THE AMERICAN SOCIETY FOR RECONSTRUCTIVE MICROSURGERY

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RECONSTRUCTIVE MICROSURGERY

Inside this issue:

What's New in Reconstructive Microsurgery and Complex Reconstruction?

Geoffrey L. Robb, MD, FACS
2005 Program Chairman

Introduction

The 21st Annual Meeting of The American Society of Reconstructive Microsurgery held at the Wyndham El Conquistador Resort in Fajardo, Puerto Rico in January 2005 presented a stimulating departure from the traditional meeting schedule and gave us some cutting edge insights into modern advancements in microsurgery and complex reconstruction.

Head and Neck

Head and neck reconstruction continues to provide us some of the more stimulating, innovative, and varied approaches to complex reconstruction of the maxilla and mandible, as well as to general facial reconstruction. The importance of long term outcomes was also emphasized in a number of studies. Boehmler addressed the reconstruction of large maxillectomy defects with the rectus abdominis muscle in association with a vascularized free rib for a composite flap intended for large complex maxillectomy defects. He found that the use of this flap eliminated the need for a secondary bone graft harvest site and the bone retained its vascularity facilitating a more stabilized and infection-resistant reconstruction. This composite design provided all of the necessary elements needed for reconstructing maxillectomy defects and maintained its stability over a several year period in follow-up.

Yazar and Fu-Chan Wei in their review of double free flaps for extensive composite defects demonstrated a lower survival rate and survival time in recurrent cancer patients so their reconstruction strategy in recurrent cancer is changing from the use of complicated double free flaps to simpler single soft tissue free flaps. The double free flap reconstruction for extensive defects in the head and neck continues to be a viable option after advanced primary cancer excisions.

Anatomical studies are the life blood of innovations in our specialty. Agarwal et al demonstrated the vast cutaneous territory and the composite tissue flaps available using the lateral femoral circumflex system to design a variety of chimeric composite tissue flap reconstructions. A large common vascular origin allows for a single stage reconstruction and a decreased complexity of the microvascular anastomosis.

Hofer further refined the concept of the facial artery perforator flap demonstrating good cosmetic and functional results in a one-stage procedure based on the reliable presence of perioral and mid cheek-facial artery perforators which allow a large arc of rotation and a reasonable donor site closure.

Our ability to facilitate better functional outcomes in head and neck

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Incoming President Chris Pederson, MD (left) with outgoing President Robert Walton, MD.

Is There a Standard of Care in Microsurgery?

EDITOR'S MESSAGE

A. Lee Dellon, MD

As you are reading this, it is time for my 35th medical school reunion, which comes during my 27th year in private practice as a Plastic Surgeon. Standards of care have involved my life daily as a physician, and yet I have never asked the question, "Is there a standard of care in microsurgery?" This question has become more prominent in my thoughts lately. Even now the program committee for ASRM begins its critical task of compiling panels, special speakers, instructional courses, and the ubiquitous, seemingly endless, string of simultaneous podium presentations. Will there be any presentations devoted to ethics and standard of care issues in microsurgery? ***Did you know that now a certain number of CME credits in these areas are required to maintain your medical license?*** In February, I obtained my medical license in the state of Nevada. (!!! But that is another story.) My medical license renewal, due to my last name starting with the letter "D", will be in June of 2005. Yet by then, in order for me to renew my license I must have not just a certain number of CME credits (no problem there, while indeed I probably earn 1 hour of CME in Category II just for writing this editorial), ***but some of these CME credits must be in bioterrorism and ethics.*** (Would that be a single course or two separate courses? And, by the way my edition of "spellcheck" does not recognize "bioterrorism" as a word!)

Just yesterday, March 10, 2005 (the deadline for submitting this article), while I was attending the 63rd annual meeting of the American College of Foot and Ankle Surgeons (Podiatric Physicians), one doctor, a residency program director at a major teaching facility, told me that, after he had participated in one of my Advanced Lower Extremity Peripheral Nerve Workshops, he was inspired to take a microsurgery workshop given by a retired neurosurgeon at his state university. The foot and ankle surgeon's goal was to be able to do an internal neurolysis, if indicated, in the posterior tibial nerve, and be able to repair a posterior tibial vessel if injured during foot and ankle surgery. *These are noble goals.* At this same meeting, a surgeon, on the program of the Peripheral Nerve Surgery session, wondered aloud "if it was now the "standard of care" to do nerve decompressions in the patient with symptomatic diabetic neuropathy". On the same program was a "pro and con" session on Morton's neuroma. The question to be debated, "Treatment of Morton's Neuroma: Neuroma resection versus neurolysis?"

Many of the subjects we present, discuss and write about do relate to standard of care; we just do not think of them in that context.

There is much to editorialize from the above paragraph, and indeed it is hard to know where to begin. ***Members of ASRM are not only excellent technical surgeons, but are all involved with surgical education and advancing the state of knowledge in our chosen fields of surgery using microsurgical techniques.*** Is it not time we addressed the concept of standard of care in Microsurgery? Is it not time that the focus of at least one of our panels at every meeting relate to this theme? We must recognize not only that ethics and standard of care issues are something we should address ourselves but also that our governing medical bodies are mandating that now is the time to include these subjects in our CME-related activities.

Many of the subjects we present, discuss and write about do relate to standard of care; we just do not think of them in that context. For example, I recently was asked to write a discussion relating to a paper on iatrogenic nerve injuries. Is this not a standard of care issue? I recently wrote a paper relating to an algorithm for management of the patient with a peroneal nerve palsy following total knee arthroplasty. Is this not a standard of care issue? When an instructional course out-

RECONSTRUCTIVE MICROSURGERY

The mission of the American Society for Reconstructive Microsurgery is to promote, encourage, foster and advance the art and science of reconstructive micro-neurovascular surgery; and to establish a forum for teaching, research and free discussion of reconstructive microsurgical methods and principles among members.

