously grateful for their help and support (see box on page 8).

Vascular surgery

In trying to decide on an order of presentation, I concluded that anatomy might be a more efficient organizing principle than the alphabet; I'm going to begin at the bottom, with the leg, a part of the body of particular concern to, among others, vascular surgeons. Today, as in 1964, a typical vascular patient might be a 65-year-old cigarette-smoking male with a history of myocardial infarction who presents with complaints of two or three weeks of ischemic rest pain as well as early gangrenous ulceration of the foot. In 1964, the surgeon would have begun the workup with a careful physical examination, including a technique known as oscillometry (basically, the application of a pressure cuff to the leg), a somewhat crude attempt to evaluate quantitatively the arterial pulses. The examination would have revealed a normal femoral pulse and no pulses distally along with signs of chronic ischemia of the foot. The surgeon would have arrived at a presumptive diagnosis of limb ischemia secondary to a superficial femoral artery occlusion, admitted the patient to the hospital, and scheduled him for an arteriogram. At the time, such an arteriogram was carried out by inserting a needle into the femoral artery and trying to reflux some contrast material with a hand injection to get an image of the iliac artery, a procedure that sometimes worked and sometimes didn't (see figure 1 on page 9). A single X ray picture was also made of the leg itself, mainly to visualize the femoral and popliteal arteries and hopefully to get some indication of the number of runoff vessels. In this case, because of the normal feeling femoral pulse and the inadequate reflux arteriogram, the surgeon would have incorrectly presumed that the iliac artery was normal and that the only significant lesion was the femoral artery occlusion. Although the advantage in patency of the saphenous vein graft over prosthetic substitutes for femoropopliteal bypass was not clear in the early 1960s, and many surgeons were using prosthetic grafts as the primary bypass, our patient underwent a femoral bypass graft to the below-the-knee popliteal artery using a reversed saphenous vein. Most likely the patient would have done well for a while.

Unfortunately, it is also likely that he would have returned to the office about six months after surgery with recurrent rest pain and gangrene; the graft had become occluded, presumably as a result of "distal disease" or "poor runoff." The surgeon would have made another attempt at revascularization, this time using a knitted dacron graft, but the second reconstruction only lasted three months, and the patient reported more severe pain. There remained no alternative but to amputate below the knee.

In 1992 the scenario is radically different. Our "typical" patient is strongly urged to stop smoking. Although the initial report by the Surgeon General warning about the health hazards of smoking came out in 1964, most Americans, including doctors, did not take it very seriously. This situation has gradually changed as more and more evidence has accumulated regarding the health problems caused by smoking. In 1965, 40 percent of adult Americans smoked cigarettes, and the percentage was increasing; in 1990 the percentage had dropped to 25.5 percent.[1,2] It is estimated that nearly half of all living Americans who smoked have now quit.[2] Vascular surgeons also can now rely on a battery of noninvasive hemodynamic measuring devices, and virtually every vascular bed in the body can be studied by totally safe means that permit accurate diagnosis. Thus, our patient now undergoes noninvasive vascular studies that demonstrate the femoral occlusion and the critical nature of the ischemia; furthermore, although the femoral pulse seems normal to palpation, the noninvasive studies identify an iliac artery stenosis. Armed with this information, the surgeon sends the patient to the vascular radiology department

Contributing colleagues

Vascular surgery
William M. Abbott
Orthopaedic surgery
William H. Harris
Henry J. Mankin
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Urology
W. Scott McDougal
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David W. Rattner
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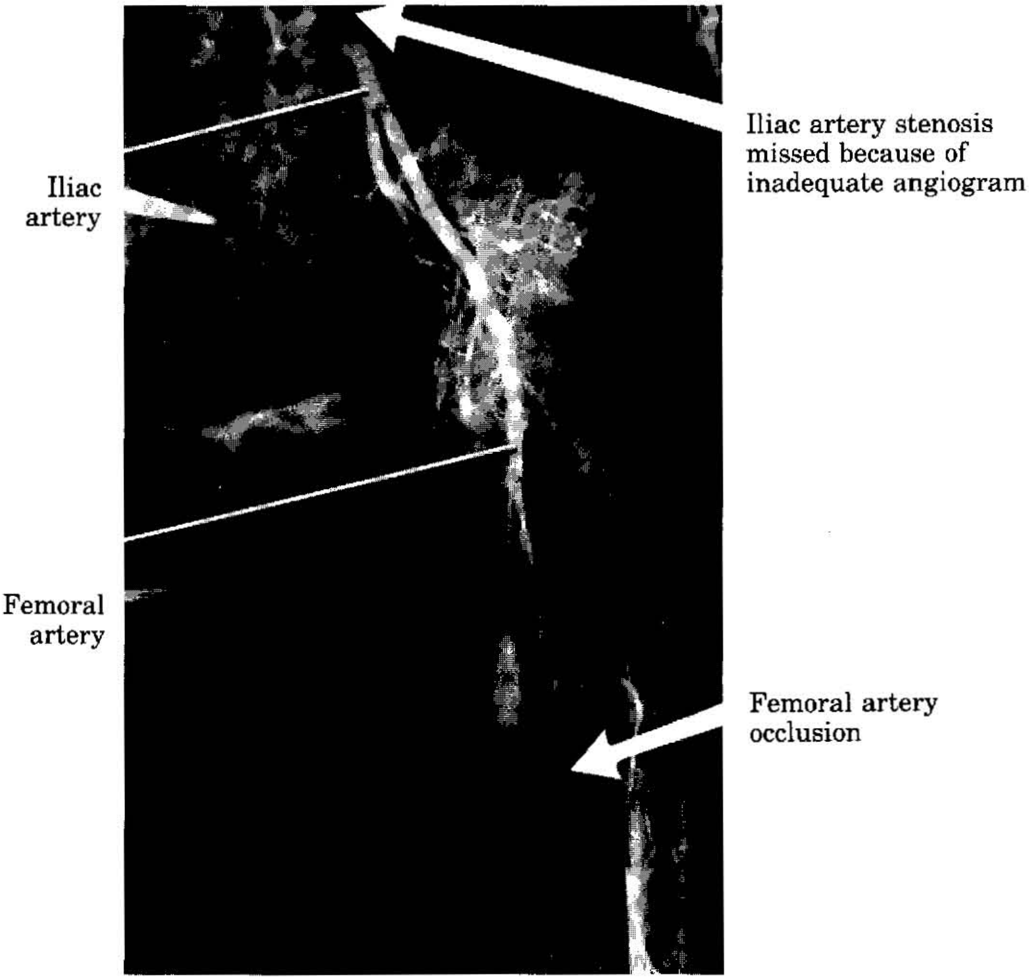
Daniel P. Ryan
Otorhinolaryngology
Joseph B. Nadol
Neurosurgery
Nicholas T. Zervas
Plastic surgery
James W. May, Jr.

