McCraw and Arnold's Atlas of Muscle and Musculocutaneous Flaps

John B. McCraw
Phillip G. Arnold

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COMPLICATIONS

All of the early proponents of muscle flap surgery have emphasized the complications associated with these new procedures. Our honesty in these matters has not been derived from an inherent personal goodness, as much as it has come from the necessity to offer something which is reproducible in the hands of another surgeon. We have already shown the good results. It comes time for the bad news. As P.G. has said: "If a fellow does any single operation enough times, he can generate a full carousel of good results. It's the two carousels he left at home that we learn from." Many times a clearly understood complication is more instructive than a vast array of home runs. Obviously, the avoidance of problems is our best defense, and that is the purpose of this chapter.

There are several questions we should ask before we do any operation:

1) Should the surgery be done at all?
2) Will the flap survive?
3) Will the flap adequately cover the defect?
4) What happens if the flap fails?

SHOULD THE SURGERY BE DONE?

The question of ***whether the surgery should be done at all*** is the most difficult consideration. Is the deformity so large that it will not be corrected by the proposed flap? For instance, a 95% successful coverage of an open joint equates with a 100% failure. Sometimes, two major flaps should be used, rather than "pushing" one flap to its physiological limits and risking a major wound healing failure. ***Can the patient cope with the prolonged reconstructive efforts?*** All these procedures are difficult for both the patient and the surgeon, and all of the involved parties need to recognize this at the outset. A below-knee amputation may be an unattractive option, but months of suffering through multiple, unsuccessful reconstructive procedures may be a worse option in retrospect. It is frequently more difficult to make this fundamental decision about a reconstructive procedure than it is for an elective esthetic procedure. ***Can the patient afford the loss of work*** and the attendant expenses? These procedures are not free even if the surgeon accepts what the "third party" carriers allow. The patient may lose time from work or may be saddled with ancillary expenses which exceed the family's financial capabilities. When one member of the household is unable to perform his normal functions, additional non-medical expenses related to the running of the home will be incurred. Expenses for travel to the hospital, the doctor's office, or the therapy department may even be a problem. In the case of a long-term disability the worker stands to lose his or her senior position or, ultimately, his or her job. One must always ask whether the patient might be better off with a simpler procedure, which might correct the problem less elegantly, when the more complex procedure may be tied to a loss of economic independence.

Another consideration is ***whether the procedure will fulfill the goals and expectations*** of the patient. Patients must, obviously, be realistic in their expectations. There are occasions when no operation, even one devised by the most clever surgeon, can ever accomplish the patient's goals. It should also be recognized that any operation can be detrimental to the patient's existing condition. There are risks with all of these operations, and certain complications can precisely be viewed as catastrophic. The surgeon can offer rationalizations and even claim that he was "badgered into doing the operation." He can thereby blame the patient if there is a problem because it was the patient's decision. That never works for obvious reasons. From the standpoint of a legal "informed consent," the patient must be adequately informed about the goals, alternatives, risks, and benefits, so that he, as a "reasonable and prudent" person, can make an intelligent decision from the information given. Flip Wilson's comment, "The devil made me do it" doesn't hold up well in or out of court.

In every muscle flap operation one should always assess the anticipated ***functional loss*** and compare it to the expected benefits of the operation. This is usually not a major consideration, with the exception of certain flaps, but it should always be taken into account.

Finally, there is the ***"unhappy patient."*** The "unhappy patient" is not unhappy for the day, instead, this is the patient who has always been unhappy and will always be unhappy. This person never intends to have a happy result and should never be expected to have one. This negative attitude is a major source of discontent because these sad patients readily become angry. Clearly, the angry patient is the common denominator in the generation of lawsuits. Short of that eventuality, they make everyone in sight miserable and negate the benefits of these elegant procedures.

WILL THE FLAP SURVIVE?

The second major consideration is ***whether or not the flap will survive.*** If it won't reliably survive, then there is little reason to undertake the procedure. There are numerous causes of flap necrosis which are beyond the

control of the surgeon, such as a ***vascular compromise*** of the lower extremity. It is obvious that one would not elect to sacrifice one of the two main vessels in the calf just to complete a muscle flap reconstruction. This is similar to the consideration of using a "free" flap in the one vessel leg. Usually, this is only a theoretical concern, but it can lead to a devastating problem. The possibility of a catastrophic complication must always be weighed against the chance that only the use of that procedure could save the extremity. In the case of the ischemic leg, a muscle flap is usually serviceable if it is non-tender and has a pink "muscular" appearance, even though the arteriorgram does not demonstrate any primary vessels to the flap. Uncomplicated ***diabetes*** is not a condition which has caused any noticeable changes in these "axial" flaps, with the exception of the distal cutaneous foot flaps. This is probably related to the fact that the very small, distal vessels are affected earlier in the course of the disease than are the major vessels. Advanced or long-standing diabetes is frequently associated with severe segmental arteriosclerosis of the major vessels, which can adversely affect the survival of a muscle flap or the survival of the entire extremity. ***Denervation*** makes some muscles unusable for soft tissue replacement because of atrophy. It does not seem to harm muscle flap viability. Denervation definitely diminishes the ability of certain long, thin muscles (e.g. the gracilis) to "carry" their overlying skin. Whether this is the direct result of denervation or is caused by the paralytic avascularity is a matter of conjecture. This effect is seldom seen in the flat muscles (e.g. the latissimus dorsi muscle) since their ability to form a compound myocutaneous flap is empirically undiminished. ***Irradiation*** does have a detrimental effect on the cutaneous segment of a myocutaneous flap, but it seldom results in flap necrosis. It is also unusual for irradiation to fatally harm the dominant vessels of the flap unless the irradiation dose has been truly massive. A more worrisome problem is the irradiated "random" skin at the site of inset. Loss of this skin is not at all uncommon, particularly when the progressive effects of the irradiation have had a long period of time to destroy the microcirculation of this skin. This may leave a viable myocutaneous flap stranded in a sea of surrounding dead "random" irradiated flaps. Necrosis of irradiated muscle flaps has not been observed even when there is "woody" fibrosis of the muscle. ***Infection*** can be a source of flap loss but it is most unusual and generally involves opportunistic bacterial invasion. It becomes effective, for the most part, in an already ischemic flap which is "fragile" enough to be lost with even the slightest additional insult. ***Smoking*** is a source of flap loss which is clearly recognized. One hates to incriminate a drug which is so commonly used, but nicotine ingestion is unequivocally harmful to flaps; and some patients are more sensitive to the peripheral vasoconstrictive and ischemic effects of nicotine than others. The harmful microcirculatory effect of nicotine may also persist for weeks after the cessation of smoking. There is no reliable preoperative cure for smoking, but there is an excellent postoperative cure. One simply maintains the patient on nasal oxygen and prohibits smoking. The "fire hazard" has proved to be a compelling motivator for these unfortunate addicts. When the cessation of smoking is critical to the survival of the flap, as in the case of the TRAM flap or a "free" flap, a preoperative urine nicotine level can be obtained to verify cessation. If the patient knows that the surgery will be cancelled because of the added risk of nicotine use, the urine nicotine test can act as a reasonable and civilized deterrent to continued smoking. ***Cold*** is a recognized cause of flap loss and should be avoided in both the operating room and the ward. There are certain flaps which are known to be cold-sensitive and they should be especially protected. The "core" body temperature can be maintained in the operating room by using warm ambient temperature, heated inspired air, heated intravenous fluids, a heating blanket, extremity wraps, and arctic body bags. Even the fluids to wash off the surface of the skin should be heated. The flap should also be protected with warm packs which are maintained at 37 degrees. We have passed the day when the "modern" operating room comes equipped with a heated Mayo basin which keeps the fluid temperature at 37 degrees. We have reinstated this antiquated practice, and until we did this, the too cold or too hot irrigation fluid temperature was determined by the nurse's gloved hand. This crude method of determining what is expected to be hot or cold to the patient's skin would never be tolerated by the awake patient. It has caused burns of the skin from steaming fluid and necrotic flaps from fluid which was too cold. The harmful effects of flap manipulation, in respect to ***torsion*** or ***tension*** which lead to vascular "spasm," are totally preventable. One must be very gentle in the amount of twist or stretch which is applied to both the vascular pedicle and the inset flap because this can make all the difference in the flap's survival. In addition, the ***"crossing tension"*** can be so excessive that it will result in the physical collapse of the subdermal plexus. When one fluoresces such a flap, it is easy to visualize the area of vascular compression, which appears as a blue streak across a nicely fluorescing "chartreuse" colored skin. This problem should be immediately corrected by "derotating" the flap and rearranging the closure.

WILL THE FLAP COVER THE DEFECT?

A third question is ***whether the flap will adequately cover the defect.*** One must always have a secondary flap choice in mind as a "back-up." This doesn't mean that when the primary flap fails, we start thinking about our alternative flap choice. Instead, it is the same mental processing which one should go through in the course of choosing a "free" flap. If a "free" flap is elected as the first line of defense, one should always have a "back-up" local flap available in the event of the loss of the "free" flap. If, as it turns out, the local "back-up" flap could do the job more efficaciously, then one should not use the "free" flap. Using a similar logic, if one loses a "free" flap and is not willing to use another "free" flap for exactly the same problem, a local flap should have been used in the first place. Secondary, "back-up" flaps must be deliberated with the same care as the primary flap choice.

WHAT HAPPENS IF IT FAILS?

Finally, ***what happens if everything fails?*** Do you do the same procedure again? Do you do a "free" flap? Do you quit? Of course this is an unanswerable question, but we think one should have some sort of parachute mechanism available. Luis Vasconez has said this best. Every year at the Flap Workshop he shows a case in which he used one TFL flap for an abdominal defect and half of it died. He then shows the opposite TFL flap transposed to the abdomen and half of it died. His conclusion to this is very simple: "If Plan A is a complete and abject failure, do not make Plan B precisely the same as Plan A." If a local flap fails, it is certainly not unreasonable to consider a "free" flap. The reverse of this condition is equally valid. In fact, every time a local flap is considered a "free" flap should be considered as a reasonable possibility. The complication rates in the near future will be very similar, if they are not already. It should be emphasized that the ***simplest solution is usually the best solution.*** This may be a skin graft or a "random" flap, but it can also be a "free" flap. Neither should the operation be designed to fit a text book description. For that reason we have not listed the four "best" options for each area of the body in the order of our preference and prejudice. This is a final consideration which must be carefully thought out by the surgeon himself. The responsible surgeon must at least be conversant with the multiplicity of options to intelligently make this fundamental decision. Since any flap can fail, it is surgically naive to be familiar with only a single method of flap reconstruction. Instead, we should contemplate "digging out" before the die is cast.

SUMMATION

The basis for success with any muscle flap procedure is a precise knowledge of anatomy. One should be prepared for the anatomical variations in the blood supply of the proposed flap and the alternative flaps as well. Luis Vasconez was the first to suggest that the branches of the profunda femoris artery enter the anterior thigh muscles parallel to the inguinal ligament, approximately ten centimeters below this ligament. This is very helpful for planning purposes, but we have all found the vascular configuration to be either better or worse than we had expected.

It seems axiomatic that one should proceed with a definite plan, but the plan should be more flexible than rigid. The defect should be excised first, and then the flap should be designed to fit the problem. This premise must be tempered by the availability of an assuredly viable flap in the case of a life-threatening defect e.g. an open chest wall. One really needs to be able to think about a number of optional flaps at the same time, as though you have access to a built-in flap computer to weigh multiple simultaneous variables. For instance, the excision of an ischial ulcer or a pretibial osteomyelitis may yield a defect which is far different than what was expected. In this case one either has to have an alternative plan or be ready to pack the wound and go home. Although there is no compulsion to complete every reconstruction in a single setting, the lack of an alternative procedure should seldom be a reason for a delayed completion. The intraoperative design of the flap is something that should present a minimal problem, unless there are intervening circumstances such as heavy irradiation or previous scarring.

The elevation and manipulation of any flap should be technically gentle, even though some of the large sutures used for closure cast the surgeon as somewhat antediluvian. Obviously, shearing forces, torsion, and the separation of the skin from the muscle should be avoided. The transfer of the flap should be straightforward, but should be performed delicately. Because muscle is extremely sensitive to compression, constricting tunnels or a tight inset of the flap must be avoided.

The aftercare is fairly simple. The patient needs to be carefully followed in an environment conducive to the healing of the flap. This may mean special beds, positioning, and room temperature control. As important

as aftercare is, it is usually of secondary importance because virtually all of our surgical misfortunes begin in the operating room. After seeing the same complications repeated over and over by subsequent generations of resident surgeons, Dr. Nathan Womack always tried to put an end to the repetition, when he said: "Do we have to keep repeating this same clinical experiment? We all know that it will work." The mistakes have already been made by others. They should not need to be reinvented by each new generation of reconstructive surgeons.

1

This seventy-four-year-old patient developed a well-differentiated squamous cell carcinoma of the buccal mucosa despite the absence of any history of alcohol or tobacco use. Positive frozen section margins were obtained throughout the procedure, and dictated the removal of half of the mandible and palate, the tonsillar area, the maxilla, and the cheek. Permanent pathological examination demonstrated microinvasion of vessels and involvement of six of twenty-six lymph nodes. An immunological deficiency and an unusually aggressive tumor should have been suspected in this elderly female who was a nonsmoker and a nondrinker. (Case of J.B. McCraw and G.L. Schecter)

2

An extremely large pectoralis "paddle" was outlined. The flap carried virtually all of the breast tissue overlying the pectoralis major muscle. This was done to enhance the viability of the distal flap and to provide soft tissue "fill" for the cheek defect. During the extirpative procedure, the patient's core body temperature fell to 94 degrees, and it was not possible to raise the core temperature during the period of flap elevation.

3

The donor site was primarily closed, and the flap was immediately inset. This particular flap design should be expected to be almost totally reliable, but the detrimental effects of the cold temperature resulted in very poor fluorescence. It was necessary to leave a large orocutaneous fistula so the palate, tonsil, and sulcus could be closed. It would have been preferable to have used a second flap to complete the reconstruction, but this was not possible for anesthetic reasons.