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lines the evidence base, or lack thereof, for use of heparin, aspirin, indwelling monitoring catheters, loupes versus a microscope... are these not standard of care issues? When we advocate the use of a pneumatic tourniquet or bipolar coagulation, are these not standard of care issues? When we indicate that an electrical stimulator be used if a motor nerve problem is likely to occur during a certain operation, is this not a standard of care issue? If one of us is asked to serve as an expert legal witness for the defense of a surgeon who has had a problematic outcome, should we be swayed in our deliberations by whether or not that surgeon has taken time to include in his or her educational experience a course in microsurgery? ***We do not currently structure our formal CME educational experiences such that one or two or three credits can be singled out by the program committee for ethics or standards of care categories. But we could! And we should!***

DIABETIC NEUROPATHY: RESULTS OF POSTERIOR TIBIAL NERVE DECOMPRESSION*

Study	Number of Patients	Number of Nerves	Improvement Pain	Improvement Sensibility
1992, Dellon	31	22	85%	72%
1995, Wieman & Patel	33	26	92%	72%
2000, Caffee	58	36	86%	50%
2000, Aszmann, Kress & Dellon	16	12	N/A	69%
2001, Tambwekr	10	10	80%	70%
2003, Wood & Wood	33	33	90%	70%
2004, Biddinger & Amend	15	22	86%	80%
2004, Valdivia, Weinand & Maloney	60	60	85%	85%
2004, Lee & Dellon	46	46	92%	92%
2005, Little et al	6	6	86%	86%
2005, Steck	25	25	84%	72%
2005, Rader,	49	49	90%	75%
2005, DiNucci	72	72	80%	80%
Totals	445	403	87%	78%

* references available upon request to aldellon@erols.com

Are there areas of current concern relating to standard of care issues that ASRM should investigate? What is the standard with regard to the use of a pneumatic tourniquet in the patient who has had an arterial bypass graft? What is the standard of care with regard to monitoring of a flap transferred by microsurgical techniques? Does this change if it is a muscle flap, a buried flap, a flap without a skin paddle for monitoring? Does this change if the skin pigment is one of an African American versus a Caucasian? If a "free" flap fails and the patient is a known smoker or a diabetic, is this malpractice? Is there currently sufficient evidence to support a position that would make certain surgical practices the standard of care in microsurgery, or does ASRM need to sponsor such directed activity in the future, as the malpractice problem continues to affect us all?

In 2004, I attended the 62nd American Society for Foot and Ankle Surgery, held in San Diego. (It was cold and raining, clearly outside the standard of care for San Diego!) I was asked to take the "con" position on the statement that "No further peripheral nerve decompressions should be done on lower extremity nerves in the patient with symptomatic diabetic neuropathy until the results of a prospective randomized study support such a result." This year, 2005, at this same meeting, the question was asked, "Is it the standard of care to do nerve decompressions to treat the symptoms of diabetic neuropathy?" [Those symptoms must be demonstrated to be due to superimposed nerve compressions, which are identified by the presence of a positive Tinel sign for the peroneal and/or tibial nerve(s) at known sites of anatomic narrowing (common peroneal nerve at the knee, deep peroneal nerve at the dorsum of the foot, and the tibial nerve branches in the four medial ankle tunnels.] The *New England Journal of Medicine*, in 2004, published a review article by a diabetologist of international renown who omitted any reference to hope for the patient with diabetic neuropathy by decompression of peripheral nerves. On January 27, 2005, the *New England Journal of Medicine* contained a review type article written by a vascular surgeon that stated in the abstract that "there was no treatment for diabetic neuropathy." I attach here, however, Table 1, with 13 prospective, cohort (I know, low level of evidence) studies that, over the last 13 years support the statement that it is possible

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Editor's Message

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most of the time in the patient with a positive Tinel sign and symptoms of diabetic neuropathy to relieve pain and restore sensation. So how is the standard of care for a surgical procedure established? If a randomized prospective blinded study is to be done for a surgical procedure like the one described for the patient with symptomatic diabetic neuropathy, what treatment should the control group receive? Since there is no other treatment for diabetic neuropathy that is successful, should the control group receive neuropathic pain medication and comprehensive monitored foot care? Hard to have such a study be blinded, or should the patients have a sham operation? If you were a surgeon achieving the success rates reported in Table 1, would you stop providing this care until a randomized study were done? Would you accept the results of a non-randomized but prospective multi-centered study as reported in an International Neuropathy Decompression Registry, available now on-line (neuropathyregistry.com)? Check it out. More than 200 surgeons have been trained now, and hopefully will begin to enter data into this registry, that just went active a few months ago. ***Members of ASRM have the training to address standards of care in our changing environment, and must do so.*** **RM**

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Get Out Your Shades, the Future's Lookin' Bright

PRESIDENT'S LETTER

William C. Pederson, MD

So, the ASRM has been around for over 20 years or so and how are we doing? I am fortunate to have ascended to the presidency of this Society at a time when we are a vibrant and growing group. Several years ago, we were seeing a slow loss of members, as many of the original members either lost some interest in microsurgery or went into retirement. From last year and this year we have had a net gain of around 20 new members, with little loss from attrition. Likewise, within the last few years we have seen the finances of the society stabilize such that we are now on a firm financial footing. While we have not seen great financial gains in the last few years (who has with this market), we have not had any significant losses. And while other specialties get together and don't really have much new to talk about, we are seeing a certain resurgence of interest in the "specialty" of reconstructive microsurgery. Our annual meetings are well attended and have actually become an international forum for reconstructive surgery.

This year's meeting in Puerto Rico gave some insight into what we're doing and where we're going. The prospect of composite allograft transplantation has re-energized many in our field. We heard presentations on the technical and immunogenic challenges of allograft tissue transplantation, especially regarding facial transplants. How cool is that? We are also seeing more cross-fertilization with other specialties, such as urology. Our members are performing nerve grafts to the cavernous nerves after prostatectomy, even using "space-age" robotic surgical hands for laparoscopic nerve repair. Come on, who really thought that we would be doing this stuff 20 years ago? We continue to have refinements in flaps with more concentration on the final cosmetic outcomes and management of the donor sites. Our presidential invited lecturer gave us insight into nasal reconstruction techniques using free flaps to give an adequate tissue volume supplemented with more traditional approaches for excellent cosmetic results. To top everything off, the first Harry Buncke lecturer was one of the giants of our specialty, Mr. Ian Taylor of Melbourne, Australia. His lecture provided an amazing finale to another excellent meeting.

As of this year, the ASRM will have a seat on the Board of Directors of the ASPS. We are in ongoing discussions with the ASPS regarding future collaboration between our two societies....