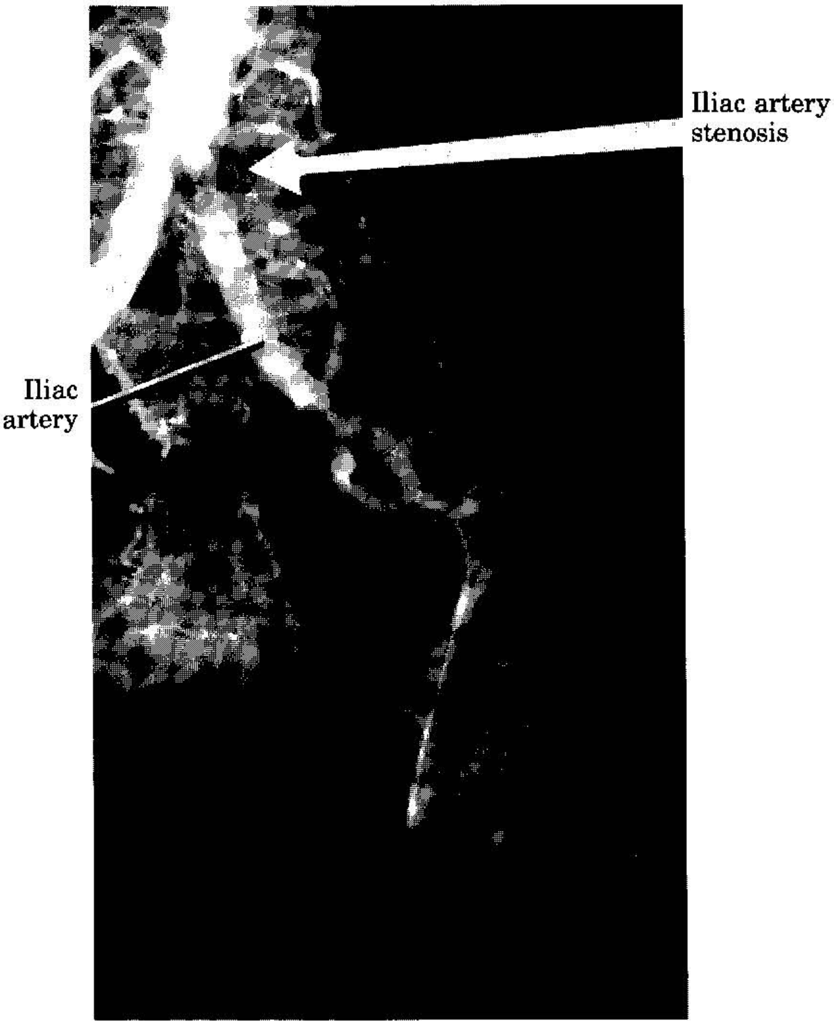
Figure 1
Angiogram, 1964



for sophisticated angiography, which illustrates in at least two planes the detailed arterial anatomy from the infrarenal aorta to the pedal vessels. The 1992 angiogram confirms and further defines the stenotic lesion in the patient's iliac artery—which the 1964 angiogram missed and which was probably responsible for the occlusion of the first vein graft (see figure 2 on page 10). Balloon angioplasty is carried out to eliminate the iliac stenosis and the reduced inflow to the leg. Laboratory studies are repeated to ensure that the inflow disease has been adequately corrected and then the patient is prepared for femoral bypass surgery.

In 1992, the surgeon is mindful of the patient's history of myocardial infarction and orders an extensive cardiac evaluation, including dipyridamole thallium scanning. In this case, because the coronary disease is only moderate, it is decided to proceed with the urgently needed vascular operation, using pulmonary artery Swann-Ganz catheter monitoring as a precaution

Figure 2
Angiogram, 1992



against myocardial problems. In contrast with what would have occurred in 1964, the operation is carried out under epidural anesthesia plus light sedation, thus minimizing the pulmonary and cardiac risks. The surgeon uses an in situ vein graft and completes the operation in about three hours, approximately half the time of the one in 1964. Postoperatively, the patient is followed regularly in the vascular laboratory; in the event that re-stenosis or occlusion occurs, if it is detected early, there is a considerable likelihood that the graft can be successfully revised or salvaged by thrombolytic therapy, a treatment that was unknown in 1964.

Altogether, then, the mortality and morbidity of vascular reconstructive surgery have been significantly reduced owing to advances in diagnostic technology and to our improved abilities to render safe and effective surgical care. Today's typical patient may expect markedly improved

Figure 3

Results of femoropopliteal reconstruction for limb salvage

	1964		1992
Conduit	Dacron	Vein	Vein
1-Year patency	45%	74%	88%
3-Year patency	30%	65%	81%
Surgical mortality	2.2%	2.0%	0.9%
Hospital stay (days)	11	14	8

1. Darling RC, Linton RR: Durability of femoropopliteal reconstructions. Endarterectomy versus vein bypass grafts. *Am J Surg*, 123(4):472-479, 1972.
2. Data from Massachusetts General Hospital Vascular Surgery Registry.
3. Abbott WM: Personal communication, 1992.

Figure 4

Results of meniscectomy

	1964 Open meniscectomy	1992 Arthroscopic meniscectomy
Hospital stay	7 days	Outpatient procedure
Return to normal nonathletic activity	6 to 8 weeks	1 week

1. Bergstrom R, Hamberg P, Lysholm J, Gillquist J: Comparison of open and endoscopic meniscectomy. *Clin Orthop*, 184:133-136, 1984.
2. Northmore-Ball MD, Dandy DJ, Jackson RW: Arthroscopic, open partial, and total meniscectomy. A comparative study. *J Bone & Joint Surg [Br]*, 65(4):400-404, 1983.
3. Patel DG: Personal communication, 1992.

results in the range of 90 percent patency at one year and 80 percent at three (see figure 3).

Orthopaedic surgery

The older surgeons among us remember the haunting picture in the early 1950s of orthopaedic wards filled with patients who were crippled by poliomyelitis, tuberculosis of the hip and spine, and hematogenous osteomyelitis. Luckily, by the 1960s, the polio vaccine and antibiotics had begun to free orthopaedists to turn their attention to other disabling or life-threatening conditions such as osteoarthritis, rheumatoid arthritis, congenital hip disease, bone tumors, and skeletal injuries.

One of the most extraordinary advances in orthopaedics has been the arthroscope, an idea so far-fetched when it was first proposed in the early part of this century that it was ridiculed: Whoever heard of peering inside a knee with an optical system? The modern clinical technique was introduced into North America by Jackson in the mid-1960s. By 1992, of course, the once improbable arthroscope has become a commonplace tool for both diagnosis and treatment of derangements of almost all joints and especially of the larger joints such as the knee and shoulder. For instance, in the knee the orthopaedic surgeon now uses the arthroscope in the diagnosis of essentially all joint derangements and to remove or repair the meniscus, to reconstruct the anterior and posterior cruciate ligaments, to carry out a complete synovectomy for rheumatoid arthritis, to stabilize intraarticular fractures and/or osteochondritis dissecans, and to remove articular and bony loose fragments. Meniscectomy provides a fine example of what orthopaedists can accomplish with the arthroscope in 1992. An outpatient procedure from which a patient can expect to return to normal nonathletic activity within one week, arthroscopic meniscectomy also gives better late results than the open procedure (see figure 4).