4

Only the distal one centimeter of the flap necrosed, but this completely disrupted the palatal and cheek closures. An opportunistic infection and gravity completed the disaster. The patient became desperately ill in the early postoperative course, and by the time it was possible to do a second flap, the aggressive tumor had recurred locally. She spent the rest of her days in the hospital in physical agony and emotional dejection, even to the exclusion of her family. This case raises a number of "should" questions about the advisability of this operation: 1) Should the procedure have been done in a single stage? 2) Should a marginally viable flap have been returned to the donor site? 3) Should the less cold-sensitive latissimus dorsi flap have been used instead of the pectoralis flap? and 4) What would the salvage procedure have been, if the patient had lived?

5
TRAM flap procedure in an ideal young candidate. The flap elevation was uneventful. Intravenous florescein has been given and is visible in the flap. (Case of J.B. McCraw)

6
TRAM flap ready for insetting. The fluorescence of the entire flap is similar to the color of the surrounding skin.

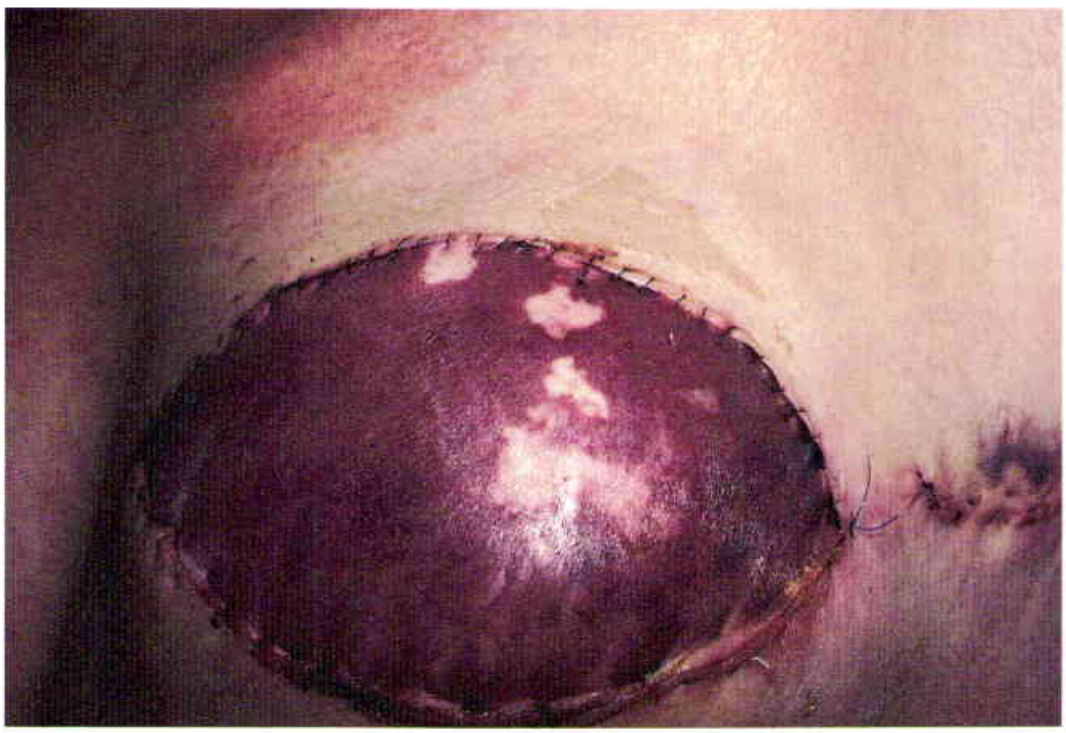
7

Appearance of the flap on the sixth postoperative day. The flap was pink and viable until the third postoperative day. The hospital room temperature dropped below 60 degrees, and the flap became totally blue over a six hour period. Warm packs corrected this cold-induced injury in the majority of the flap, but the lateral aspect of the flap was mortally wounded.

8

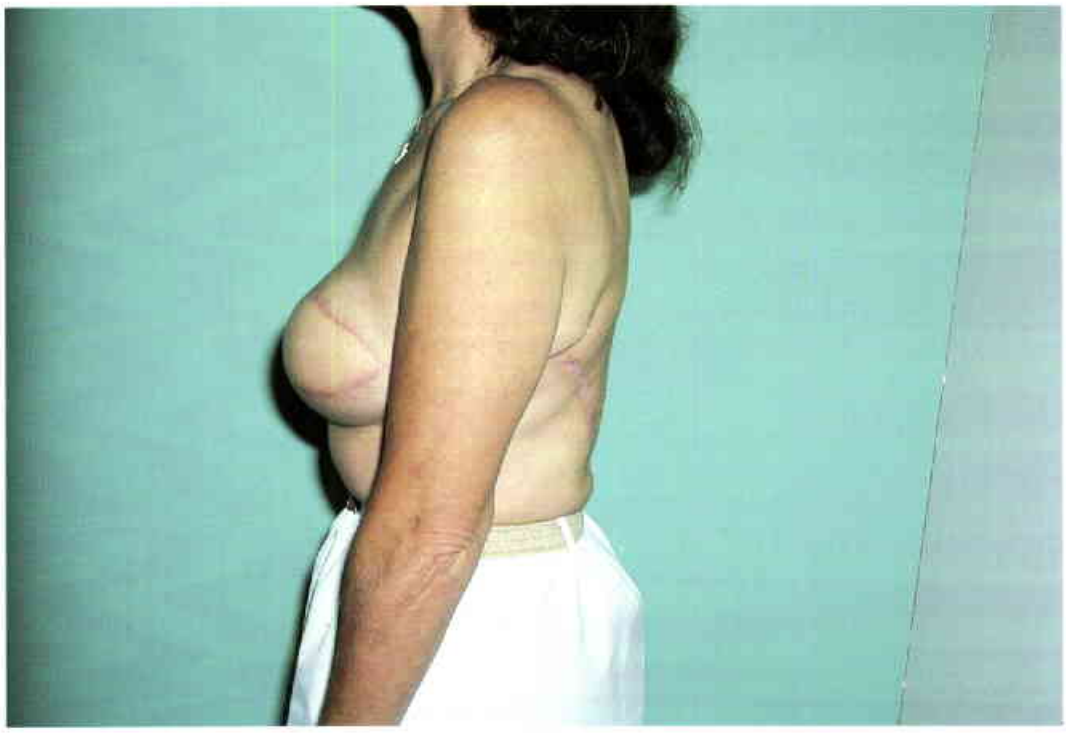
The lateral portion of the flap was excised and closed. This late loss of an initially healthy flap can only emphasize the fact that the TRAM flap is "cold-sensitive." Protection of the flap from cold must be extended through the early postoperative period.

9
A left rectus abdominis myocutaneous flap was elevated and returned to the donor site because of very poor fluorescence. In this early case an attempt was made to remove very little anterior rectus fascia, and some obviously significant perforators were inadvertently excluded. Appearance of the flap at forty-eight hours. (Case of P.G. Arnold)

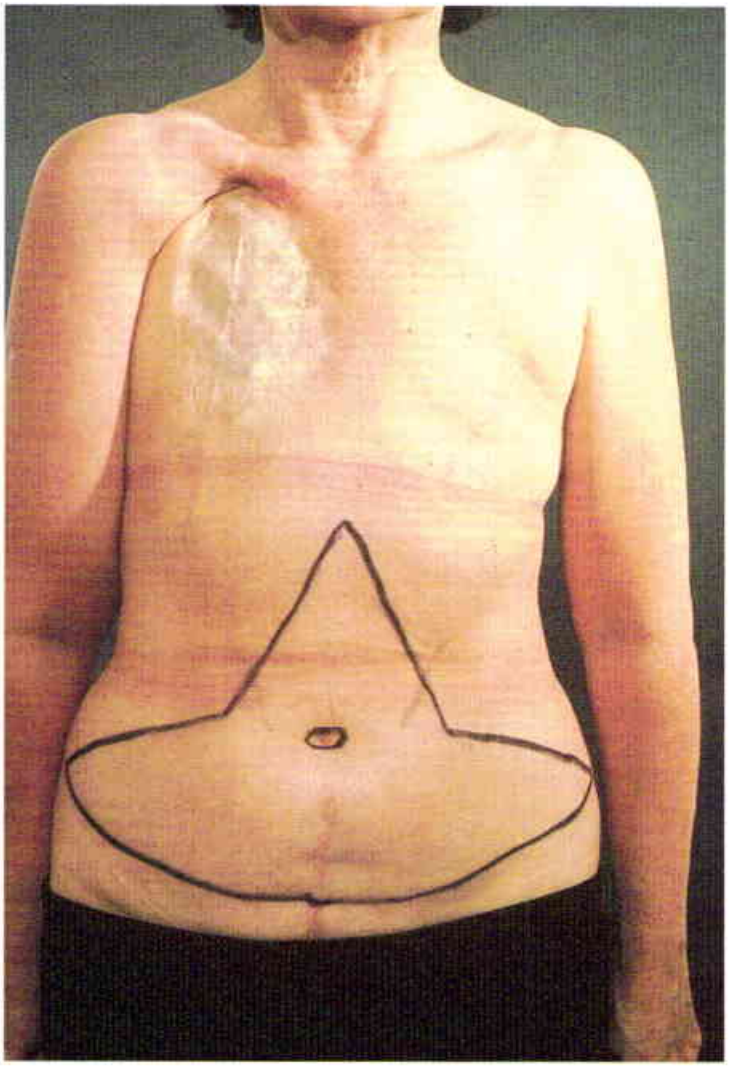


10
The flap was transferred at two days and was clearly nonviable at four days. The rectus abdominis flap was excised and replaced with a latissimus flap and an implant on the fourth day.

11
Appearance of nicely healed latissimus myocutaneous flap at six months. When a "salvage" flap is indicated, it should be done before the wound becomes stiff, unpliable, and infected.



12
Lateral view at six months.

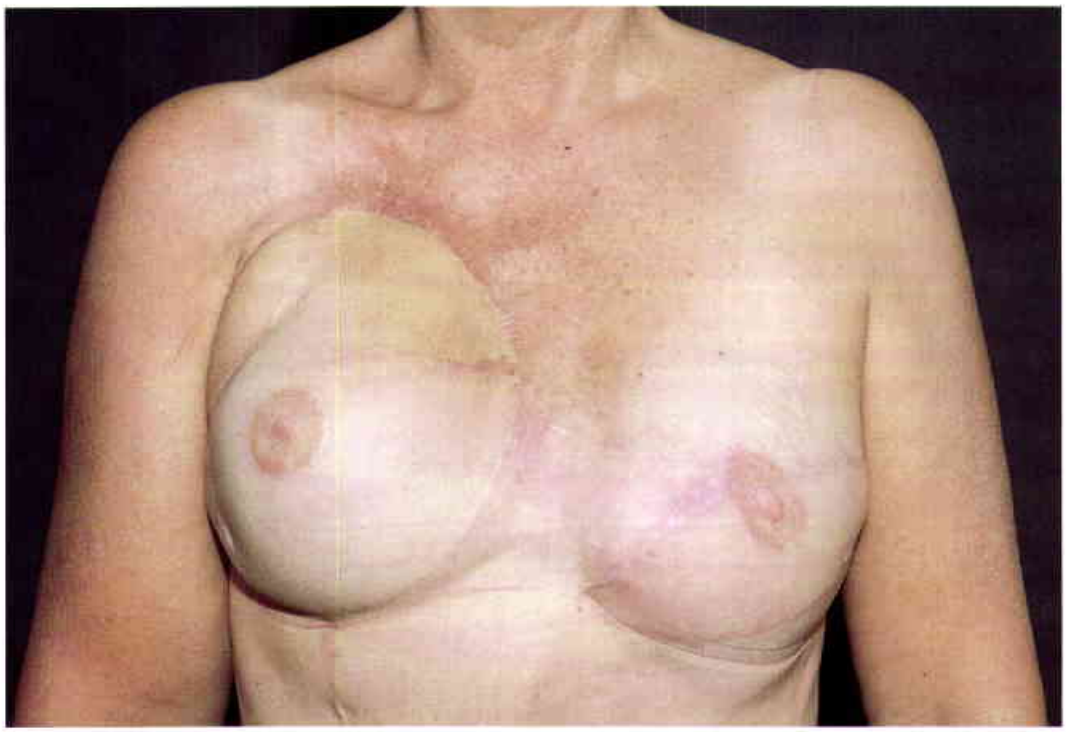


13
This patient offered every conceivable mastectomy deformity, including lymphedema. The breast and sternal areas had also been heavily irradiated. A combined vertical and horizontal TRAM flap was outlined because of the lower midline abdominal scar. This case predates the double muscle pedicle TRAM flap. (Case of J.B. McCraw)

14
The tip of the TRAM flap was lost. An attempt was made to retain a portion of the "opposite" abdominal skin in order to correct the axillary deformity. This flap ulceration started out as a one centimeter breakdown and evolved into a full-blown irradiation ulcer. Any flap introduced into a severely irradiated area must be totally self-sufficient since it will not receive any blood supply from the site of inset. It is also a futile exercise to hope that the "opposite" skin of a TRAM flap will survive beyond a midline scar.