As for the future, there are several challenges facing the ASRM. The American Society for Plastic Surgery has shown a renewed interest in embracing reconstructive surgery, and as of this year the ASRM will have a seat on the Board of Directors of the ASPS. We are in ongoing discussions with the ASPS regarding future collaboration between our two societies, which may include more input into the ASPS annual meeting as well as the potential for administrative support for the ASRM from the ASPS. In parallel with this, we are working with the Plastic Surgery Educational Foundation to improve funding for basic research for reconstructive surgery. While the ASRM leadership is not ready to give up our autonomy, we are considering a number of ways to improve our relationship with the ASPS.

In terms of further collaboration, the new Composite Tissue Allotransplantation group has asked to be included in our annual meeting and we have arranged for this society to meet immediately following ours. This will probably include some combined papers on the last day of the ASRM with the Composite Tissue Allotransplant group. This collaboration should only increase interest in this exciting new area where we may apply our microsurgical skills in the future. In line with the new Masters Series in Microsurgery, which was begun last year, the Society hopes to sponsor some hands-on courses on flap dissection in the coming years to utilize our members' expertise in teaching.

The hope is that this President's Message can serve to let the members know what's going on in our Society and to let you know that we're working to improve the benefits of membership. While we will never have the membership or clout of the larger "main-specialty" societies, it would certainly appear to me that the ASRM is not a backwater group. I hope that we can continue to grow and provide our membership with enthusiastic leadership.

(O.K., based on past performance, this wasn't too funny, but hey, I'm the president now and have to be serious sometimes!) **RM**

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reconstruction is rapidly becoming an area of defined concentration for microsurgeons around the world.

Yu and Lewin demonstrated in their retrospective study that patients who had total pharyngoesophageal reconstruction with either a free jejuneal flap or an anterolateral thigh flap had similar rates of fistula and stricture formation comparing reconstructions that occurred over different time intervals in the past. More current experience with the ALT flap reconstructions of circumferential pharyngoesophageal defects

Julia K. Terzis, MD, PhD, and A. Lee Dellon, MD

indicated that these patients tended to have a shorter hospital and ICU stay as well as better speech and swallowing outcomes as the approach to the management of these complex patients has evolved.

De Santis et al carefully evaluated osseointegration implant stability with the introduction of the use of resonance frequency analysis (RFA) using "implant stability quotient" units as a measure during the course of implant treatment and loading. Instrumental evaluation of implant stability with RFA supported by xray imaging is a good objective way to assess osseointegration when clinical evidence is equivocal.

In the area of further refinements in vocal function following laryngectomy, Chen et al refined the original strategy of bowel transfer by adding a specially designed deltopectoral flap to form a lip used to facilitate voice production in these patients. This provided a significant improvement in voice production from their original bowel transfer procedure allowing for a simultaneous release of neck skin contracture, release of stricture for tracheostoma, and easy approximation of the voice tube to the tracheostoma with proper drainage of the regurgitated food or saliva to prevent aspiration.

Lewin and Yu analyzed functional speech outcomes in patients with ALT flap reconstruction for laryngopharyngectomy defects. Their findings demonstrated a majority of tracheoesophageal puncture patients became fluent tracheoesophageal speakers. The presence of a tracheoesophageal puncture did not influence the development of post-operative complications but complications did limit the tracheoesophageal speech success. The emphasis continued to be on pre-operative speech pathology referral in the care of these patients to ultimately achieve better speech and swallowing outcomes.

Innovation in flap design and unique means to achieve an end are characterized by many of our contributors. Topalan et al demonstrated the use of free prefabricated flaps in facial surface reconstruction. Free radial forearm fascia was transferred to the supraclavicular region under a tissue expander, enabling the expansion of supraclavicular skin expanded to the size necessary for the individual reconstructions which involved multiple areas of the face. The use of these prefabricated flaps has the advantage of preparing a large vascularized flap with good color, texture, and pliability with acceptable donor scars in the neck and supraclavicular area. The facial resurfacing was performed after the confirmation of free flap survival with the surface skin replacement thin enough to allow for satisfactory facial expression.

Klebuc and Shenaq have documented experience with the masseter-to-facial nerve transfers for reanimating the paralyzed face in the clinical circumstance of having distal facial nerve branches and viable mimetic muscles. This approach allows for limited donor site morbidity since mastication function is still preserved. There's incomplete denervation of the masseter muscle with the use of the distal motor nerve

The Wyndham El Conquistador Resort and Golden Door Spa afforded attendees spectacular views.

branch of the masseter and the anatomic location allows for a tension free closure directly to the facial nerve. A rapid reinnervation recovery is generally seen clinically within 6 months after surgery and there appears to be efficient cerebral adaptation and a production of an effortless smile using this approach.

Finally, Lutz reviewed the continued aesthetic and functional usefulness of free muscle flaps in head and neck reconstruction with applied full or split-thickness skin grafts. Skin flaps in head and neck reconstruction are frequently prone to prolonged post-operative edema and subcutaneous tissue of some reconstructive skin flaps may increase as the patient experiences weight gain in cancer treatment, whereas skin-grafted muscle flaps can provide consistently acceptable cosmetic and functional results with negligible donor site morbidity.

BREAST

Continued application of the various types of perforator flaps in breast reconstruction was highlighted along with refinements in the creation and insetting of the different flap designs. Hamdi et al emphasized the role of the superficial inferior epigastric system for breast reconstruction indicating that the SIE flap is more suitable in post-mastectomy breast reconstruction when a moderate amount of tissue of zones I and II is required. Including the circumflex iliac vessels within the flap can increase the vascular territory of the SIEA flap, but if the SIE vessels are not suitable, the flap is converted to a DIEAP flap and the SIE vessels can be used to promote blood supply to or as additional venous drainage of a DIEAP flap. One drawback seems to be that seromas occurred in this SIE flap study in more than 50% of the cases.

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Microsurgical Nurses Attend ASRM 2005 in Puerto Rico

By Charles K. Lee, MD

Five nurses from California Pacific Medical Center at Davies attended the ASRM meeting in Puerto Rico. Under the auspices of Dr. Robert Walton and with the support of CPMC nursing management, the nurses attended the meeting to witness the full breadth and depth of microsurgical research and practice on an international stage.

This represents a new chapter in the history of ASRM and underscores the importance of nursing in the management of microsurgical patients. The five nurses combined represent over 60 years of microsurgical expertise. Each nurse represented a part of patient care from the operating room, the ICU, and the floor. They are all an integral part of the Microsurgery Team at Davies Medical Center – a legacy and concept that begun with Dr. Harry Buncke.