Millions of patients have also benefited from the advances that have occurred in joint replacement surgery. In the 1950s a patient suffering from osteoarthritis of the hip or knee, or from rheumatoid arthritis of the weight-bearing joints, could look forward to an unhappy future of braces, exercises, canes, crutches, aspirin, and pain. Between then and now, orthopaedics has progressed from arthrodesis and resections, through somewhat unreliable hemiarthroplasties or cup arthroplasties, to the present very successful total joint replacement techniques that relieve approximately 90 percent of the pa-

Figure 5
Results of total hip replacement vs. cup arthroplasty

	Mid-1960s cup arthroplasty	Early 1990s total hip replacement
Hospital stay	21 days	7 days
Good to excellent results	45%	90%
Durability	8 years	15 years

1. Aufranc OE: *Constructive surgery of the hip.* St. Louis, MO: CV Mosby Co., 1962.
2. Harris WH, Sledge CB: Total hip and total knee replacement (1). *N Engl J Med,* 323(11):725-731, 1990.
3. Harris WH: Personal communication, 1992.

tients and restore them to an almost normal life (see figure 5).

Three decades ago approximately 75 percent of patients with osteosarcoma, and nearly all patients with Ewing's sarcoma, died painful deaths within three years after the onset of symptoms.[3,4] Today, a combination of chemotherapeutic regimens, radiation therapy, and surgery ensures a better than 65 percent survival rate in both groups.[5,6] Surgical resection with either allograft or prosthetic reconstruction allows greater than 80 percent of these patients to retain their limbs with relatively good functional results.[6-8]

Urology

Among the many accomplishments in the field of urology, innovations in the diagnosis and treatment of calculus disease have produced particularly striking results. Significant ground has been gained in defining the etiology of stone formation and in prevention. The most remarkable advances, however, have occurred in the area of surgical treatment. In the 1960s a small stone of less than 0.5 centimeter could be extracted blindly with the cystoscope only if it had passed to the distal ureter, while bladder calculi could be crushed or fragmented electrohydraulically. But all other ureteral and renal calculi that did not pass were treated by open surgical techniques. These procedures were quite morbid. Average hospitalization was seven days for a ureterolithotomy and 12 days for an anatrophic nephrolithotomy (renal split procedure); patients were not able to return to work for four to six weeks postoperatively.[9]

Today, extracorporeal shock wave lithotripsy allows fragmentation of stones in the upper ureter and in the kidney itself without open surgery. This procedure may be done on an outpatient basis and in some instances without general anesthesia. Most of these patients return to work one or two days after their procedure.[10,11] Usually, stones that are not amenable to this therapy can now be removed from the ureter by ureteroscopy with laser, mechanical, and electrohydraulic lithotripsy, again avoiding open surgery and allowing the patient to return to work in two to four days.[12] In addition, large renal calculi can now be destroyed endoscopically employing percutaneous access to the kidney; these patients usually leave the hospital within three days and return to work in seven.[10]

Urology can also claim significant progress in the diagnosis and treatment of cancer of the prostate, which is the second most common solid malignancy and third most common cause of cancer death among American males. Back in the 1960s, a diagnosis of prostate cancer was suspected by digital rectal examination. Acid phosphatase when elevated suggested it was too late for surgical cure. Furthermore, the ability to obtain a pathologic specimen by biopsy was only 80 percent accurate. Thus, only 7 to 10 percent of patients who were newly diagnosed with cancer of the prostate were amenable to curative therapy. Surgical treatment at the time took the form of perineal or retropubic prostatectomy, procedures that resulted in an impotence rate exceeding 95 percent, an incontinence rate of 5 to 8 percent, and seven to 10 days of hospitalization.[13] Endocrine manipulation involved orchiectomy or the administration of estrogen.

In the 1990s, digital rectal exam with ultrasound and prostatic specific antigen (PSA) has markedly improved the urologist's ability to diagnose the disease in its early and treatable stages; it is estimated that about 30 percent of newly diagnosed patients are now amenable to curative therapy, a three- to four-fold increase.[14] Better staging became available in the 1970s with the introduction of bilateral pelvic lymphadenectomy; the technique has since been improved by utilizing the laparoscope for the node dissection, which significantly reduces the morbidity for node positive disease. Surgical treatment has kept pace with diagnostic developments. Nerve-sparing radical prostatectomy has substantially reduced morbidity: impotency rates are down to 30 percent, incontinence to 2 to 3 percent, and hospitalization is now only five to six days.[15] With better staging, the 15-year survival rate following surgery for confined disease now stands at 82 percent.[16] In patients whose cancer has spread outside the confines of the prostate, receptor inhibitors and antiandrogens can now accomplish total hormonal ablation without orchiectomy or the untoward effects of estrogen administration.

General surgery

I don't need to go back very far in time to find an example of a stunning advance in the field of general surgery—laparoscopic cholecystectomy. As you know, standard cholecystectomy used to be one of the most commonly performed general surgical procedures. Although relatively safe on an elective basis, mortality following standard cholecystectomy in the early 1960s was not unheard of (1 to 2% overall), particularly in cases of acute cholecystitis. Hospital stays of 10 to 14 days were routine, and most patients did not return to work for six weeks.

The simultaneous development of laparoscopic cholecystectomy by Reddick in the U.S. and Dubois in France was possible because of technologic advances in video systems and microsurgical instrumentation, and occurred in the context of increasingly complex gynecologic laparoscopic procedures. The rapid acceptance of laparoscopic cholecystectomy is unprecedented. Within two years of its introduction, nearly three-fourths of all practicing general surgeons had taken training courses and were performing it (see figure 6). Reddick reported excellent results in a recent series of 94 patients, nearly all of whom were elective cases: 31 were done as outpatients; of the 63 admitted to the hospital, only five required stays longer than 24 hours, and all were discharged within four days. Ninety-two of the laparoscopic procedures were successful; the remaining two patients required open surgery. There were no deaths and no major complications. All 92 patients who had undergone successful laparoscopic cholecystectomy returned to full activity within one week.[17]

Figure 6
Results of cholecystectomy

	1964	1992
Open cholecystectomy:		
Operative mortality	1-2%	0.2%
Hospital stay	10-14 days	5 days
Return to work	6 weeks	4 weeks
Laparoscopic cholecystectomy:		
Operative mortality	—	0.1%
Hospital stay	—	90% of pts, 1 day or less; rarely, up to 4 days
Return to work	—	1 week

1. Arnold DJ: 28,621 cholecystectomies in Ohio. Results of a survey in Ohio hospitals by the Gallbladder Survey Committee, Ohio Chapter, American College of Surgeons. *Am J Surg*, 119(6):714-717, 1970.
2. Glenn F, McSherry C: Etiological factors in fatal complications following operations upon the biliary tract. *Ann Surg*, 157:695-704, 1963.
3. McSherry CK: The National Cooperative Gallstone Study report: A surgeon's perspective. *Ann Intern Med*, 95(3):379-380, 1981.
4. Pickleman J, Gonzalez RP: The improving results of cholecystectomy. *Arch Surg*, 121(8):930-934, 1986.
5. Rattner D: Personal communication, 1992.