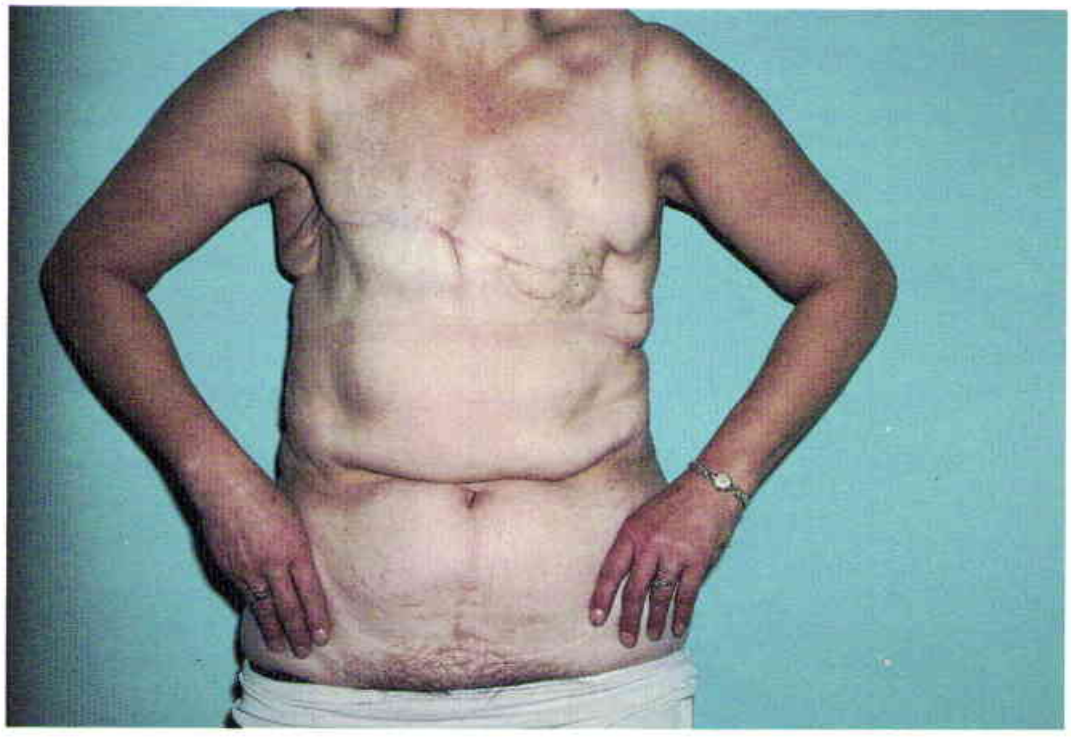
15

A small latissimus flap was brought into the axilla and the upper outer quadrant of the breast to repair the irradiation ulcer which we had created. In retrospect, it would have been advisable to have used both flaps in the initial operation because of the magnitude of the defect. Today, we would prefer a double muscle pedicle TRAM flap.

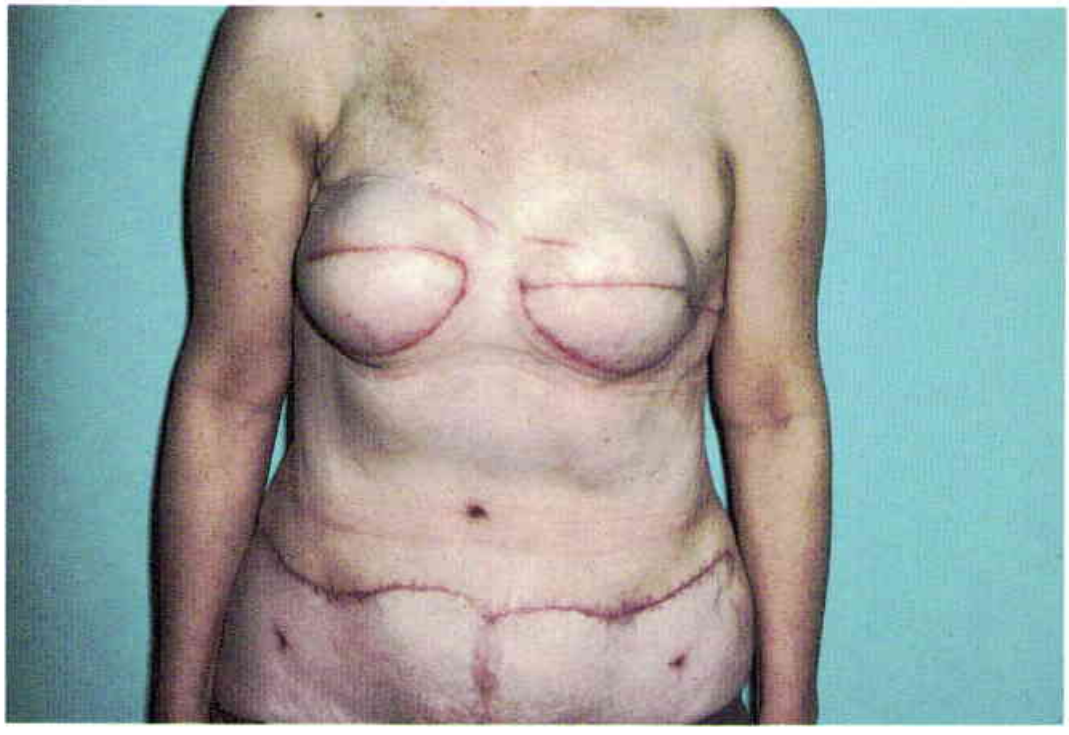


16

The rectus abdominis and latissimus dorsi flaps adequately reconstructed the massive right breast defect without an implant. Only the TRAM flap can be expected to correct such a complex deformity. The left breast was later reconstructed with a latissimus dorsi myocutaneous flap and an implant.



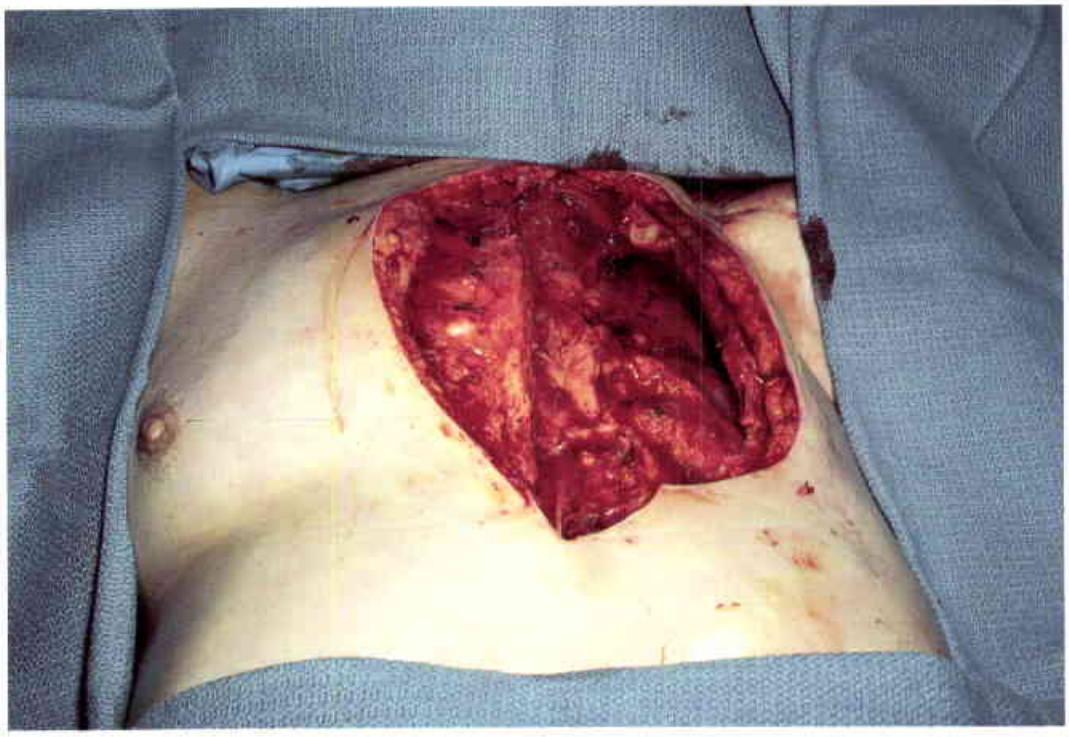
17
Fifty-eight-year-old female twelve years following a bilateral modified mastectomy. A lower midline scar extends from the umbilicus to the pubic area. Bilateral TRAM flaps were planned. (Case of P.G. Arnold)



18
Appearance one year postoperatively. The level of flap inset at the "new" inframammary folds was chosen prior to the abdominal closure. The reconstructed breasts were positioned two to three centimeters lower than ideal. This could have been avoided by closing the abdominal donor site before a commitment had been made as to the level of the "new" inframammary fold. It is a difficult problem to correct after the fact.

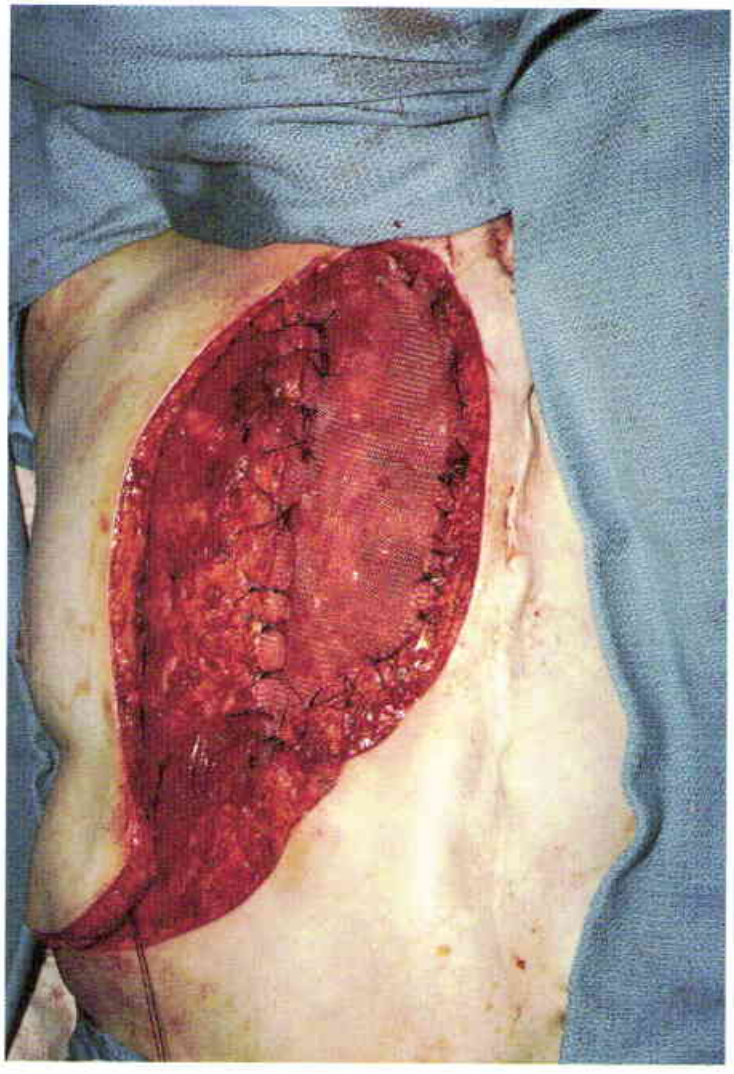
19

Fifty-seven-year-old female twenty-five years following a left radical mastectomy and irradiation therapy. Although the sternal ulceration had been present for only three weeks, the patient bled profusely from this ulcer on the day of admission. An emergency median sternotomy was required for control of an eroded internal mammary vessel. Her consultant, P.G. Arnold, personally held pressure on this vessel in the vascular radiology suite, until operative control could be achieved. (Case of P.G. Arnold)



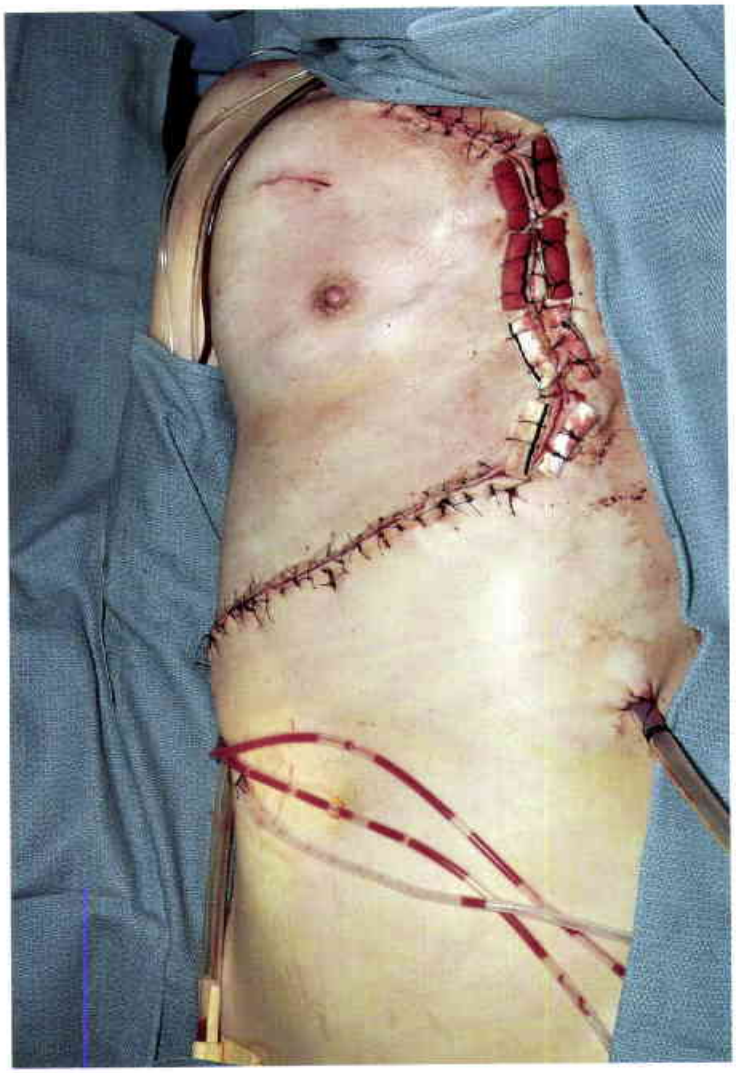
20

It was necessary to excise the left hemisternum and a major portion of the left anterior chest wall to remove the damaged tissue.



21
The thoracic skeleton was reconstructed with Prolene® mesh. The wound appeared to be "clean" following the debridement.