A well educated, supportive, and vigilant nursing staff can make the difference between success versus failure and surgical enjoyment versus frustration. The plastic surgeons at Davies have been fortunate in this respect. After the ASRM meeting, the nurses have returned to Davies with even more enthusiasm and a deeper understanding of reconstructive plastic surgery.

This past year, the team of Jeane Caperton led the first Microsurgical Nursing Symposium to cover many of the nursing issues involved in microsurgical patient care. They have already invited a nursing team at MD Anderson to come to this year's symposium which will be held in September 2005 in San Francisco. This invitation is open to all in the nursing profession who desire to share ideas and advance patient care. The long term goal will be to bring this symposium to the annual ASRM meeting and establish a forum for nurses.

Please contact Michelle Foster or Jeane Caperton at CPMC-Davies at (415) 565-6281 or fosterkm@sutterhealth.org.

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Vermeulen et al looked at results and complications in 43 SIEA flaps for breast reconstruction and compared these outcomes with an experience of 236 DIEAP flaps. There were no differences in flap loss and no higher fat necrosis rate was seen in the comparison of the two groups. A slightly higher tendency towards seroma formation was seen in the SIEA flap group, but the operative time and flap dissection time in the SIE group was significantly less than that in the DIEAP group.

Nahabedian considered the clinical controversy surrounding the use of the internal mammary artery as an arterial conduit for coronary revascularization and also as a recipient artery for microvascular reconstruction of the breast. Six hundred and twenty five women with breast cancer who had reconstruction were reviewed. Based on the results of this study, it appears that the use of the interal mammary artery as a recipient vessel for microvascular reconstruction of the breast was justified, since the incidence of coronary artery disease in women with breast cancer who have reconstruction is 0.69%. The incidence of factors related to cardiac function and incidence of risk factors related to cardiac disease appear to increase with advancing age and other options for coronary revascularization included the opposite IMA, a saphenous vein graft, or angioplasty.

Fabre et al retrospectively reviewed the results of 39 superior gluteal artery perforator flaps for breast reconstruction. The overall complication rate of the group was 31% with post-operative fat necrosis and fibrosis occurring in 8% of the flaps. Seventy-one percent of the patients rated the shape of the breast reconstruction excellent or good, and breast symmetry was rated excellent or good in 62%. Contour and symmetry at the donor site was rated fair or poor in 36% and in 14% of the patients respectively. Overall satisfaction was excellent or good in 78% of the patients. Their conclusion supported the use of the SGAP flap for breast reconstruction when a DIEP perforator flap was not available; however, studies continue to show that the complication rate is statistically higher and the donor site contour deformity remains a major complaint.

Beahm and Walton considered bilateral lower abdominal free flaps for unilateral breast reconstruction in a retrospective analysis of consecutive microsurgical breast reconstructions from 1994 to 2003 in 22 patients. There were no flap losses but 5 out of the 22 patients experienced major complications. The authors concluded that double free flaps for unilateral breast reconstruction can be conducted safely and that the risk of abdominal bulge appeared to relate to resection of the rectus abdominis muscle. In this particular series, the in-lay mesh repair of the fascia was found to be superior to an on-lay mesh technique in preventing a bulge. The clear advantage of the double free flap technique was in the ability to more predictably duplicate the opposite breast volume and achieve symmetry.

Hamdi et al reported on the use of pedicled perforator flaps in breast reconstruction as a new concept. He uses a Doppler-located thoracodorsal perforator (TAP) or another vessel such as the intercostal perforator. If the perforators are very small but pulsatile, the TAP flap was harvested as a muscle-sparing latissimus flap. If the perforators are non-pulsatile, larger segments of a latissimus dorsi muscle are incorporated to include a maximum number of perforators. The mean flap dimensions included in this particular study of 51 patients was 20 x 8 cm. The pedicle perforator flap can be a useful tool for breast reconstruction whenever an adequate perforator can be located.

The safety and efficacy of particular breast reconstruction procedures as well as differences in outcome

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were primarily emphasized by several authors.

Friedman considered secondary breast reconstruction with a delayed pedicled TRAM flap as an option following chest wall radiation to avoid free flap failure in a radiated field. His study involved 14 patients, 13 of whom had unilateral reconstructions. There was a higher rate of early wound healing complications, but all the patients healed and achieved successful breast reconstruction and cosmetic results were judged good to excellent in all cases with the incidence of fat necrosis similar to that of the free TRAMs (<10%).

Dr. and Mrs. Scott Levin enjoy a twilight stroll.

Langstein et al considered bilateral breast reconstruction with TRAM flaps, considering whether the "ends justify the means". Three hundred consecutive patients were retrospectively reviewed in the study documenting that bilateral TRAM flap procedure as a substantial endeavor involving prolonged operative times, frequent use of prosthetic mesh in the abdominal closure as well as a lengthy hospital stay. However, the overall high success and relatively low complication rate appear to justify the effort.

Beahm et al evaluated the safety of free TRAM flaps for breast reconstruction in patients with collagen vascular disease identifying 6 patients in a retrospective review of 1200 consecutive cases who met the American College of Rheumatology criteria for systemic collagen vascular disease. She concluded that the heterogeneous nature of collagen vascular disease makes objective analysis difficult but this small series suggests that microsurgical breast reconstruction can be conducted successfully in selected patients with these disorders. Although the complication rate was 50% in these patients, the ultimate outcome was uniformly good. Local wound problems were the most common complications encountered, but the microvascular flap surgery itself was uneventful.

Basu et al considered whether recipient vessel choice impacted the outcome of microvascular breast reconstruction through an outcomes analysis of the M. D. Anderson experience. In this large series of 502 free TRAM breast reconstructions, anastomosis to either thoracodorsal or internal mammary vessels showed no difference in outcome with respect to vessel choice. The selection of recipient vessels for most cases continues to be somewhat random, often depending on multiple factors including the ease of dissection of the recipient vessels, the quality of the vessels, the length of the flap pedicle, and the particular preference and experience of the individual surgeon.

Vega et al studied the efficacy of preoperative autologous blood donation in free TRAM flap breast reconstruction using a retrospective chart review of 201 patients. Total surgical complications were much more common in the autologous donor group by a rate of 48% versus 28% (p <0.004). In addition, the autologous donor group was likely more to receive a transfusion intraoperatively or post-operatively (p <0.001), as compared to the non-donor group.