Transplantation

During the past three decades, no area of surgery has captured the imagination of the public as effectively as solid organ transplantation. In 1954, Murray and his associates performed the first successful human organ transplant, transferring a kidney from a healthy man to his uremic identical twin brother. Yet eight years later this procedure was still limited to monozygotic twin pairs. Further expansion of clinical transplantation did not occur until 1962 with the introduction of Azathioprine (Imuran) and steroid double-drug immunosuppression that produced survival rates of 40 to 50 percent in recipients of nonidentical donor kidney allografts.[18] However, the successful transplantation of other organs had to await further improvements in immunosuppression.

The early renal allograft experience demonstrated that outcome was highly dependent upon genetically determined factors. Recognition of this fact prompted the collaboration of basic scientists and surgeons in research that provided the technology of tissue typing and the identification of histocompatibility (HLA) antigens. Outcome studies showed conclusively that these HLA antigens were of overwhelming importance to the success or failure of the transplant. But unfortunately, the benefit of tissue matching has thus far been restricted predominantly to living-related kidney transplants. For unrelated donor transplants, the HLA system has proved to be so enormously polymorphic that even with a nationwide organ sharing program less than 10 percent of patients are able to receive a highly matched allograft.[19]

Accordingly, the use of more powerful nonspecific immunosuppressive agents has been responsible for much of the enormous progress in the field. Rodent model studies undertaken by Sir Peter Medawar's group and others in the mid-1960s, followed by clinical studies by Starzl and associates, Najarian and associates, and Russell and Cosimi led to the addition of antilymphocyte serum (ALS) to the clinical protocol. This event provided the triple-drug immunosuppression that finally made it possible to extend transplantation to extrarenal organs. In 1967 Starzl reported the first successful human hepatic allograft procedure. After Barnard carried out the first human heart transplant a few months later, the Shumway team patiently refined the procedure, improving the one-year survival rate for heart transplantation from 22 percent in 1968 to almost 70 percent in 1978.[20]

Unfortunately, the survival of recipients of the technically more complex liver, pancreas, and lung transplants remained highly unsatisfactory. A 1979 study showed that no patient had survived longer than 10 months after lung transplantation, and only a small percentage of patients had long-term improvement after liver or pancreas transplantation (see figure 7 on page 15). However, while this dismal report was being printed, two new elements were bursting onto the transplantation scene: Calne in Cambridge, England, reported on a new fungal metabolite called cyclosporine; shortly thereafter Cosimi's group reported on monoclonal antibody immunosuppression. The addition of these two powerful immunosuppressive agents further expanded the possibilities of transplantation and greatly improved the survival rates.

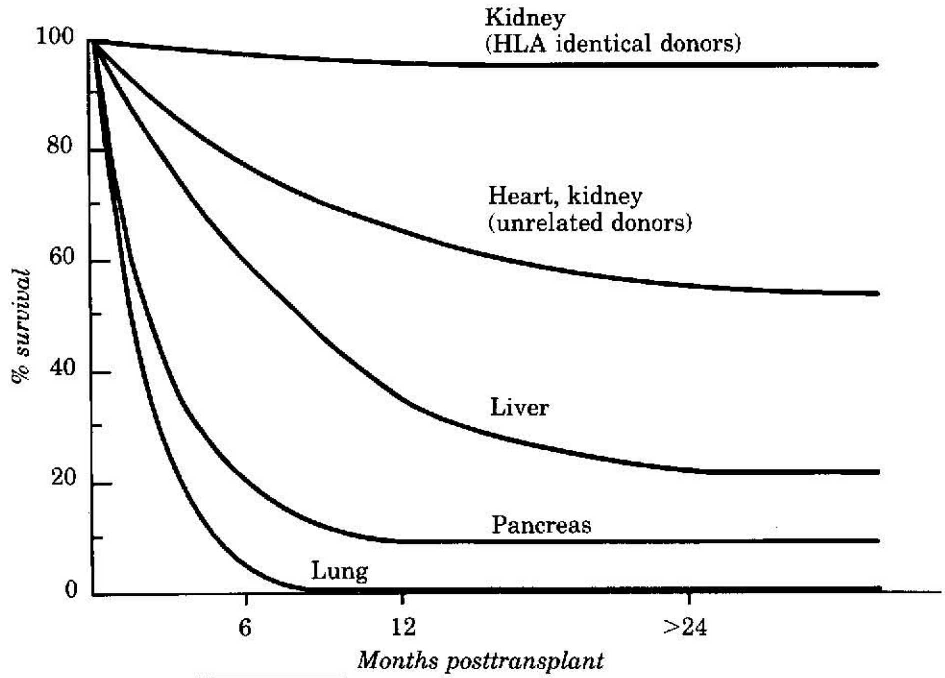
Thus, in 1981, Reitz and his colleagues performed the first successful heart/lung transplant, and Cooper and his group accomplished the first long-term successful lung transplant in 1983. In 1988 a German team performed the first successful isolated small bowel transplant, and some months later Grant and associates in Canada achieved the transplantation of the liver and in-continuity small intestine. Just this year the Starzl group reported 10 of 11 survivors in a consecutive series of small bowel transplantations using the new immunosuppressive drug FK506. Figure 8 on page 16 shows the much improved recent one-year patient and graft survival rates for organ transplants.

Cardiac surgery

Do you remember that patient I told you about earlier on—the man with severe aortic stenosis who nearly died in the operating room back in 1965? I can assure you that such a patient enjoys considerably brighter prospects today. The field of valvular cardiac surgery has come a long way since 1960 when Starr and Harken, working independently, first inserted caged-ball prostheses in patients in the mitral and aortic positions, respectively.