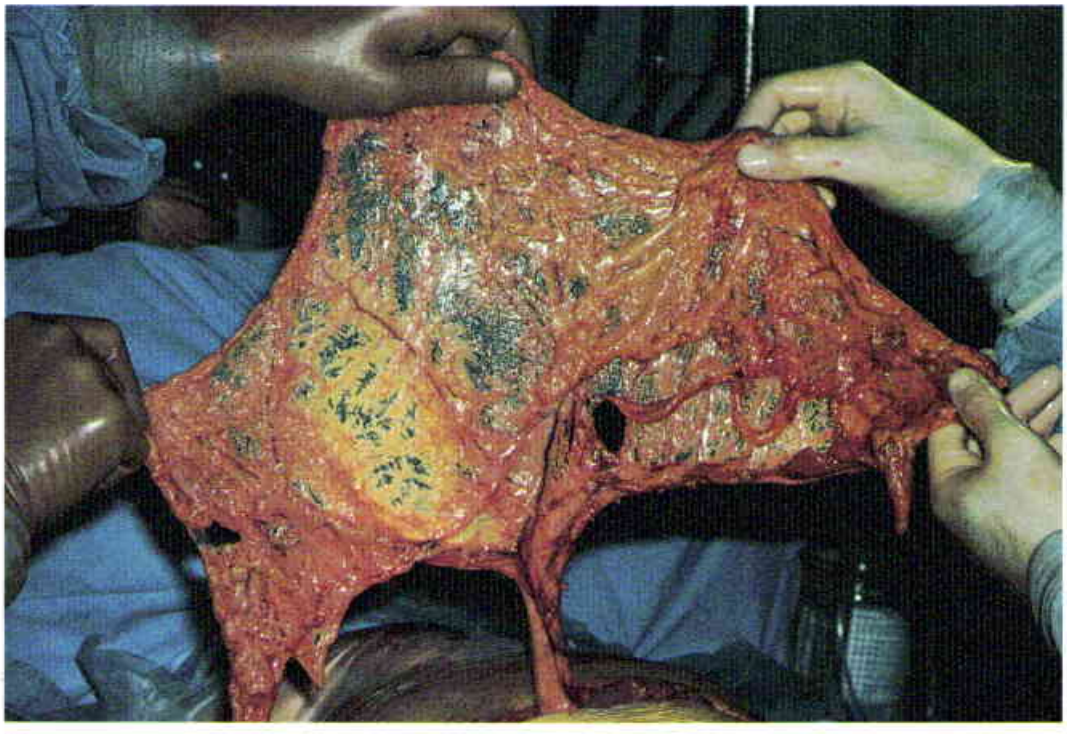
22
A massive myocutaneous flap was raised from the right chest wall. Both the pectoralis major and the latissimus dorsi muscles were included in the flap.



23
The compound chest flap was rotated anteriorly, and the donor defect was primarily closed.

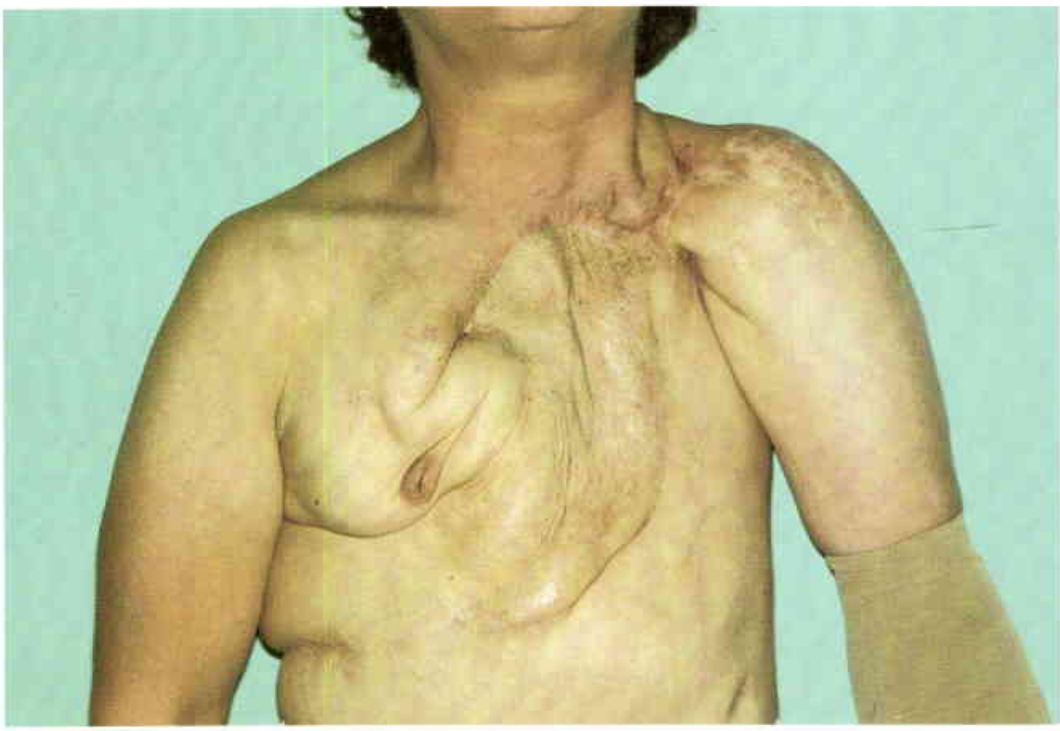
24
Appearance five days postoperatively. The wound was frankly infected. The flap survived completely.

25
Even though the flap survived, the wound totally dehisced. The Prolene® mesh had to be removed. Serial debridements and saline dressings were used to prepare the wound for a secondary closure.

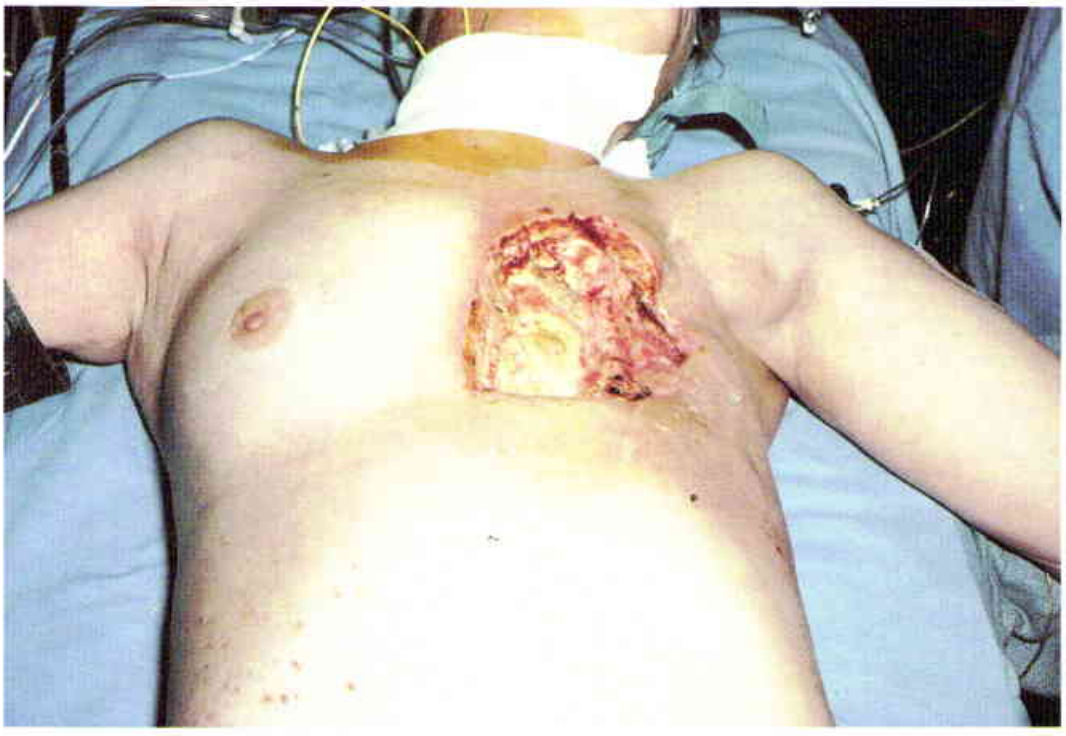


26
The omentum was elevated on the right gastroepiploic vessels to help "dig out" from this surgical maelstorm.

27
The omentum was passed through a subcutaneous tunnel and grafted in a delayed fashion.



28
Appearance of the chest several months following a heroic but unattractive salvage. In retrospect, it was a mistake to place Prolene® mesh in an already infected wound. This problem would have been extremely difficult to solve if the omentum had not been available.

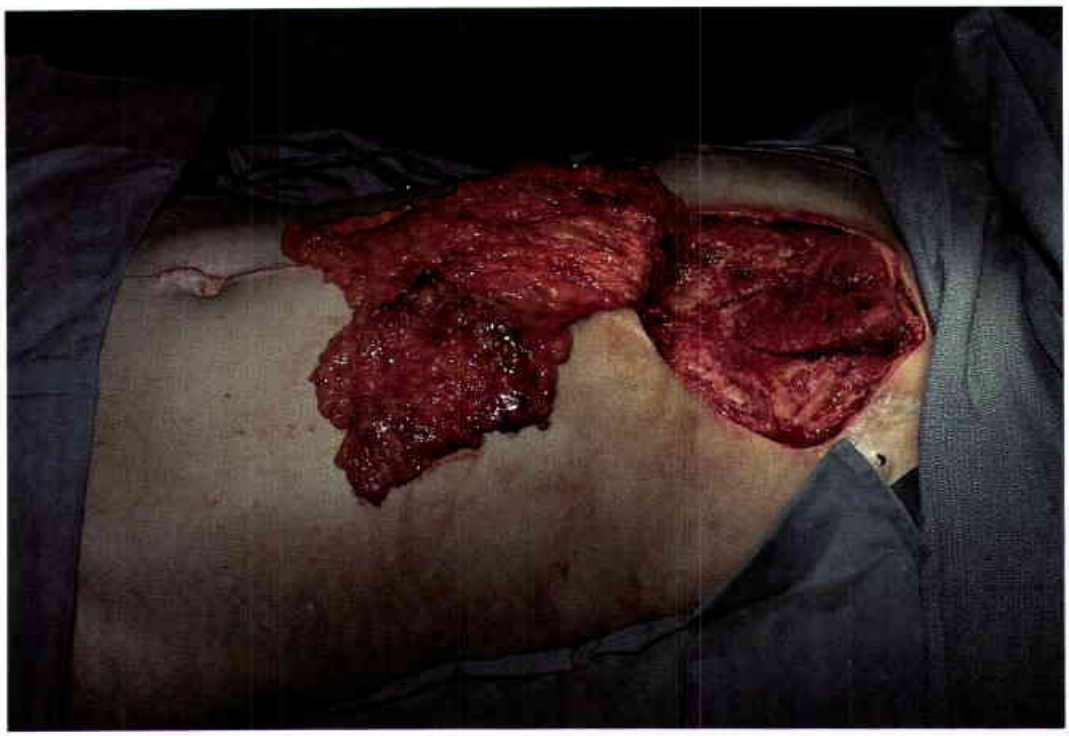


29

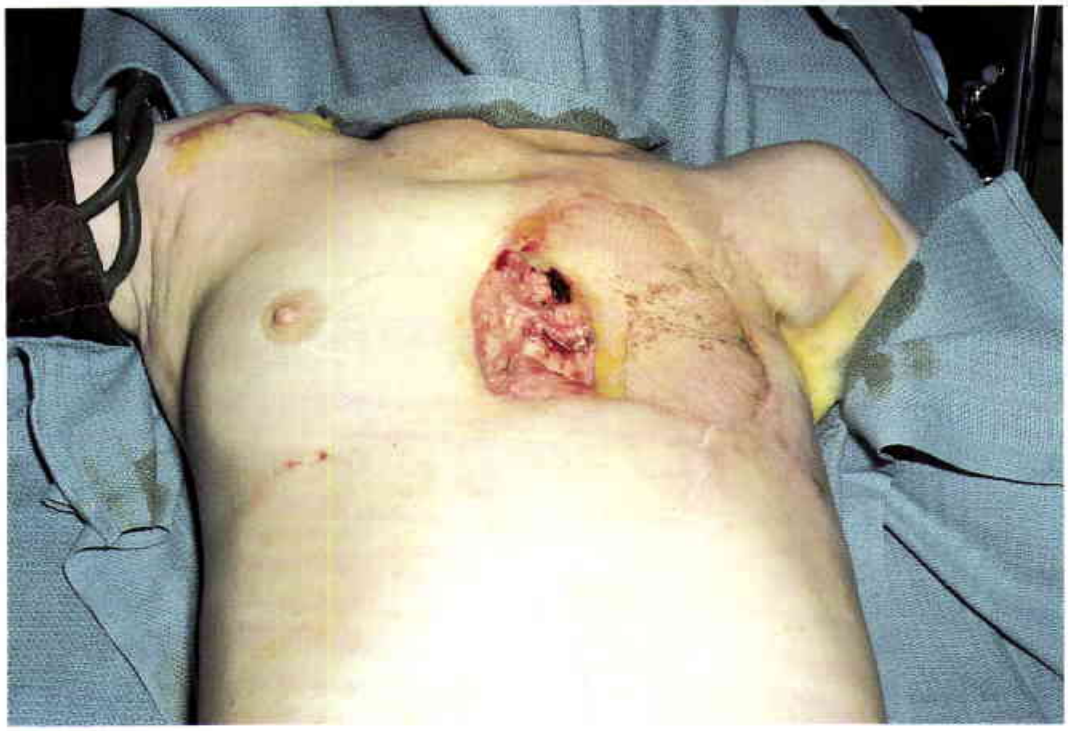
Forty-nine-year-old woman following a left radical mastectomy and chest wall irradiation. The ulcerated wound of the left anterior chest had been present for several months. The latissimus dorsi muscle was denervated and devascularized. This was the appearance at the time of the initial debridement. (Case of P.G. Arnold)

30

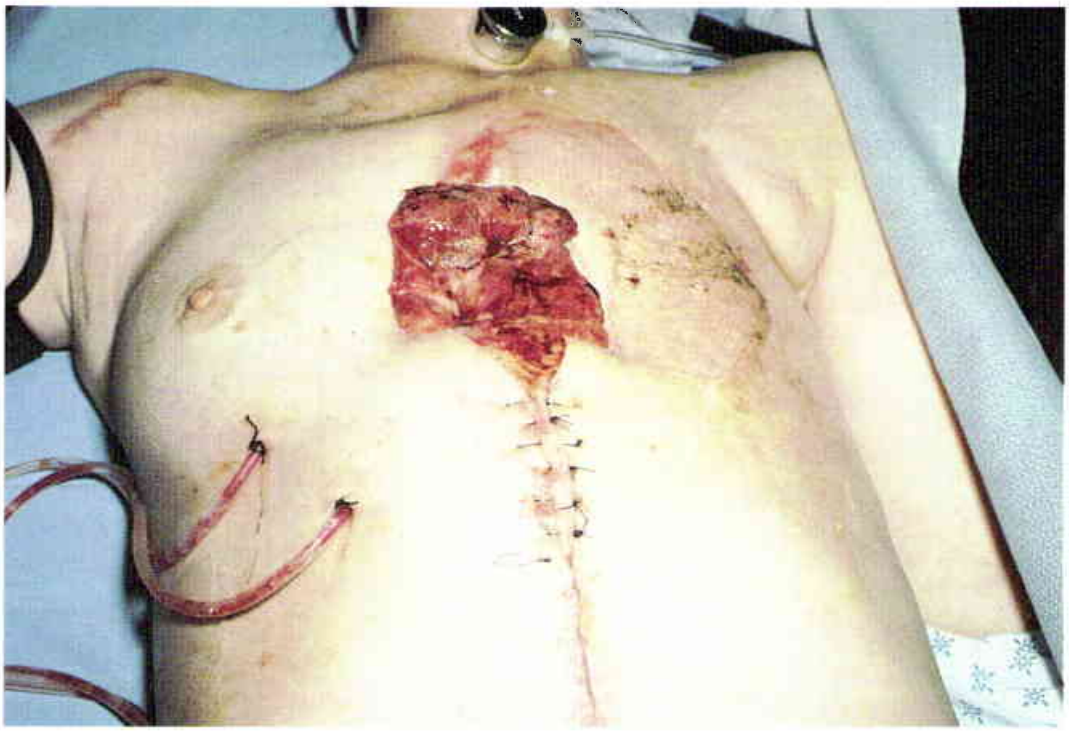
The right pectoralis major muscle was elevated on the internal mammary perforators and transposed into the left chest wall defect. This "turnover" pectoralis major flap was inadequate to close the wound.