PEDIATRICS

Van Landuyt presented a series of 15 consecutive free perforator flaps in 14 children, ages 6 months through 16 years of age. All the children presented with soft tissue defects of the lower limb necessitating coverage with a skin flap. Flaps involved included DIEAP flaps, thoracodorsal artery perforator flaps and chimeric thoracodorsal artery perforator flaps. All but one flap was successful, and operative time, outcome, and complications compared favorably to that of perforator flaps in adults as well as to other free flaps used in the pediatric population.

GENERAL

Complex wound reconstruction continues to be a highly important area of development along with innovations in technology that support its advancement. Butler et al studied the reconstruction of large complicated trunk defects using allodermand flaps in cancer patients. Noting that the complication rates are increased in pelvic, chest, and abdominal wall reconstructions with standard mesh when it is placed directly over viscera or when the operative site has been irradiated or contaminated with bacteria, the authors conduct a retrospective study of trunk reconstruction using a decellularized allodermis which becomes vascularized and remodeled into autologous tissue after implantation even in such high risk wounds. Nine patients primarily following oncologic resection were studied with the mean musculofasical defect size of 470 cm2. No clinical mesh infections, hernias, laxity, or bulges occurred. The techniques in this approach considered to improve the outcome included a dual-concentric suture line inset technique, maximal mesh-musculofasical edge

surface area interace, suture fixation through drill holes in adjacent bone, use of thick or extra-thick Alloderm, and quilting sutures for seroma prophylaxis.

Yu presented an estimation of the accuracy of the preoperative handheld Doppler examination in locating cutaneous perforators of the anterolateral thigh flap. A study using different dopplers including the Huntleigh Mini Dopplex and the Koven mini Doppler. Results of the accuracy of the two dopplers were compared and significant differences in the detection of actual locations of flap perforators were noted. Yu concluded that pre-operative hand held Doppler examination is not always accurate and should be used carefully in ALT flap design. He further suggested that finalization of the flap design should be done only after the perforators have been identified and dissected out.

Lee et al from the Buncke Clinic introduced a new technology for monitoring free tissue flap perfusion in reconstructive microsurgery called thermodilution technology. In their study, 22 patients were monitored with a thermodiffusion probe inserted into the substance of the free flaps. There were no false negatives and actually 2 true positives that were salvaged with emergent exploration. The thermodiffusion probe enables the measurement of tissue perfusion through the calculation of convective heat loss. The monitor's advantages include real time, continuous, quantitative perfusion data in units of perfusion with simplicity in design and use.

TRANSPLANTATION

Silverman et al represented a heterotopic primate model for facial composite tissue transplantation. Cynomologous monkeys were immunologically matched by performing a mixed lymphocyte reaction between recipient and donor animals. Composite facial segments including a portion of mandible with overlying muscle and cheek skin based on the common carotid artery were removed from 4 donor animals and microvascularly transplanted into the groins of 4 recipients. All of the composite tissue transplants demonstrated good perfusion until the time of sacrifice. Histologic review indicated healthy tissue without sign of necrosis or rejection of the skin, muscle, bone, neural tissue, and blood vessels. The animals had been on an immunosuppressive regimen that included thymoglobulin, Rapamycin, and Tacrolimus. This model will facilitate the potential opportunity for further study into reducing or eliminating the need for immunosuppressants in facial transplantation.

Sari et al from the Cleveland Clinic Foundation proposed a concurrent intraosseous bone marrow transplantation to extend the hemifacial allotransplant survival through the achievement of multilineage chimerism. This group had previously established functional tolerance induction in the fully MHC mismatched rat hemiface allotransplantation model under long-term cyclosporineA (CsA) monotherapy. Here the success was evaluated of a combined CsA and alphabeta-Tcell receptor monoclonal antibody (TCRmAb) in a 7-day protocol, augmented with an intraosseous donor bone marrow (BM) transplantation on tolerance induction and flap survival. In their study, significant extension of hemifacial allotransplant survival was achieved across the MHC barrier under combined CsA and TCRmAb protocol that was significant. Augmentation with the bone marrow transplantation further extended allograft survival and correlated with higher levels of donor specific multilineage chimerism.

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2005 Day at the Links Golf Tournament Results

Winning Foursome, scoring 69
David Groth, Loren Scheter
Paul Groth, David Song

Longest Putt
Paul Groth (12' 1")

Closest to the Pin
Eruyn Radek (13')

Longest Drive
Gabriel Kind

ISCHEMIA/REPERFUSION

Wang from the University of Nevada reported on the effect of melatonin in the microcirculation of skeletal muscle ischemia/reperfusion (I/R) in the rat cremaster muscle model. A purpose of the study was to determine how nitric oxide was effected by melatonin and also whether melatonin had a significant impact on NOS gene expression after I/R in skeletal muscle. In this study, melatonin significantly increased arterial diameter to 93% from 74% in the I/R group, increased capillary profusion to 85% from 54% in the I/R group, and increased reflowing arterioles to 95% from 69% in the I/R group. The study concluded that melatonin produced a significant microvascular protection from skeletal muscle I/R injury but there was no significant impact on the NOS gene expression in skeletal muscle.

Hung addressed ischemic preconditioning attenuation of the post ischemic leukocyte-endothelial cell adhesion interactions focusing in particular on the role of nitric oxide. Recent studies indicate the possible role of nitric oxide in regulating leukocyte-endothelial cell interactions which play a key role in ischemic preconditioning (IPC) in preserving the microvascular integrity of ischemia-reperfusion (I/R) – injured tissues. However, it was not clear which NOS was responsible for the beneficial effect of the ischemic preconditioning on I/R-induced microcirculatory disturbance. Their study concluded that eNOS, but not iNOS or nNOS, may be involved in the protective effect of IPC in the I/R-induced microcirculatory disturbance.

MICROVASCULAR REPAIR

Zeballos et al also presented an interesting concept of photochemical tissue bonding (PTB) representing a nanosuture approach to vascular repair. This repair technique utilizes photoreactive dyes and visible light to produce intermolecular covalent cross-linking (nanosutures) of collagen molecules between two tissue surfaces. Bonding occurs immediately and forms a water-tight seal facilitating blood vessel repair. The first step included an ex-vivo swine carotid artery study to determine the use of PTB in blood vessels. Additional Sprague-Dawley rat studies were done looking at primary repair of femoral artery transections with 10-0 sutures and also repair with PTB. Post-operatively the animals are monitored for adequate perfusion via Doppler and results demonstrated that a strong circumferential vascular bond can be obtained with less than 3 minutes of illumination. The ex-vivo example of blood vessel repair using PTB on swine carotid artery shows no tissue damage after application of Rose Bengal dye prior to and after irradiation at 532 nm.