In the intervening years, more than 36 different mechanical cardiac valvular prostheses have been developed and implanted in patients in the United States. Of these, four mechanical prostheses are currently approved by the FDA—the Starr-Edwards silastic ball in stellite cage Models 1260 and 6120; the Medtronic-Hall single tilting disk prosthesis; the St. Jude Medical bileaflet valve; and the Omniscience single tilting disk valve. In addition, a variety of tissue valve sub-

Figure 7
Patterns of survival of transplanted organs in 1979 using triple-drug immunosuppression



Adapted from Russell PS, Cosimi AB: Transplantation. *N Engl J Med*, 301(9):470-479, 1979.

stitutes have been developed; those most commonly used at present are the Hancock and the Carpentier-Edwards glutaraldehyde-preserved porcine xenograft prostheses, the bovine xenograft pericardial valve, and the cryopreserved aortic homograft valve. While the present heart valve substitutes are not perfect in that the mechanical valves still have some thromboembolism and anticoagulant-related hemorrhage problems, and the tissue valves have some late durability problems, the present valve substitutes are much better than what was available in the early 1960s, and they are very good indeed.

In addition to improved valve replacements, there has been tremendous progress in our understanding of how to protect the heart during cardiac surgery. In 1950, Bigelow described the protective effects of hypothermia. In 1955, Melrose reported diastolic cardiac arrest with potassium citrate and prompt recovery of myocardial function with reperfusion, but unfortunately the potassium citrate solution used was hypertonic and tissue damage was noted by other investigators. In the early 1960s, none of the various different techniques employed gave satisfactory myocardial protection. In 1973 Gay and Ebert pointed out the importance of a moderate concentration of potassium chloride and an isotonic solution to achieve cardiac arrest. Together, deep hypothermia and potassium cardioplegic arrest have allowed greatly improved operative conditions and excellent myocardial recovery. Appreciating the potential nutritive effects of the cardioplegia solution given in multidose fashion, blood, oxygen, and metabolic substrates have been added. In addition, Buckberg and others have demonstrated that altering the conditions of reperfusion considerably decreases the severity of ischemic injury. Retrograde cardioplegia delivery into the coronary sinus may help cir-

Figure 8
Current one-year survival rates for organ allograft recipients

Organ	Patient survival rate	Graft survival rate
Kidney (CD)	92%	78%
Kidney (LRD)	97%	90%
Pancreas	91%	72%
Liver	76%	68%
Heart	84%	83%
Heart-lung	61%	61%
Lung	67%	67%

Adapted from Registry Reports in: *Clinical Transplants 1991*, UCLA Tissue Typing Laboratory, Terasaki PI, Cecka JM (eds), p. 1-44.
CD = Cadaver; LRD = Living related donor.

Figure 9
Aortic valve replacement
Elective procedure—First operation

Characteristics	Mid 1960s	Early 1990s
Average patient age	50-55 yrs	65-70 yrs
Length of operation	6-7 hrs	3-4 hrs
Hospital mortality	10-15%	2-3%
Postoperative hospital stay	14 days	7 days
Thromboembolic rate (mechanical valves)	4-5%/pt-yr	1-2%/pt-yr

1. Herr RH, Starr A, Pierie WR, et al: A review of six years' experience with the ball-valve prosthesis. *Ann Thorac Surg*, 6:199-218, 1968.
2. Cooley DA, Bloodwell RD, Beall AC, et al: Total cardiac valve replacement using SCDK-Cutter prosthesis: Experience with 250 consecutive patients. *Ann Surg*, 164:428-444, 1966.
3. Effler DB, Favaloro R, Groves LK: Heart valve replacement: Clinical experience. *Ann Thorac Surg*, 1:4-24, 1965.
4. Akins CW, Carroll DL, Buckley MJ, et al: Late results with Carpentier-Edwards porcine bioprosthesis. *Circulation*, 82(Suppl IV):IV65-IV74, 1990.
5. Akins CW: Mechanical cardiac valvular prostheses. *Ann Thorac Surg*, 52:161-172, 1991.
6. "End results in cardiac surgery," Massachusetts General Hospital, Boston, MA, unpublished data.

cumvent coronary occlusions and improve the distribution of cardioplegic solutions. Recently, Lichtenstein and co-workers have shown that excellent myocardial protection can be obtained with normothermic arrest of the heart with the technique of continuous warm blood cardioplegia. Many others have made key contributions.

In the mid-1960s, when I operated on the man I mentioned earlier, the operative mortality for an elective aortic valve replacement was 10 to 15 percent, and it was very common for patients to suffer severe cardiac dysfunction initially following surgery. Today the operative mortality for such a patient is 2 to 3 percent, and significant cardiac dysfunction following isolated aortic valve replacement is rare. Improved valve prosthetics have drastically reduced the incidence of late emboli. We expect these patients to lead essentially normal lives (see figure 9).

Before I leave the subject of cardiac surgery, I want to say a few words about the treatment of coronary artery disease because there have been so many changes and improvements. In 1964 there was really no effective interventional therapy. Some cardiac surgeons were doing Vineberg procedures, and a few coronary endarterectomies were being carried out—all with, at best, equivocal results. Coronary artery bypass surgery actually began that same year with Garrett in Houston who used a saphenous vein graft in a patient but didn't report it until much later. Meanwhile, Sones at the Cleveland Clinic was developing cine coronary angiography. Favaloro's report of the procedure in 1967 marked the formal dawning of the age of coronary artery bypass surgery.

The employment of reversed segments of saphenous vein to bypass severely blocked coronary arteries gradually gave way to the use of the internal mammary arteries (in combination with reversed saphenous veins) as pioneered by Green in New York; this approach has proved to have a patency of 90 to 95 percent at 10 years—compared with 65 percent for vein grafts.[21,22]

Whereas early operations were customarily directed at revascularizing one or two severely stenosed arteries in very symptomatic patients with

Figure 10
Coronary artery bypass
Elective procedure—First operation

Characteristics	Late 1960s	Early 1990s
Average patient age	~50 yrs	65-70 yrs
Length of operation	6-7 hrs	3-4 hrs
Average number grafts per patient	2	4
Hospital mortality	7-15%	1-2%
Postoperative hospital stay	14 days	6-7 days

1. Favaloro RG: Saphenous vein graft in the surgical treatment of coronary artery disease. *J Thorac Cardiovasc Surg*, 58:178-185, 1969.
2. Green GE, Spencer FC, Tice DA, Stertzer SH: Arterial and venous microsurgical bypass grafts for coronary artery disease. *J Thorac Cardiovasc Surg*, 60:491-503, 1970.
3. Johnson WD, Lepley D: An aggressive surgical approach to coronary disease. *J Thorac Cardiovasc Surg*, 59:128-138, 1970.
4. Kirklin JW, Naftel DC, Blackstone EH, Pohost GM: Summary of a consensus concerning death and ischemic events after coronary artery bypass grafting. *Circulation*, 79(6 Pt 2):I81-I91, 1989.
5. Akins CW: Hypothermic fibrillatory arrest for coronary artery bypass grafting. *J Cardiac Surg*, (in press).
6. "End results in cardiac surgery," Massachusetts General Hospital, Boston, MA, unpublished data.

good left ventricular function, the average number of vessels grafted at operation now is approximately four, and in spite of the increasing age of the patients, the operative mortality has decreased markedly (see figure 10).