31
Forty-eight hours later a celiotomy was performed, and the greater omentum was transposed and skin grafted.

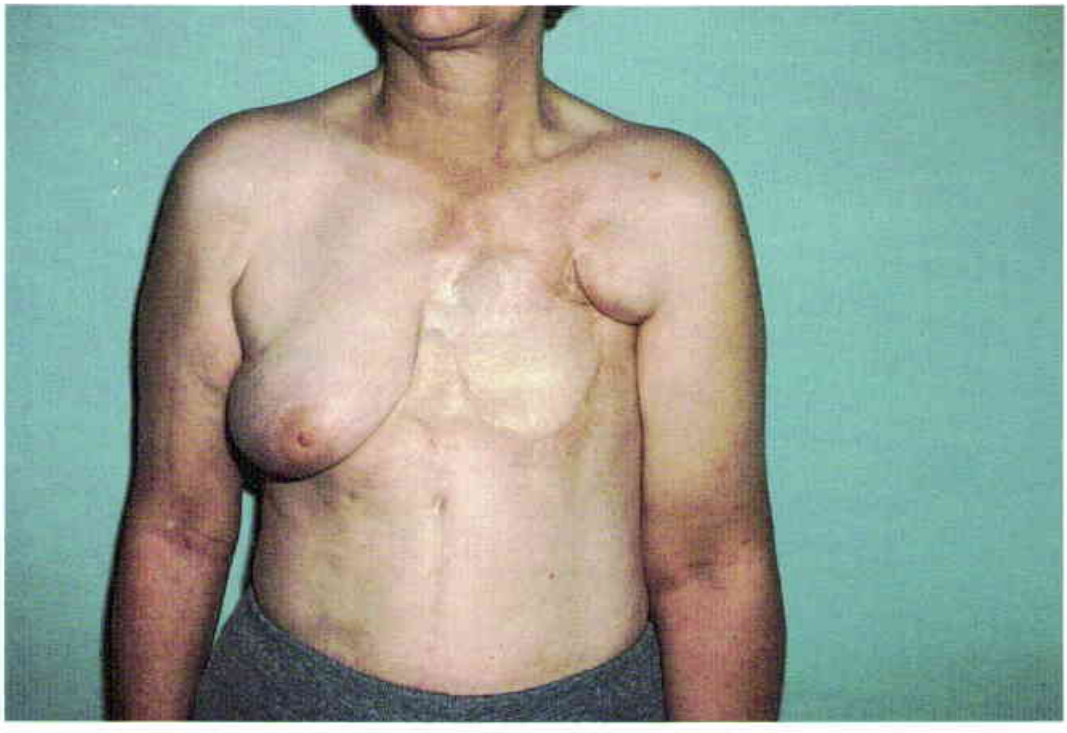


32
Five weeks following the omental transposition, the patient returned with drainage from an obviously necrotic sternum.



33

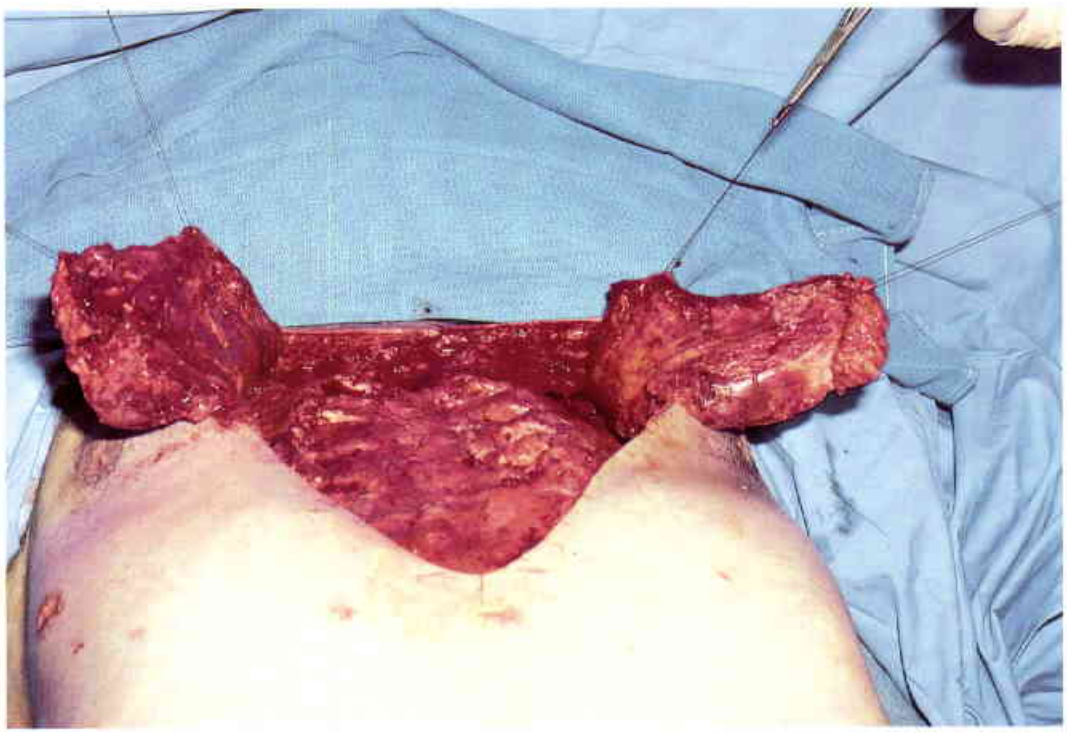
The lower half of the sternum was removed. The defect was closed by transposition of a right rectus abdominis muscle flap which was skin grafted.



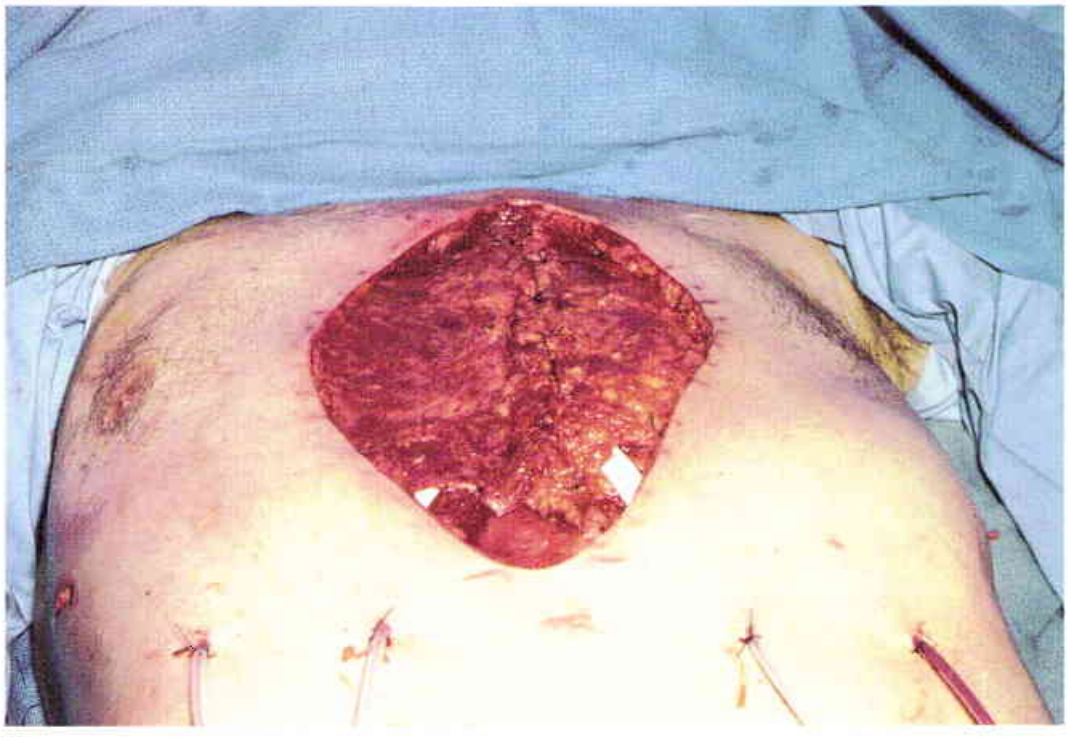
34

Appearance at five years with no further recurrence. The choice of the medially based pectoralis major muscle was a poor one for this particular defect. In fact, it's hard to find a reason to use the pectoralis major "turnover" flap at all, in light of the other available options. The failure of the greater omental transposition was caused by the retained, nonviable sternum. The rectus abdominis muscle flap was probably a more reasonable choice for this lower sternal defect from the outset.

35
Total infection of a median sternotomy following a coronary artery bypass in a forty-eight-year-old male. The staphylococcal infection was resolved with multiple debridements, which included the total removal of the sternum and costal cartilages. (Case of P.G. Arnold)



36
Pectoral insertion of the "nondominant" upper extremity was divided.

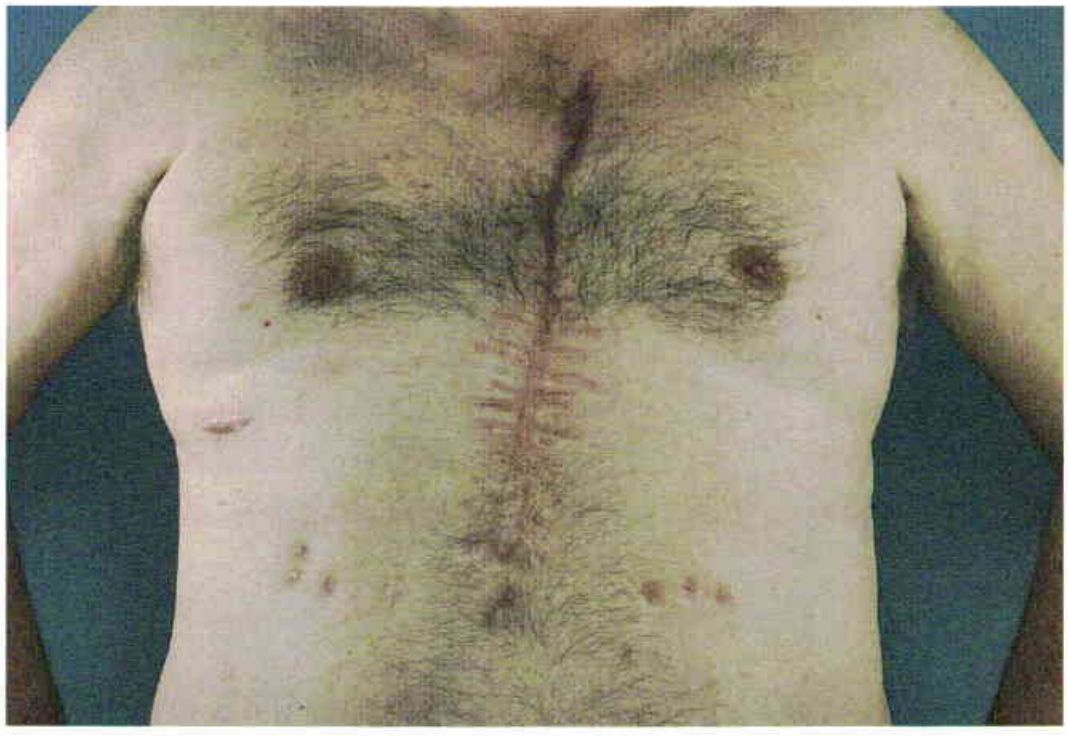


37
Approximation of the pectoralis muscles in the midline. A primary skin closure was possible.

38
Appearance six months following the bilateral pectoralis muscle flap closure.

39
Twenty-three months following the first closure with the pectoralis muscle flaps, the patient returned with persistent drainage in the upper anterior midline. The sternoclavicular joint was the source of the infection.