Katz studied robotic assisted microsurgery using a porcine animal model for vessel anastomoses of 1.5 – 2.0 mm in diameter using the Da Vinci robot. A randomized prospective trial demonstrated set-up time for the operating microscope vs. the Da Vinci robot were comparable. The time for anastomosis completion was more favorable with the robot than with the traditional microvascular technique ($p<0.05$). All the anastomoses remained patent with both techniques but the advantage of improved dexterity, greater precision, and the elimination of tremor in student surgeons was specifically noted. Additionally illustration indicated that instruments can be rotated through 360 degrees with 6 degrees of freedom, permitting anastomoses potentially in deep operative fields and around external fixators. The robotic method potentially opens the portal even further for minimally invasive microsurgery via small incisions.

LOWER EXTREMITY

Peng from the National University Hospital in Singapore described the versatility of the anterior tibial artery flap system for lower limb reconstruction. He indicated that the long vascular pedicle in this approach has facilitated the fusion of the knee and ankle joints or resurfacing of the foot and toe based on the vascular anastomosis around the ankle joint. Five to seven periosteal perforators originate evenly along the length of the anteri-

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ASRM Welcome Reception and other happy moments...

American Society for Reconstructive Microsurgery
2005 New Members

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Bronx, New York

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or tibial artery, lying on the lateral surface of the tibia to reach the anterolateral skin of the leg. Skin flaps, vascularized bone or composite osteocutaneous flaps can be harvested based on these perforators. Moreover, there were no complications from the donor site and there were no difficulties with foot or toe extension weakness. There were no flap failures in their small series of 9 cases, in which a resurfacing outcome that was thin, supple and durable was notably achieved.

Deune reported on a 6 year study involving limb sparing surgery for extremity sarcomas. One hundred twelve patients underwent salvage of 115 limbs with the thigh as the most common tumor location. Fifty percent of the patients had minor or major wound complications (most commonly seromas) but of the 103 patients with at least 6 months of recovery, 64% of the patients completed a TESS survey at a mean of 28 months post-surgery. The mean TESS score was 83 indicating slight disability in daily activities. Patients who had three different modalities of adjuvant therapy were more likely than those with only one modality to have lower TESS scores although this was not significant and there was no significant difference in the TESS score with respect to age, sex, or adjuvant therapy or the type of adjuvant therapy. This underscores that even with major lower extremity surgery and a high rate of minor wound complications, many of these patients with limb preservation surgery noted only limited disability.

Parrett et al studied lower extremity trauma and the trends in management of soft tissue reconstruction of open fractures. The interesting evolution of their treatment protocols from 1992 to 2003 were examined and results demonstrated a change in practice with a trend down the reconstructive ladder from free flaps to regional flaps, local flaps, and skin grafts, with frequent use of the VAC sponge. Their justification included a better understanding of local vascular anatomy of the foot, improved wound care technologies and an increased demand for plastic surgery involvement in the care of these patients.

Bansal reported on an outcome analysis of tibial defects treated with Ilizarov distraction and soft tissue flaps. Their 8 year retrospective review evaluated 90 patients treated with Ilizarov distraction of which 25 patients required soft tissue coverage by plastic surgery. The results indicated that essentially all the patients had successful healing and returned to ambulation without assistance. Fifty-two percent of the patients had a free muscle flap, 24% had a local fasciocutaneous flap, and 24% had a local muscle flap. Twenty-two percent of the patients had a minor soft tissue complication and 15% of the patients had a major soft tissue complication. Their study concluded that Ilizarov distraction osteosenesis was compatible with all types of soft tissue reconstruction with acceptable complication rates and was a valuable adjunct to limb salvage.

Baumeister et al studied 75 free flaps performed in 60 burn patients to investigate decision making in microsurgery burn reconstruction and the timing of free flap coverage. Forty-three flaps were performed for primary reconstruction and 32 flaps for secondary burn reconstruction. The overall flap success rate was 87% but 80% of the flap failures occurred within 5 to 21 days after injury. No flap failures occurred during secondary reconstruction.

The above review represents only a small sampling of the excellent recent contributions to the research and clinical advancements presented at the 21st annual meeting of the American Society of Reconstructive Microsurgery in Fajardo, Puerto Rico this past January. We can only continue to build on this ever-expanding platform of clinical and research expertise with the expectant innovation, dedicated creativity, and collegial inspiration of our international microsurgical membership. All of us certainly look forward in excited anticipation to our next venue at the Loew's Ventana Canyon Resort in Tucson, Arizona, January 11-14, 2006. **RM**

ASRM
FUTURE ANNUAL MEETINGS

2006

JANUARY 14-17, 2006
Loews Ventana Canyon Resort
Tucson, AZ

2007

JANUARY 13–16, 2007
Westin Rio Mar Beach Resort
Rio Grande, Puerto Rico

2008

JANUARY 12-15, 2008
Century Plaza Hotel and Spa
Los Angeles, CA

2009

JANUARY 10-13, 2009
Grand Wailea Resort
Maui, HI

2010

JANUARY 9-12, 2010
Boca Raton Resort & Spa
Boca Raton, FL

Invitation to Attend

Chris Pederson and I began working on the program for the 2006 Annual Meeting during our 2005 meeting in Puerto Rico. We all agree that the meetings over the last several years have represented cutting edge topics in reconstructive microsurgery, presented in both panel, speaker, and paper presentation format. These meetings have been very well balanced and coordinated by the past program chairs, representing some of the best programs our annual meeting has had. Chris and I have been working together to ensure this high level of program excellence continues for next year's meeting.

We will have 20 different instructional courses representing a mix of new and old. We have also assigned panel and course faculty to some of our younger membership so as to promote our young surgeons and hopefully infuse new concepts to conventional processes. We will have 4 panels which include discussions on education, the players behind successful microsurgery, combining microsurgery and craniofacial surgery, and revising your reconstruction. The panel participants are all recognized experts and we have devoted enough time to the panels this year to allow for audience participation. We will limit the papers all to 5 minute presentations, keeping about the same number as last year. Chris will be selecting our guest speakers and David Chang will be giving the Godina lecture.