Pediatric surgery

Here I'll take a detour from my somewhat erratic journey up the human body to talk about what's happened in the surgical treatment of children. The establishment of a specialty journal, *The Journal of Pediatric Surgery* in 1966, and the decision by the American Board of Surgery in 1974 to award certificates of special competence in pediatric surgery, helped tremendously to focus attention on the surgical problems of children. Specially trained pediatric anesthesiologists have allowed longer, more complex reconstructions and routine day care surgery. The development of pediatric intensive care units and the subspecialties of pediatric critical care and neonatology have vastly improved survival rates of premature infants.

In 1964 infants with respiratory distress were usually given only supplemental oxygen. Occasionally, the sickest infants in some centers were placed on a respirator, but most died. Endotracheal tubes and ventilators were technologically primitive and could not be used for very long without complications. In fact, many of the concepts regarding the respiratory care of all patients, adult and infant, were still in the laboratory phase. Among them was the spiral coil silicone membrane lung, which was developed by Kolobow and associates at the NIH who correctly thought that many of the problems caused by cardiopulmonary bypass were due to the oxygenators that were available at that time.

Extracorporeal membrane oxygenation (ECMO) presented the possibility of treating severe lung disease and respiratory failure for prolonged periods while allowing the lung injury to heal. Results in the 1970s suggested that ECMO had no advantage over conventional care in the treatment of adults with severe respiratory failure. However, after achieving the first success in an infant in 1975, Bartlett employed the technology in the treatment of a series of infants and had excellent outcomes, while developing circuit components and monitoring systems to improve ECMO's safety. The survival rate of over 6,000 infants worldwide who were treated with ECMO since 1984 is 83 percent—a number that gains meaning when you consider the fact that infants are not candidates for ECMO treatment unless they meet established criteria for 80 to 90 percent mortality.[23] Infants with meconium aspiration syndrome have nearly 93 percent survival, with respiratory distress syndrome 85 percent, and with neonatal sepsis complicated by respiratory failure and persistent fetal circulation usually due to group B strep 77 percent. Infants with congenital diaphragmatic hernia who have severe respiratory failure and pulmonary hypertension remain the most difficult patients to treat, but instead of a near hopeless situation without ECMO, 63 percent survive.[23] These successes with infants have prompted the reevaluation of ECMO for treatment of older children and adults.

Improvements in the treatment of nephroblastoma (Wilms' tumor), which is the second most common extracranial solid malignancy among children, represent one of the most heartening accomplishments in pediatric surgery. In the early 1960s the two-year disease-free survival rate, a 95 percent predictor of cure, in children with a diagnosis of Wilms' tumor ranged from 34 to 47 percent.[24-27] Presence of metastatic disease was invariably associated with death. At that time, a child presenting with an abdominal mass underwent contrast studies including vena cavography with concomitant IVP and often an arteriogram. These radiographic studies carried a certain morbidity, particularly among small children in whom arterial occlusion from vascular spasm or endothelial flaps occurred at a rate approximating 15 percent; furthermore, the diagnosis of Wilms' tumor was incorrect in 5 to 8 percent of the cases with neuroblastoma being the most common source of error.[28,29] If a Wilms' tumor was suspected, the child was taken to the operating room where a radical nephrectomy was attempted. Twenty percent of the lesions were considered inoperable owing to the size of the tumor or its extension into nearby vital structures, a finding that was essentially a death sentence. Because surgery was considered the only curative treatment, radical excision was the norm. Retroperitoneal lymph node dissection was recommended, and excision of contiguous structures involved by the tumor was accomplished with some morbidity and mortality. Once the tumor was out, high-dose external irradiation was administered to the abdominal bed, and a few centers also used chemotherapy in an effort to prevent or to control metastatic disease.

Today, a child with an abdominal mass is evaluated by ultrasound and CT-scan, and Wilms' tumors are rarely misdiagnosed. Although surgery remains the primary treatment of Wilms' tumor, chemotherapy has been found to be extremely effective as well, and the operative approach is now much less aggressive. The radical excisions that were performed to try to remove all intraabdominal disease are no longer considered necessary, and a limited lymph node dissection essential for appropriate staging has replaced the former extensive retroperitoneal lymphadenectomy. Intraabdominal radiation has been eliminated in patients without evidence of intraabdominal metastases. The recently reported and ongoing National Wilms' Tumor Study has documented a two-year disease-free survival rate of 88 percent in children in all stages of disease.[30] Additionally, a combined treatment strategy of surgery, chemotherapy, and radiation therapy has markedly increased disease-free survival in children with metastatic disease to 83 percent.[30] Recently, the gene for the familial form of Wilms' tumor has been cloned by Housman and associates. This genetic marker may lead to earlier diagnosis of Wilms' tumor in families at risk and should give us a broader understanding of the etiology of embryonic tumors of childhood.

Otorhinolaryngology

The practice of otorhinolaryngology has also made tremendous progress during the last 28 years. Particularly striking have been the developments in otology. The emphasis on reconstruction and restoration of function in otology is epitomized by the evolution of surgery for otosclerosis, a dysplasia of the otic capsule of unknown etiology that produces serious conductive hearing loss in one in 100 individuals. Prior to 1960, this condition was usually treated by mastoidectomy and fenestration of the lateral semicircular canal, a procedure that resulted in significant morbidity, including vestibular dysfunction in many patients, and sometimes complete deafness.[31,32] The introduction of stapedectomy with the use of the operating microscope, microdrills, and laser technology now permits surgery with minimal morbidity resulting in elimination of conductive hearing loss in over 90 percent of patients.[33] The procedure takes about an hour and is usually done on an outpatient basis.

Major advances have also been achieved in the rehabilitation of profound sensorineural deafness. The elucidation of neural coding in the first order auditory nerve by Kiang provided the basis for a neural prosthesis to bypass the nonfunctional inner ear. The single channel electrical stimulation developed by House, which provided sound awareness, has been replaced by multichannel cochlear implants that commonly produce open set speech discrimination without the aid of lip reading.

Neurosurgery

The changes that have occurred in neurosurgery in the last three decades have been absolutely astounding. I remember being the general surgical resident rotating onto neurosurgery in the spring of 1957 and being very unhappy because all 15 postoperative craniotomy patients were comatose. There was no one to talk to! Almost everything in neurosurgery has changed since then, and now most neurosurgical patients make uneventful recoveries following surgery. Let me use the treatment of brain aneurysms and arteriovenous malformations as examples. In the early 1960s, most operations for aneurysms and arteriovenous malformations carried a very high mortality and morbidity. Then, in 1962, Jacobson and Donaghy introduced microsurgery to neurosurgery and spawned a new generation of neurosurgeons. Great strides have also been made in neuroradiology—CT scanning, magnetic resonance imaging, and vascular imaging. These advances coupled with the prevention of perioperative brain swelling by the use of corticosteroids, dehydrating agents such as Mannitol, and hyperventilation have changed everything.