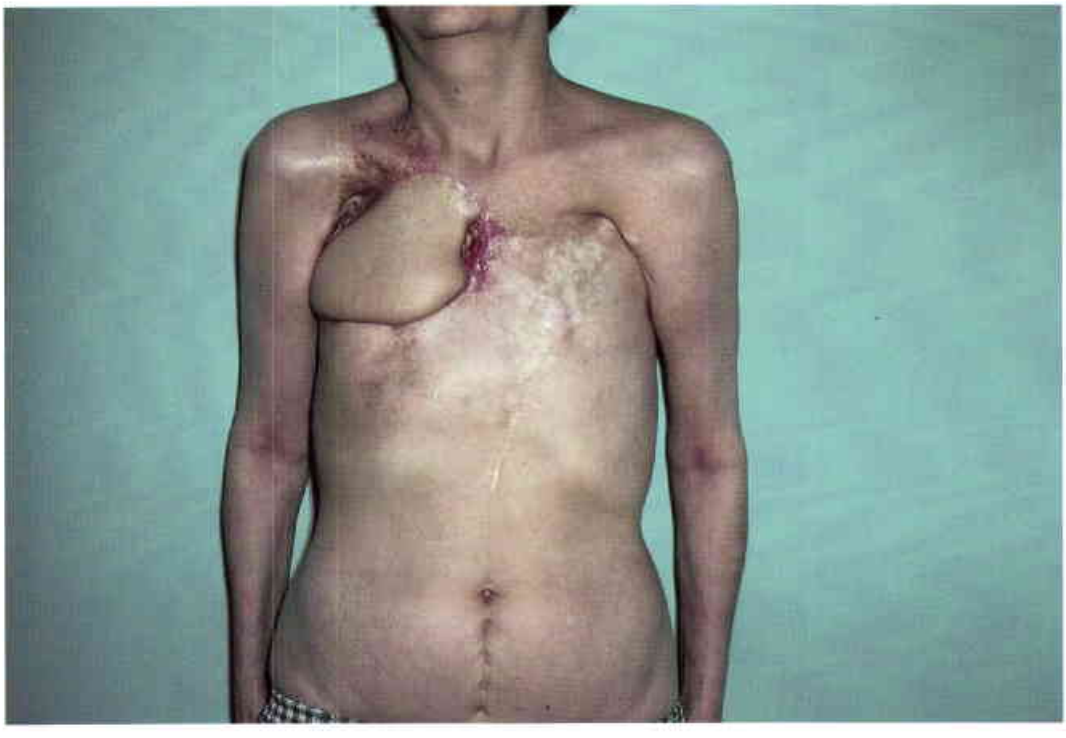
40
The pectoralis major muscles were mobilized again. The infected sternoclavicular joint was removed and covered with the pectoralis muscles.



41

Appearance five months following the secondary closure with no further drainage. This represents the unfortunate case of an apparently adequate debridement and closure with muscle flaps and a delayed expression of a subclinical infection. Osteomyelitis of the sternum and the adjacent structures is similar to osteomyelitis of the long bones. It may be dormant for months or even years before it becomes clinically evident. It must be treated just as aggressively the second time around.

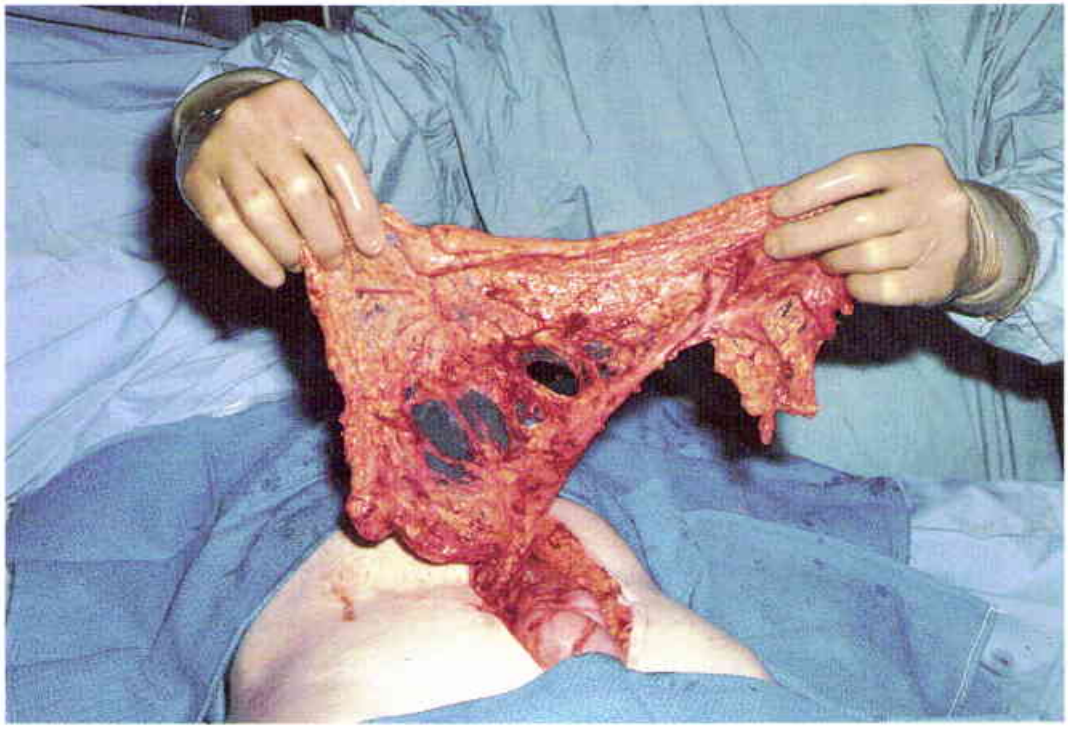
42
Fifty-four-year-old female who had undergone bilateral radical mastectomies with radiation therapy to the right chest. A painful ulceration had been present for several months. (Case of P.G. Arnold)



43
The irradiation ulcer was excised and closed with a latissimus dorsi flap. The patient was referred after three months of persistent drainage.

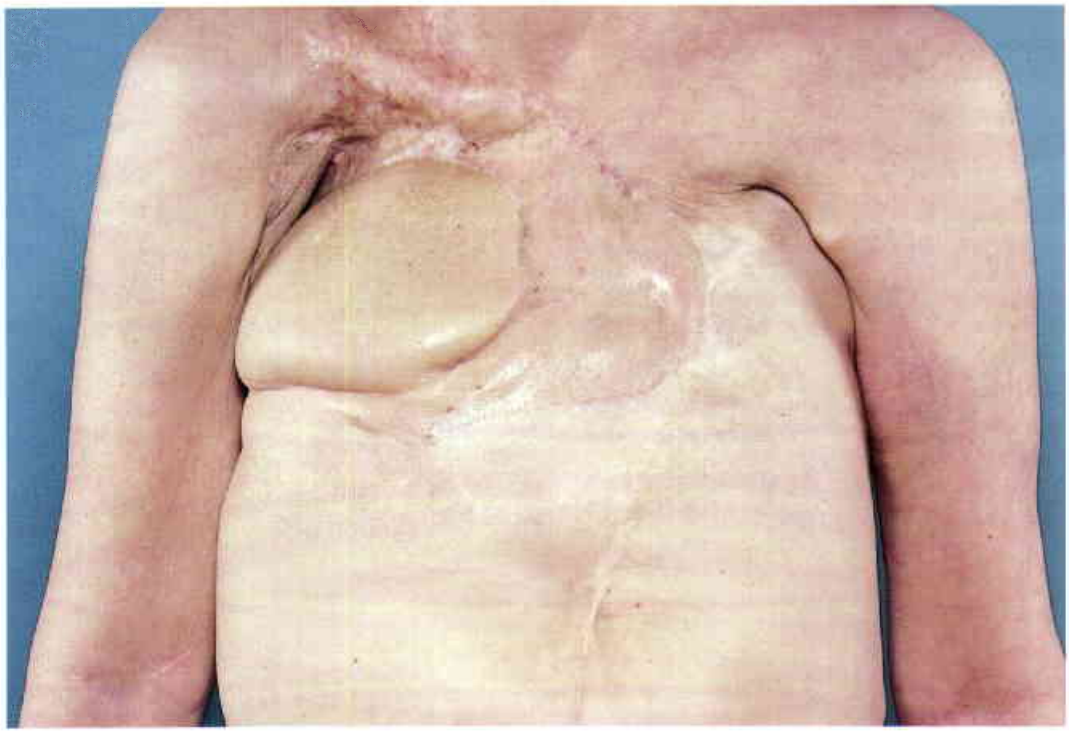
44

The stiffened latissimus flap was reelevated and advanced centrally in a V-Y maneuver in order to avoid a large secondary procedure. The advancement did not provide adequate muscular coverage of the sternum and disrupted because of the tense closure. This is a good example of a wasteful ''small'' procedure. This is usually done because someone says: ''but doctor, I've already had a big operation.''



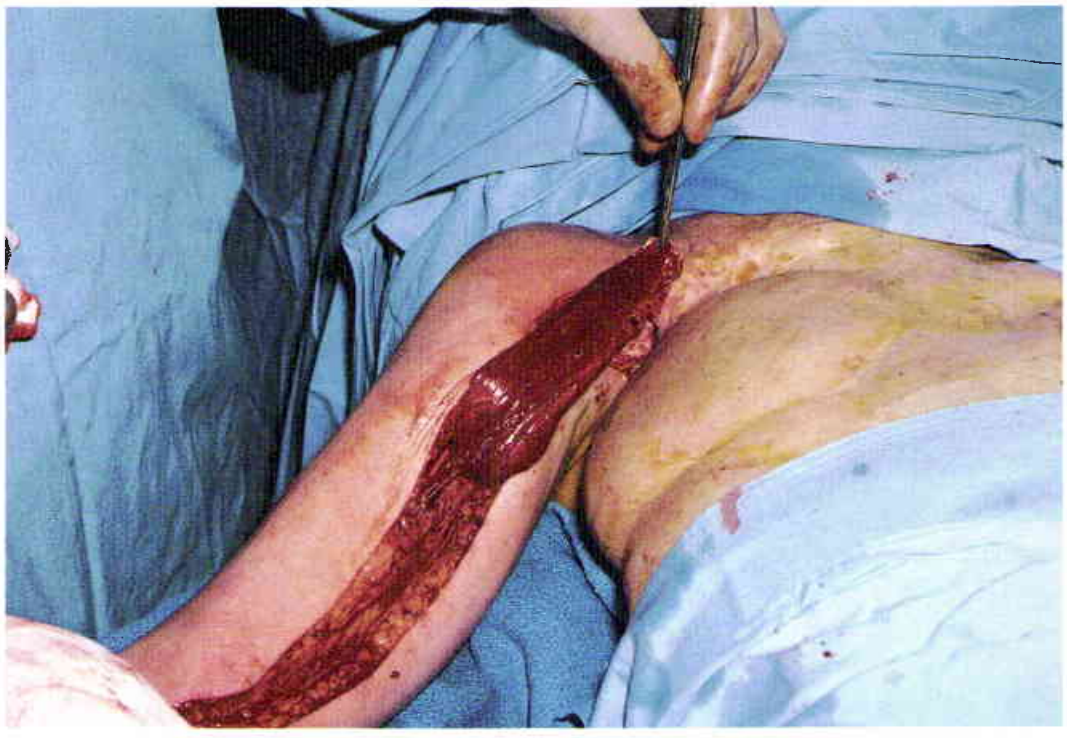
45

A celiotomy was performed, and the omentum was transposed into the remaining chest wall defect.



46
Appearance of the chest wall at ten months. The skin-grafted omental flap provided stable coverage.

47
Two years later the patient had a new irradiation ulcer of the proximal humerus. The latissimus, pectoralis, serratus, and omental flaps were unavailable.

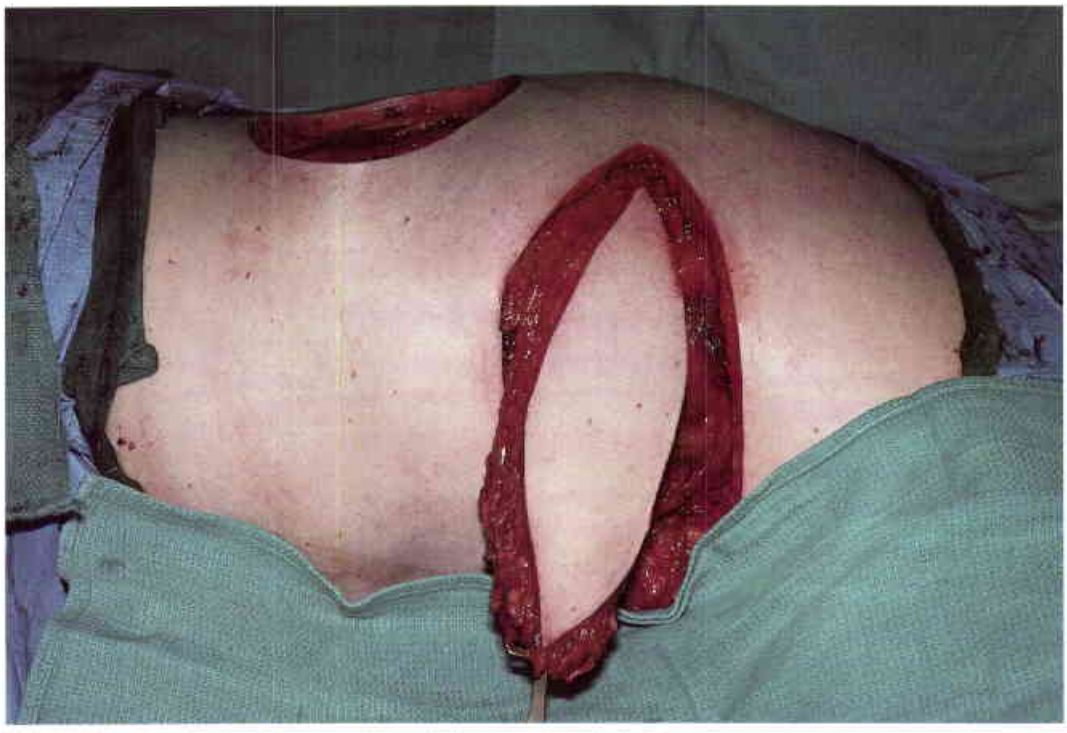


48
The long head of the biceps muscle is elevated on the proximal blood supply and transposed into the defect.

49
Two months following the biceps muscle flap reconstruction. The function of the arm was not harmed by the use of the biceps muscle flap.