We have already had a conference call with the leadership and program chairs for the AAHS and ASPN so as to coordinate our combined day on Saturday. The preliminary program looks great. We will also be continuing with our second Masters Series in Microsurgery. The first series occurred at this year's meeting and was an overwhelming success.

A significant component to the quality of any meeting is the abtracts received for presentation. Please strongly consider having you or your fellows or residents submit one or more abstracts to the program committee. Also, put in your calendars now the dates and place of next year's meeting. The ASRM will occur from Saturday, January 14 through Tuesday, January 17 at the Loews Ventana Canyon Resort, in Tucson, AZ.

I look forward to seeing you there,

Joe Serletti, MD, FACS
2006 ASRM Scientific Program Chair

Robotic-Assisted Microsurgery

Gedge D. Rosson, MD

History of Early Microsurgery

We can trace the history of microsurgery back to the late 1800s and early 1900s, with major advancements in conceptual and practical application within the area of vascular surgery, microsurgery's predecessor. Perhaps most notable are the prodigious achievements of Alexis Carrel, who first triangulated blood vessels to assist in the repair of arteries and veins. He was ultimately awarded the Nobel Prize in 1912 for his work on vascular suture and transplantation of blood vessels and organs. Julius Jacobson, a famous cardiovascular surgeon, then utilized the existing microscopes of the ENT surgeons to help him suture blood vessels down to the size of 1.4 millimeters in diameter. The earliest major obstacle encountered by these surgeons was a dearth of adequate suture material, needles, and other appropriately diminutive instruments. The microscopes of that period were insufficient for this emerging form, especially in the context of a surgeon performing with an assistant, as these early microscopes lacked two operating scopes encompassing one operating field.

From these early beginnings in vascular surgery, surgeons grasped the necessity of suturing blood vessels as small as one millimeter or even smaller. This practice began in animal models and digital replantation in the 1960s. Harry Buncke first reported the reattachment of rabbit ears with blood vessels of one millimeter or less in the 1960s. This experiment was considered monumental, as it demonstrated that the tiniest blood vessels in digits could be reproducibly anastomosed. Drs. Kamatsu and Tamai reported the first successful digit replantation using a surgical microscope in 1968. The first free flaps were performed in the late 1960s and early 1970s and reported in the early 1970s by Drs. Harry Buncke and Donald McLean, who performed the first free omentum transplant for a scalp reconstruction, and then by Drs. Ian Taylor and Rollin Daniels, who performed the first transplantation of a free groin flap. These first two free flaps using surgical microscopes were historically significant in that they demonstrated that we could transfer tissue from one part of the body to reconstruct defects in another part of the body in a single stage.

In the 1970s and 1980s, many centers worked on improving the survival of these free flaps to bring them into general use by reconstructive surgeons. A dramatic increase in modifications and refinements occurred in the 1990s, and the ideas of aesthetic reconstructions and decreasing the donor site morbidity came into vogue.

Current Status

Now in 2005, there are many published series with success rates in the 90% to nearly 100% range for free flaps. Additionally, there has been considerable aesthetic refinement with ultra-thin free flaps as well as prefabricated free flaps. Microsurgeons are now moving into tissue engineering of free flaps. We have also witnessed decreased morbidity at the donor sites with the dissemination of perforator free flaps. This has been noted significantly in breast reconstruction with DIEP flaps, as there is no longer a need to transfer the rectus abdominis muscle for breast reconstruction.

Further Questions

How can microsurgery become easier, more predictable, and more ergonomic as we advance through the 21st century?

We have been noticing that in the operating rooms across the hall from ours, the general surgeons, cardiac surgeons, and urologists have been very successful in using robotic telemanipulators to assist them in their surgeries. Radical retropubic prostatectomies are now being performed more easily with robotic assistance. Difficult procedures such as laparoscopic gastric bypasses are performed more easily with robotic assistance, and the cardiac surgeons are starting

Surgeon comfortably seated at robot telemanipulator console while performing microsurgery.

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trials performing coronary artery bypasses with these same robots.

Thus, the obvious subsequent question looms before us: can robotic telemanipulators help the reconstructive microsurgeon?

Our Studies

We feel that there are really three main categories in which the robotic telemanipulator may be of assistance to us: (1) with free flaps and the microsurgical anastomosies; (2) with digital replantations and revascularizations; and (3) with microneurorrhaphy. In discussing the use of the robotic telemanipulators with our other surgical subspecialty colleagues, we learned of some of the advantages they have experienced. Superior ergonomics while seated at a consul can optimize the surgeon's comfort during performance of the microsurgical anastomosies, given the improved dexterity and increased access to the controls for the surgical robots. Another important point is that there is a great deal of increased precision due to scalability of movements, which can be either 1:1 or 1:3 or even 1:6 scale, such that moving your hand or moving your finger six millimeters will only result in a one millimeter movement of the actual forceps and the microsurgical needle. This increased precision theoretically can have great advantages. Perhaps most critically, there is absolutely no tremor by the robots. Any tremor in the surgeon's own hands and fingers is completely eliminated through the instrumentation and the computer software.

As a feasibility study, we first tried to anastomose the femoral arteries and veins in canines in our microsurgical laboratory. These canines had been used previously for other training purposes, and therefore we could not test flow in the blood vessels after the anastomosis. We noticed that the surgical repair of these vessels was greatly facilitated by using the surgical robot. There was a relatively short learning curve, and at the end of the feasibility study, all of the vessels were grossly patent. However, again, we could not measure flow as the animals had already been sacrificed. The instruments were quite adequate for this use, but the vessels were in the three to four millimeter range and thus were not similar to many free flaps and clearly were outside the realm of digital replantation.

We therefore felt that we had to develop a free flap model with vessels in the range of sizes that we would encounter ourselves clinically. Our porcine free flap model seemed to fit the bill, and again we noticed a short learning curve; in fact, even one of our residents without prior microsurgical experience became proficient rapidly at microsurgical anastomoses using the surgical robot. We also noticed that one could always find the perfect angle toward the vessels, due to the ability to rotate the camera, and we appreciated the improved dexterity and range of motion. It is important to note that we actually have more range of motion and more degrees of freedom using the robot than we do using our own fingers and wrists. The scalability of movements truly seemed to improve the precision, and we felt that the complete absence of tremors was a benefit.