The long-term satisfactory outcome for aneurysms of the anterior circulation in good grade patients has increased from approximately 50 to 60 percent to 90 percent, and operative mortality has fallen from 20 to 37 percent to 1 percent (see figure 11). Aneurysms of the posterior circulation, which were once considered virtually inoperable, can now, in most cases, be successfully obliterated.

New percutaneous catheter techniques with detachable balloons and fine metallic spring coils have shown great promise in the treatment of aneurysms and arteriovenous fistulas. Some arteriovenous fistulas can also be handled with carefully placed embolic materials. Neurosurgeons have also turned to intense focused radiation (radiosurgery) to eliminate small to moderate-sized AV malformations. These radiosurgical techniques—especially proton beam radiation—have been used very successfully to eradicate lesions under 3 centimeters in size, which, because of their location, had previously been considered untreatable.

Figure 11
Operative results for intracranial aneurysms

Good grade patients

Location of aneurysms	Early 1960s	1992
Anterior circulation		
Mortality	20-37%	1%
Morbidity	10%	4%
Posterior circulation		
Mortality	(Virtually	2-3%
Morbidity	inoperable)	6-8%

1. McKissock W, Paine KW, Walsh LS: An analysis of the results of treatment of ruptured intracranial aneurysms. Report of 772 consecutive cases. *J Neurosurg*, 17:762-766, 1960.
2. Kassell NF, Torner JC, Haley EC Jr, et al: The International Cooperative Study on the Timing of Aneurysm Surgery. Part 1: Overall management results. *J Neurosurg*, 73(1):18-36, 1990.
3. Zervas N: Personal communication, 1992.

Plastic surgery

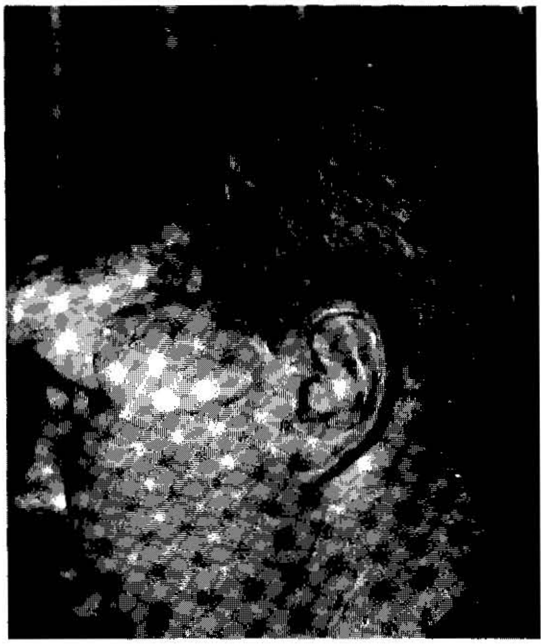
In the late 1950s, Sir Harold Gillies observed that "plastic surgery is a constant battle between blood supply and beauty."[34] The realization that many anatomical regions were supplied by vascular pedicles that could be completely divided and reanastomosed, with the ability of the transferred tissues to tolerate the temporary ischemic insult, set the stage for the first successful elective microvascular free skin flap transfer by Daniel and Taylor in 1973. Since then microsurgical free tissue transfer principles have been applied successfully to move many other tissues such as muscle, nerve, bone, as well as composite tissues such as an entire toe.

To give you a more vivid idea of what plastic surgeons can now achieve, I'm going to present a brief case history. On March 10, 1971, a 32-year-old construction worker was struck on the head by a 20-foot-long four-by-four that had fallen from the top of a 20-story building. The man was rushed to the Massachusetts General Hospital for treatment. At the time of injury, the patient had severe subdural and epidural hematomas, a skull fracture, a right temporal lobe hematoma, and a severe cerebral contusion, which required emergency bifrontal craniotomies. Ultimately, the bifrontal bone was lost, leaving the patient with a very severe deformity.

Over the next nine years, this patient underwent a total of 18 operations designed to reconstruct his anterior cranium, using then conventional techniques of split thickness skin grafts and local and distant pedicle flaps. Figure 12 is a photograph showing how the patient looked after all these operations.

In September 1980, James May reconstructed the patient's anterior head employing microvascular techniques and carrying out a latissimus dorsi free tissue transfer in a single stage to the anterior cranium. The flap was fashioned so that the hair from the patient's back would mimic scalp hair in the reconstructed position. The thoracodorsal artery and vein were anastomosed to the temporal artery and vein, as shown in Figure 13 on page 21. Figure 14, a late postoperative picture, illustrates the dramatic improvement with this one operation accomplished by using a breakthrough technique that is now, of course, standard treatment.

Figure 12
Photograph of patient after 18 operations using conventional techniques of split thickness skin grafts and pedicle flaps



Conclusion

Although I have just scratched the surface of the list of achievements, I hope these examples have given you some insights into how much more effectively we care for our patients now than was possible just a few years ago in 1964.

The advances have not been cheap. Contemporary research is costly with respect to both personnel and equipment. So, too, is clinical practice. Heart, liver, lung, and pancreas transplantation, coronary bypass surgery, ECMO support, microvascular surgery—all are very costly and none was available in 1964.

The high costs of treatment crop up frequently in discussions about the problems of our health care system. We are also reminded of the 35 million uninsured Americans who have inadequate access to medical care, an injustice that must be corrected. As physicians, we are painfully conscious of the maze of regulations and the frustrating issues surrounding the medical malpractice situation. These are all very serious problems, and we as responsible surgeons should participate in the design of their solutions.

As we engage in the debate, it is important for us to help a confused public differentiate between the legitimate costs of medical care and questionable expenditures such as those caused by excessive administrative overhead, unnecessary services, and the inflated costs created by our legal system. We must make certain that our patients and our elected representatives in Washington understand that continued investment in basic and clinical research, in technological development, and in human expertise is a sound decision.

Figure 13
Schematic representation of latissimus dorsi skin muscle flap procedure

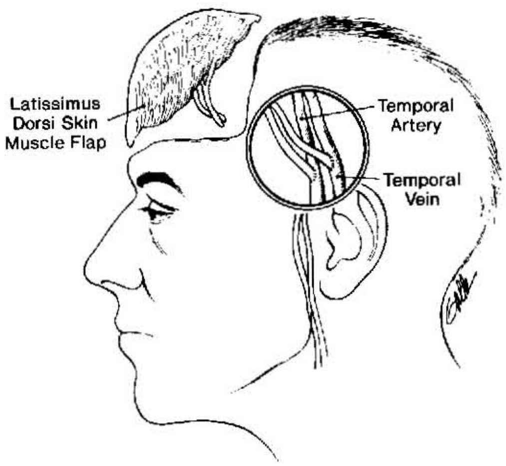


Figure 14
Late postoperative photograph of patient after one procedure—a latissimus dorsi skin muscle flap

When doctors are being assailed every day by complaints about the problems of our health care system, it is easy for us to lose sight of the tremendous progress that has been made in the care of patients, and how much better our diagnostic and therapeutic results are today than they were just a short time ago. Indeed, as I think of all the marvelous improvements in patient care that have occurred in recent years, I feel grateful to be a surgeon, and I am very proud of our profession. Surgery is a great career that gives us an opportunity to relieve the suffering of others; we can do that much better today than we could 28 years ago, and I have no doubt that you will do it vastly better 28 years from now.