50

Forty-seven-year-old male with a level IV melanoma of the lower right back. Because the adipose layer was at least three inches in depth, it was felt that a skin graft would present a more difficult healing problem than a flap. (Case of J.B. McCraw)



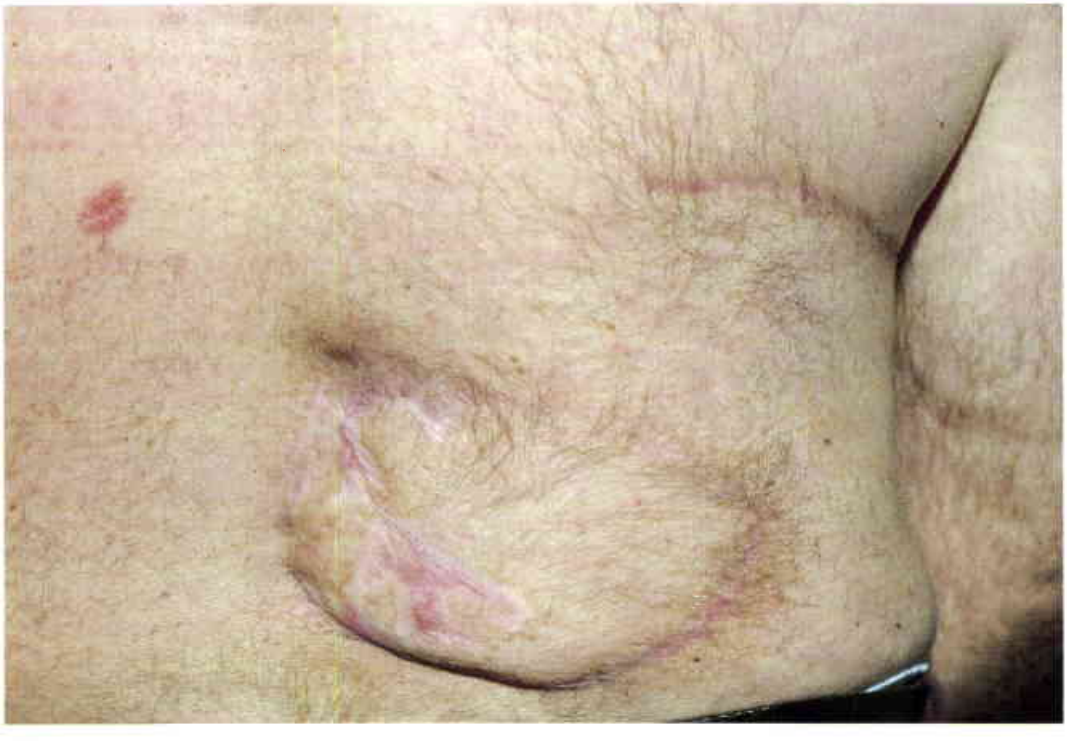
51

A ''reversed'' latissimus dorsi myocutaneous flap was elevated. No deep posterior perforating vessels were divided, and the flap fluorescence was excellent. All of the cutaneous segment was in direct contact with the underlying latissimus muscle. The proximal latissimus muscle itself was tunneled beneath the intervening skin bridge.

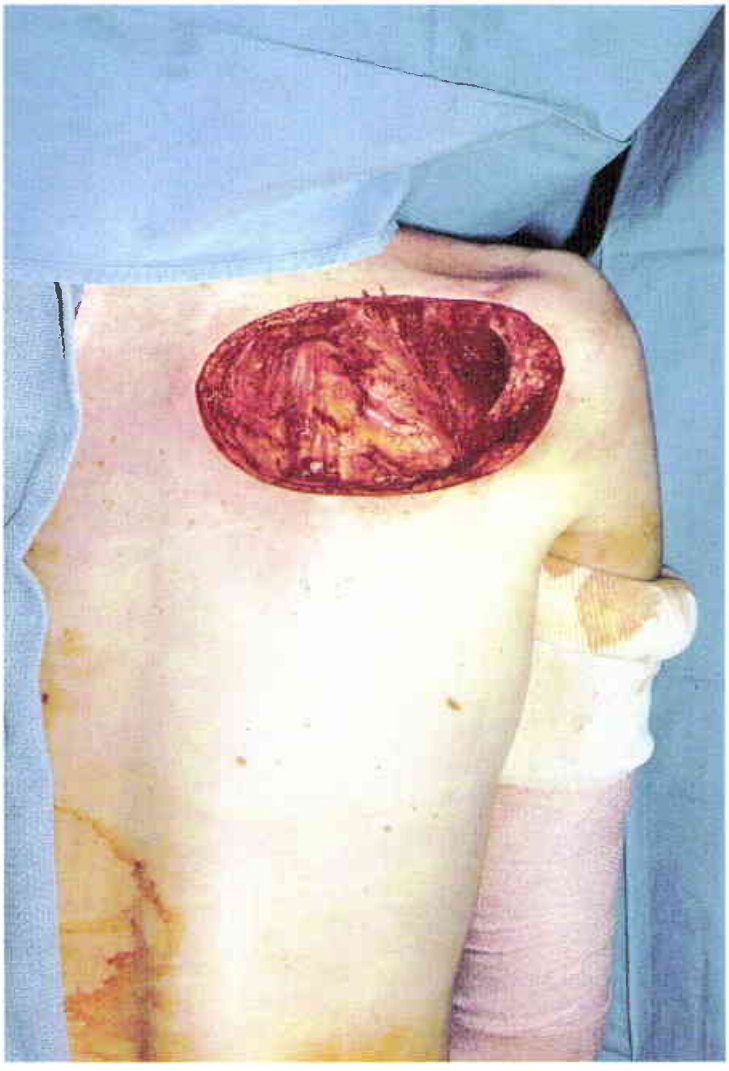
52
At five days the skin bridge constriction of the bulky muscle had caused the necrosis of the distal flap skin. Even the hardy latissimus muscle can be injured by external compression.

53
At three weeks this deep wound extended to the paraspinous muscles. This busy man had already returned to work and had chosen home care with the WaterPik® over further salvage surgery. Fortunately, he couldn't see his back.

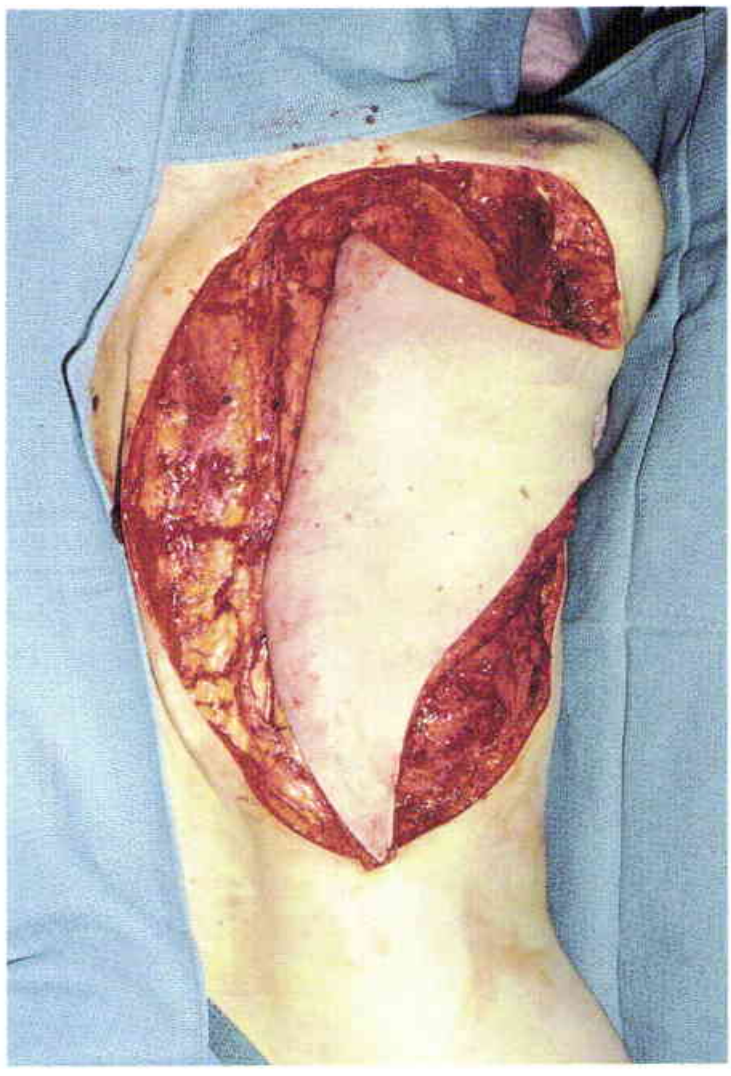
54
Over a period of two months the granulations reached the wound surface. Skin grafting was not required.



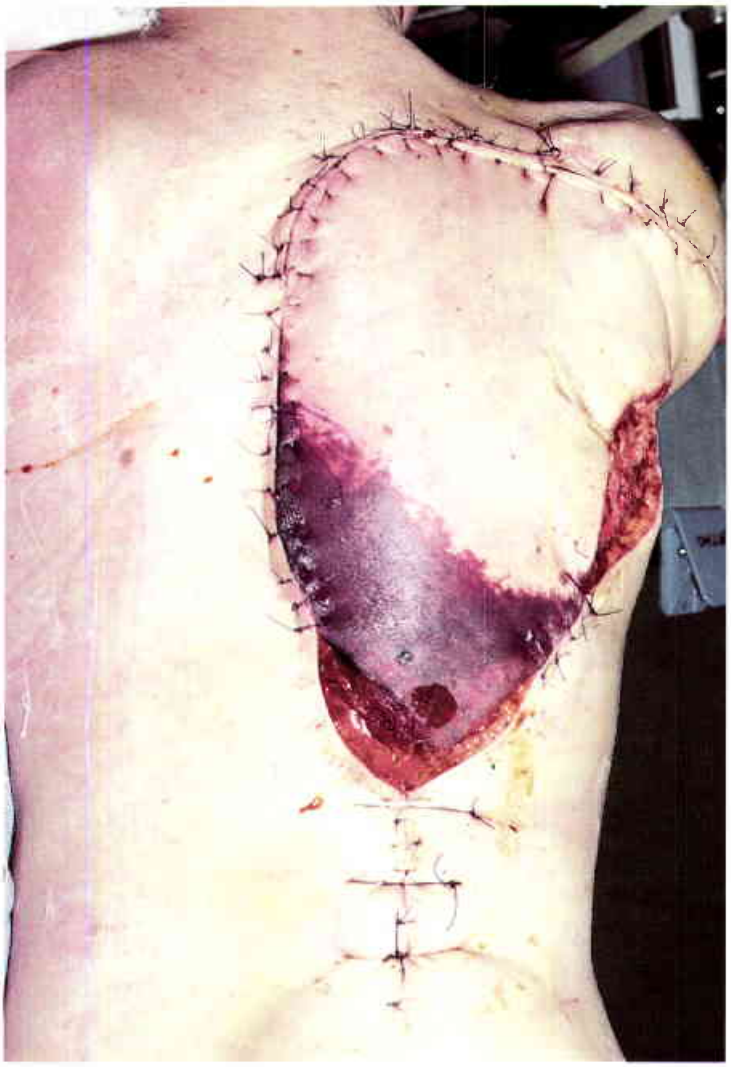
55
The wound eventually healed, but in this case a very simple technical error resulted in a greviously protracted postoperative course.



56
Fifty-seven-year-old woman with recurrent malignant fibrous histiocytoma following three previous resections and radiation therapy. The lower half of the scapula has been excised along with the paraspinous musculature. (Case of P.G. Arnold).



57
A latissimus dorsi musculocutaneous flap was elevated on the thoracodorsal vessels and advanced superiorly. The donor site was closed in a V-Y fashion.



58
Appearance five days later. The lower half of the flap was lost.

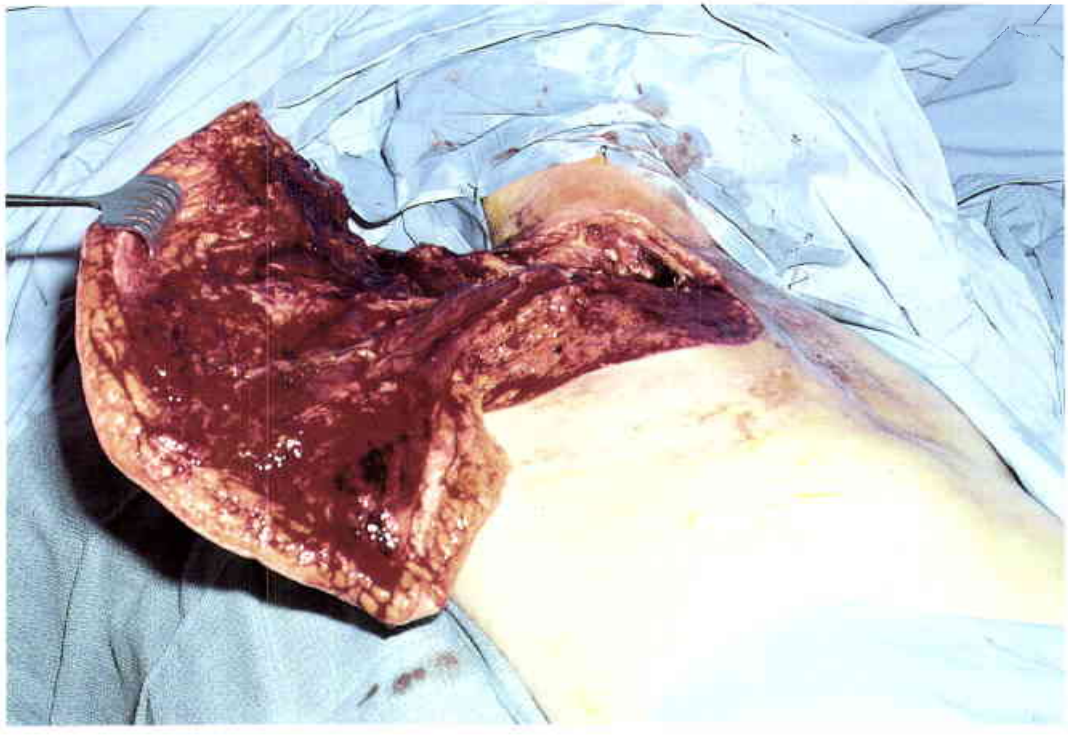
59
The necrotic flap was excised, and the remaining wound was closed with a skin graft. Although the reason for the flap loss is not known, it was undoubtedly related to the acute injury of one of the dominant flap vessels which had been heavily irradiated.