Limitations

The limitations are few but important to note. (1) There is no haptic feedback, the potential drawbacks of which are minimized by the fact that microsurgery itself is extremely visual. By the time a surgeon might tear a vessel using traditional microsurgical techniques, s/he would see it prior to feeling it anyway. (2) The other limitation which is perhaps more critical is that the current instruments are not yet small and fine enough. This may not be a problem for coronary artery bypass or our canine model, but it is very noticeable in our porcine free flap model. The other limitation that people note is the expense of these robotic telemanipulators, and certainly as more institutions, both academic medical centers and non-academic medical centers, purchase these surgical robots for use by other surgical subspecialties, the capital expense will have been made already, and the surgical robot will be available for the other surgeons in the hospital as well. Because we have access in our institution to these surgical robots, we are in a position to provide feedback to the producer in order to develop finer instruments. As this collaborative process progresses, the benefits of the surgical robots could become realized in time at many more institutions.

The Future

It seems that we are back to some of the same problems that the early microsurgeons such as Dr. Harry Buncke dealt with in the 1960s, i.e.: that the instruments themselves are not fine enough to really allow us to perform the anastomoses of these one-millimeter vessels at this time. We will encourage the manufacturer to scale down its current instruments to make them more usable for the reconstructive microsurgeon. Once this transpires, these robotic devices could be the next important leap in microsurgical advancement. **RM**

Gedge D. Rosson, MD, Johns Hopkins University School of Medicine, Baltimore, Maryland.

The Humble Platelet

Contributed by
Michael J. Miller MD

Tip #51

Well-mannered platelets are invisible. We notice them only when we are pulling them from an anastomosis. "Doctor, the flap does not look right." Soon, you are staring at a plug of the little things—it's hard not to hate them. But are they really all bad? No, of course not. Well-behaved ones heal the microanastomosis. We must learn to work with them. What are platelets doing at the microvascular suture line? What can we do to encourage platelets to work for and not against us in free tissue transfer?

A microvascular anastomosis is a vascular injury. When blood begins to flow, platelets immediately start to coat exposed subendothelial collagen and foreign body (i.e., nylon) in the injured vessel walls. As each one anchors it changes from discoid to irregular shape and releases stored bioactive factors, initiating an amplifying series of steps to recruit more platelets. This release reaction is exhausted within 20 minutes after anchoring (*important point... please, remember*). A loosely adherent mound forms, which rapidly grows away from the vessel wall into the stream of blood. Flowing blood exerts a shear force at the surface that dilutes release products and resists adherence of new platelets. Shear is lowest in the periphery and highest in the center of the lumen (if flow is non-turbulent). The balance between the shear and adhesive forces on the surface of the plug determines how many more platelets will accumulate. When equilibrium is reached, the platelet plug stops growing, and fibrin stabilizes it to form a less thrombogenic biologic surface covering the subendothelial collagen and nylon. Over the next 5 to 7 days this temporary repair provides a scaffold for endothelial cell migration. Under normal conditions the intima is healed by the end of this time and the subsequent risk of thrombosis and flap failure is extremely low. The microanastomosis is healed.

Thrombosis occurs when the platelet plug is allowed to span the entire diameter of the vessel. This happens when the balance between platelet aggregation and blood flow is upset at the microanastomosis. In patients with normal clotting function there are only two important factors: (1) a technical problem with the anastomosis or (2) inadequate blood flow. Avoiding these is essential to success.

Technical precision when performing the microanastomosis is most important. A technically sound anastomosis minimizes vessel injury and platelet aggregation. The vessel is manipulated as little as possible. The intima is never grasped with forceps. Precise suture placement minimizes the number. A smooth transition between donor and recipient vessel lowers turbulence. Each suture everts the vessel edges and approximates the intima. Following the curve of the needle creates a hole in the vessel wall that matches the diameter of the suture. Care is taken to prevent strands of adventitia from draping into the lumen. These are fundamental principles of microsurgical technique.

When the anastomosis is complete, there should be no leaks. If leaks occur, I like to suture them. Although many may stop on their own, it requires additional platelets. Therefore, when the vascular clamps are released, I have a suture ready in hand. I prefer to not use antiplatelet drugs or anticoagulants unless I cannot achieve a technically sound anastomosis, as in some cases of severe atherosclerosis or radiation tissue damage.

Good flow must be maintained, especially during the first 20 minutes. Remember, this is when platelets are actively coating the injured vessel walls. Even a momentary reduction in flow can result in rapid platelet aggregation leading to occlusion. I inspect the flap pedicle to ensure it is arranged to permit maximum flow, and then leave it undisturbed for 20 minutes after removing the vascular clamps. I do not to manipulate the flap or the surrounding tissues during this period of active platelet recruitment. If I observe signs of thrombosis (e.g., decreased pulsations, color changes, etc.), I will massage the anastomosis gently between my fingers to disrupt loosely adherent platelets. These are the active platelets, and facilitating their removal exposes the more quiescent platelets beneath. If good flow is present after 20 minutes, I will complete insetting the flap and start closing the surrounding tissues. The microanastomosis tolerates transient reductions in flow more readily now without aggressively recruiting new platelets. If perfusion shuts down during this period, I will again massage the anastomosis and allow a period of undisturbed flow for another 20 minutes. If the flap continues to shut down, I will conclude that a technical problem exists. At this point, I will take down and inspect the anastomosis.

In summary, these are some things we can do to keep the platelets working for and not against us:

1. Select recipient vessels that provide maximum inflow.
2. Minimize vessel injury; be attentive to technical details and personally committed to refining your technique with each case.
3. Try to suture leaks before they stop by platelet aggregation.

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Microsurgical Pearls

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4. After flow is established, allow the flap to rest undisturbed for at least 20 minutes.
5. If flow stops, gently massage the anastomosis and again allow 20 minutes for platelet stabilization. Repeat this two or three times before taking down the anastomosis.
6. For uncomplicated free tissue transfer, avoid antiplatelet drugs.

I learned these steps from my mentors, and my patients repeatedly reinforce their value. Remember the humble platelet, or be humbled by them. **RM**

Michael J. Miller, MD, FACS, is a Professor of Plastic Surgery at University of Texas MD Anderson Cancer Center, in Houston, Texas.

Call for Abstracts

Please visit www.microsurg.org to submit an abstract for the 2006 ASRM Annual Meeting, January 14-17.

The submission deadline is June 1, 2005. We look forward to your participation!

RECONSTRUCTIVE MICROSURGERY

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