As we look back with pride at the accomplishments of the past, and anticipate with excitement the advances yet to come, we should remind ourselves to use these achievements wisely and to listen to our patients, answer their questions fully, and show our concern for their welfare, for there is no substitute for human attention and compassion. And please remember that when all is said and done, the quality of patient care is still the most important thing!

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References

1. The Surgeon General's 1989 Report on Reducing the Health Consequences of Smoking: 25 Years of Progress. *Morb Mortal Wkly Rep*, 38 (Suppl 2):1-32, 1989.
2. Centers for Disease Control: Cigarette smoking among adults—United States, 1990. *JAMA*, 267(23):3133, 1992.
3. Goorin AM, Abelson HT, Frei E III: Osteosarcoma: 15 years later. *N Engl J Med*, 313(26):1637-1643, 1985.
4. Jaffe N: Chemotherapy for malignant bone tumors. *Ortho Clin No Am*, 20(3):487-503, 1989.
5. O'Connor MI, Pritchard DJ: Ewing's sarcoma. Prognostic factors, disease control, and the re-

emerging role of surgical treatment. *Clin Ortho,* 262:78-87, 1991.
6. Mankin HJ: Personal communication, 1992.
7. Mankin HJ, Gebhardt MC, Tomford WW: The use of frozen cadaveric allografts in the management of patients with bone tumors of the extremities. *Ortho Clin No Am,* 18(2):275-289, 1987.
8. Simon MA, Aschliman MA, Thomas N, Mankin HJ: Limb-salvage treatment versus amputation for osteosarcoma of the distal end of the femur. *J Bone & Joint Surg [Am],* 68(9):1331-1337, 1986.
9. Smith MJV: Anatrophic nephrolithotomy. In: Roth RA, Finlayson B (eds): *Stones, clinical management of urolithiasis.* Baltimore, MD: Williams and Wilkins, p. 349-371, 1983.
10. McDougal WS: Personal communication, 1992.
11. Chaussy C, Schmiedt E, Jocham D, et al: First clinical experience with extracorporeally induced destruction of kidney stones by shock waves. *J Urol,* 127(3):417-420, 1982.
12. Dretler SP, Keating MA, Riley J: An algorithm for the management of ureteral calculi. *J Urol,* 136(6):1190-1193, 1986.
13. Jewett HJ, Bridge RW, Gray GF Jr, Shelley WM: The palpable nodule of prostatic cancer. Results 15 years after radical excision. *JAMA,* 203(6):403-406, 1968.
14. McDougal WS: Personal communication, 1992.
15. Walsh PC, Donker PJ: Impotence following radical prostatectomy: Insight into etiology and prevention. *J Urol,* 128(3):492-497, 1982.
16. Lepor H, Kimball AW, Walsh PC: Cause-specific actuarial survival analysis: A useful method for reporting survival data in men with clinically localized carcinoma of the prostate. *J Urol,* 141(1): 82-84, 1989.
17. Reddick EJ: Laparoscopic cholecystectomy after the learning curve. *Surg Tech Internatl,* 1:248-249, 1991.
18. Russell PS, Winn HJ: Transplantation II. *N Engl J Med,* 282(15):848-854, 1970.
19. Takemoto S, Terasaki PI, Cecka JM, et al, for the UNOS Scientific Renal Transplant Registry: Survival of nationally shared, HLA-matched kidney transplants from cadaveric donors. *N Engl J Med,* 327(12):834-839, 1992.
20. Jamieson SW, Stinson EB, Shumway NE: Cardiac transplantation in 150 patients at Stanford University. *Br Med J,* 1(6156):93-95, 1979.
21. Green GE, Stertzer SH, Reppert EH: Coronary arterial bypass grafts. *Ann Thor Surg,* 5:443-450, 1969.
22. Loop FD, Lytle BW, Cosgrove DM, et al: Influence of the internal mammary artery graft on 10-year survival and other cardiac events. *N Engl J Med,* 314:1-6, 1986.
23. Stolar CJ, Snedecor SM, Bartlett RH: Extracorporeal membrane oxygenation and neonatal respiratory failure: Experience from the extracorporeal life support organization. *J Pediatr Surg,* 26(5): 563-571, 1991.
24. Gross RE, Neuhauser EBD: Treatment of mixed tumors of kidney in childhood. *Pediatrics,* 6:843-852, 1950.
25. Garcia M, Douglass C, Schlosser JV: Classification and prognosis in Wilms' tumor. *Radiology,* 80:574-580, 1963.
26. Westra P, Kieffer SA, Mosser DG: Wilms' tumor: A summary of 25 years of experience before actinomycin-D. *Am J Roentgenol Radium Ther Nucl Med,* 100(1):214-221, 1967.
27. Sutow WW, Gehan EA, Heyn RM, et al: Comparison of survival curves, 1956 versus 1962, in children with Wilms' tumor and neuroblastoma. Report of the Subcommittee on Childhood Solid Tumors, Solid Tumor Task Force, National Cancer Institute. *Pediatrics,* 45(5):800-811, 1970.
28. Lister J, Levick RK: Errors in diagnosis in Wilms' tumor. *J Pediatr Surg,* 1(5):488-497, 1966.
29. D'Angio GJ, Evans AE, Breslow N, et al: The treatment of Wilms' tumor: Results of the national Wilms' tumor study. *Cancer,* 38(2):633-646, 1976.
30. D'Angio GJ, Breslow N, Beckwith JB, et al: Treatment of Wilms' tumor. Results of the Third National Wilms' Tumor Study. *Cancer,* 64(2):349-360, 1989.
31. Davis H, Walsh TE: Limits of improvement of hearing following fenestration operation. *Laryngoscope,* 60:273-295, 1950.
32. House HP: Fenestration operation: Survey of 500 cases. *Ann Otol Rhin & Laryngol,* 57:41-54, 1948.
33. Houck JR, Harker LA, McCabe BF: Otosclerosis. In: Cummings CW et al (eds): *Otolaryngology head and neck surgery.* St. Louis, MO: CV Mosby Co., p. 3095-3112, 1986.
34. Gillies H, Millard DR Jr: *The principles and art of plastic surgery.* Boston, MA: Little, Brown & Co., Vol. 1, p. 49, 1957.

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