60

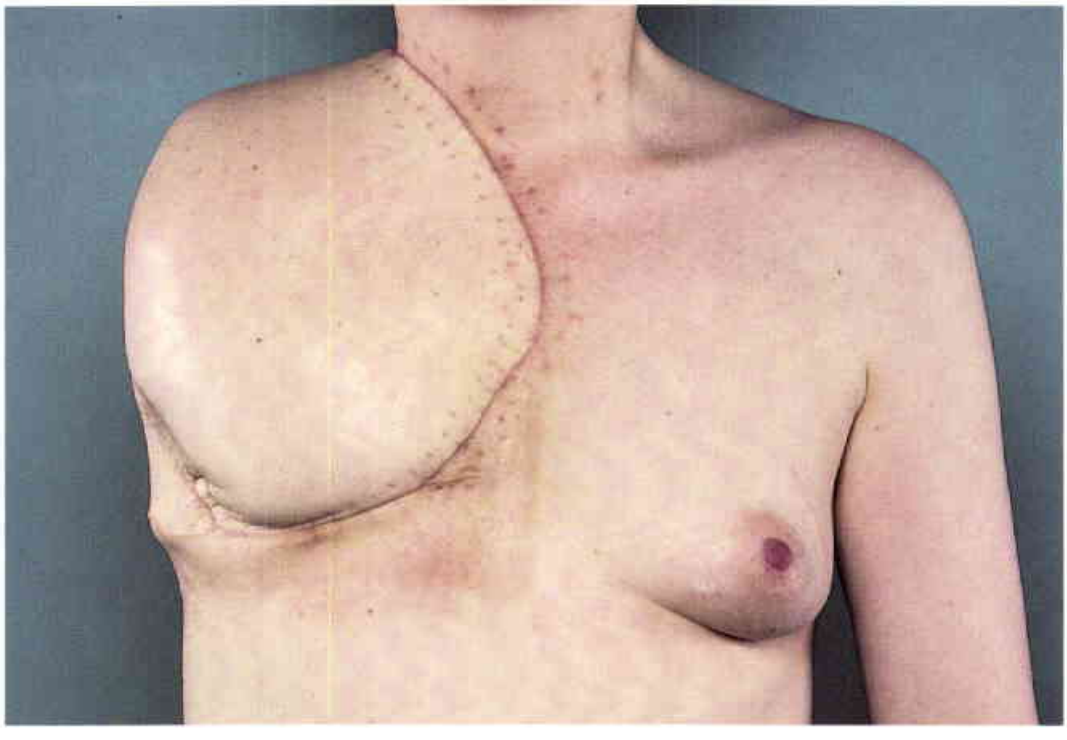
Forty-one-year-old female following a right modified radical mastectomy. Positive clavicular adenopathy had been treated with high-dose irradiation. Five months later the skin of the neck and upper chest necrosed and exposed the clavicle and the subclavian vessels. The right upper extremity was constantly painful and completely useless because of brachial plexopathy and lymphedema. (Case of P.G. Arnold)

61

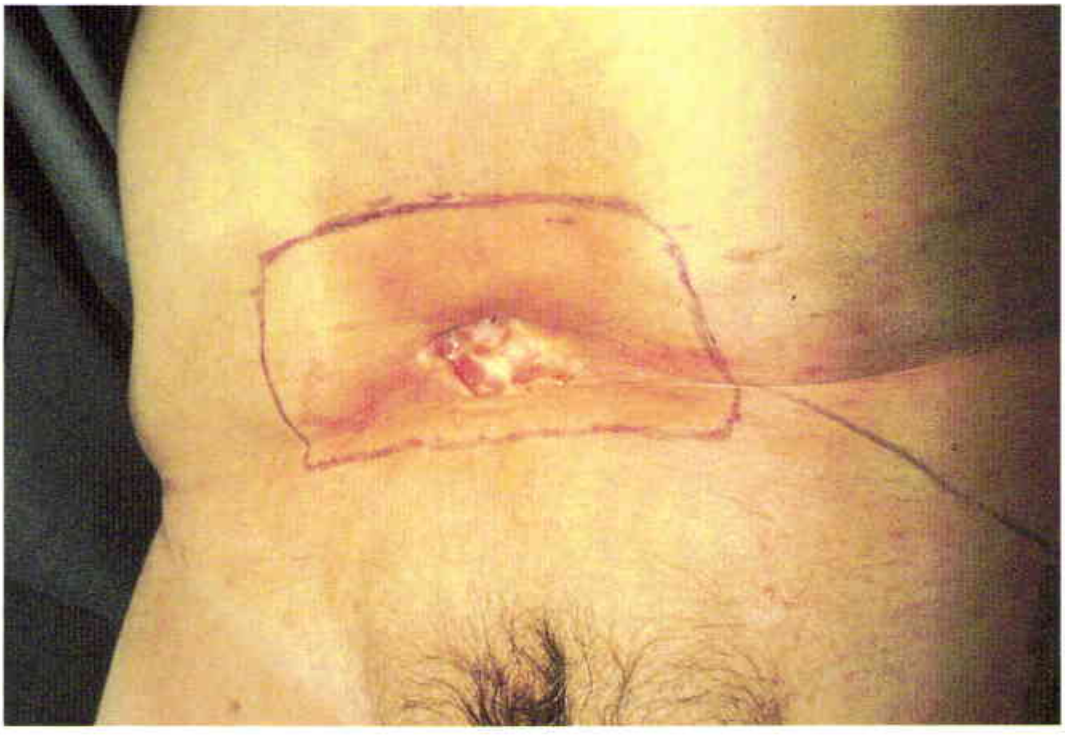
The wound was debrided, and the subclavian vessels were spared.



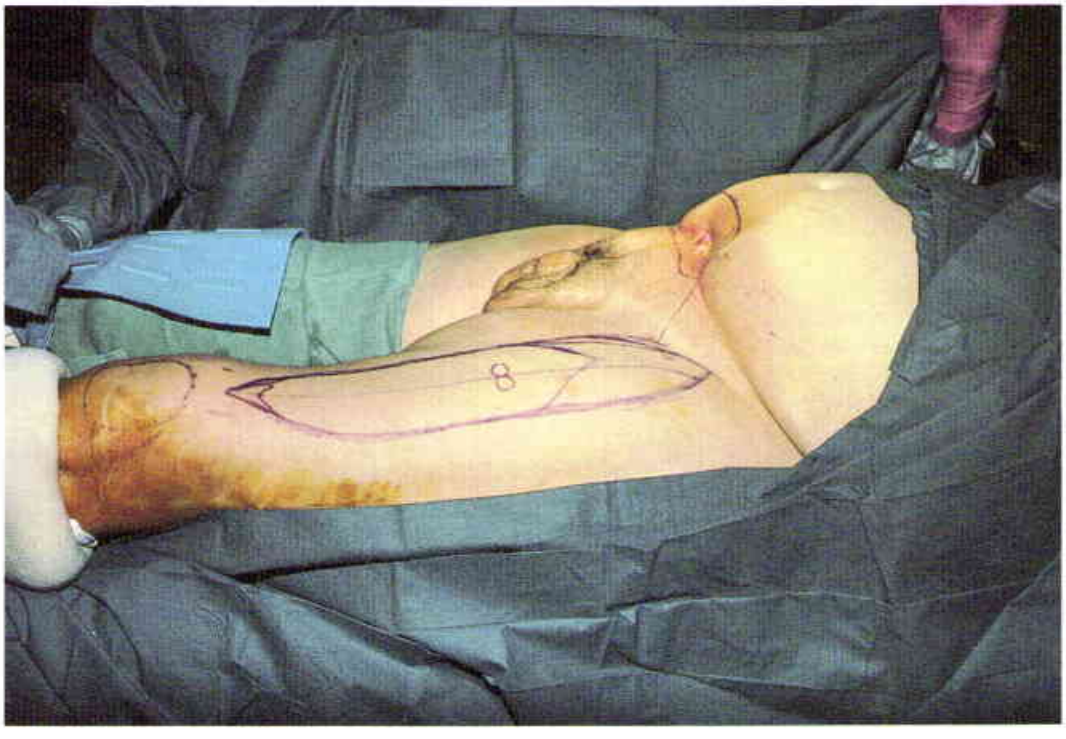
62
The humerus was removed, and the proximal upper extremity was treated as a large musculocutaneous flap. Forty-eight hours after the initial debridement the flap was inset.



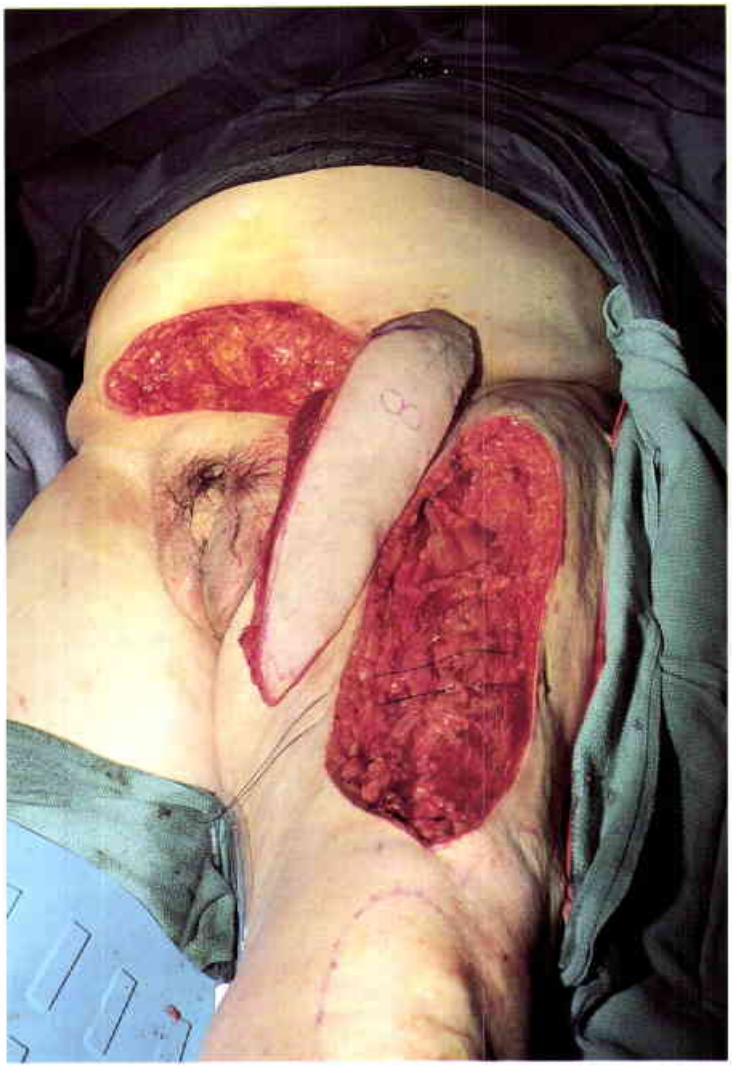
63
Appearance of the healed wound at four months. A reasonable contour of the shoulder was maintained, and the patient was relieved of her pain. The "total arm flap" seems drastic, but in this case, the arm was heavy, painful, insensate, and immobile.



64
Eighty-year-old man with a painful irradiation ulcer of the suprapubic area following external beam therapy for a prostatic carcinoma. (Case of J.B. McCraw)

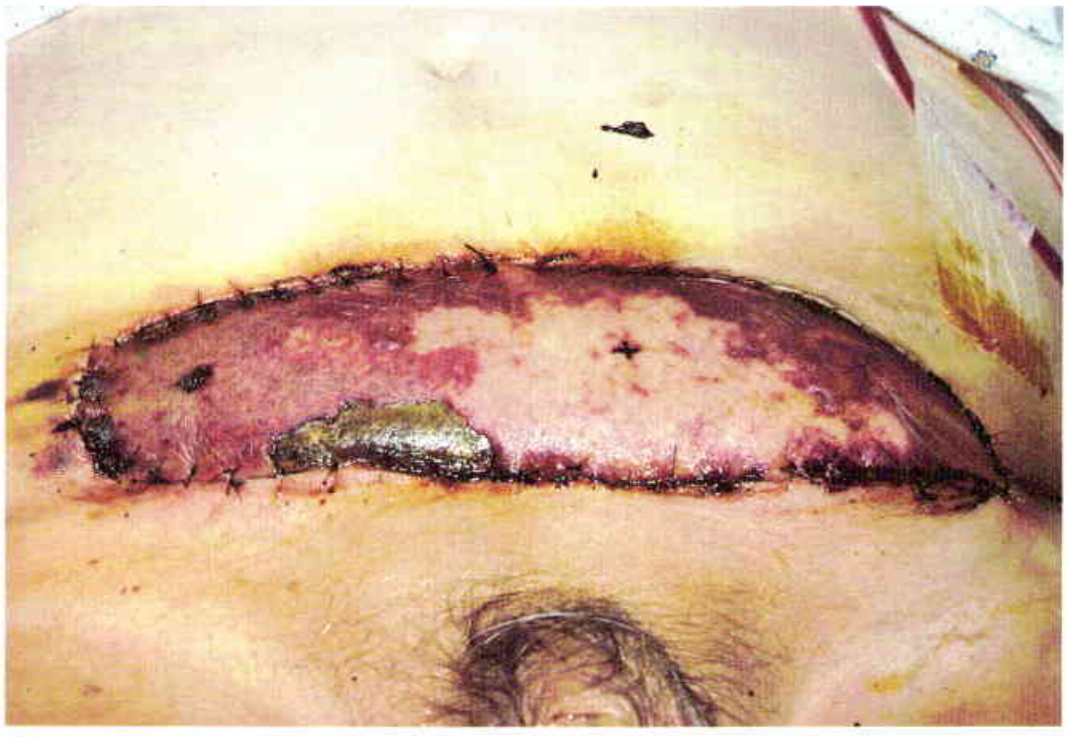


65
A left rectus femoris myocutaneous flap is outlined for coverage of the suprapubic ulcer.



66
Two major mistakes were made in this case. The flap was raised as an "island" flap to avoid a bulge in the groin, which would have been a matter of little concern to this elderly man. The flap could have easily been inset into an incision passing between the donor site and the recipient site, leaving the proximal skin base of the flap intact. The dominant flap vessels were also placed under enough tension to result in vascular "spasm." Rather than stretch the vessels of a single flap, it is preferable to use two flaps.

67
The second mistake was in the management of a "sick" flap. The cutaneous segment of the flap did not fluoresce well. At a minimum the flap should have been returned to the donor site. A better option would have been to discard the cutaneous segment and to skin graft the rectus femoris muscle immediately.

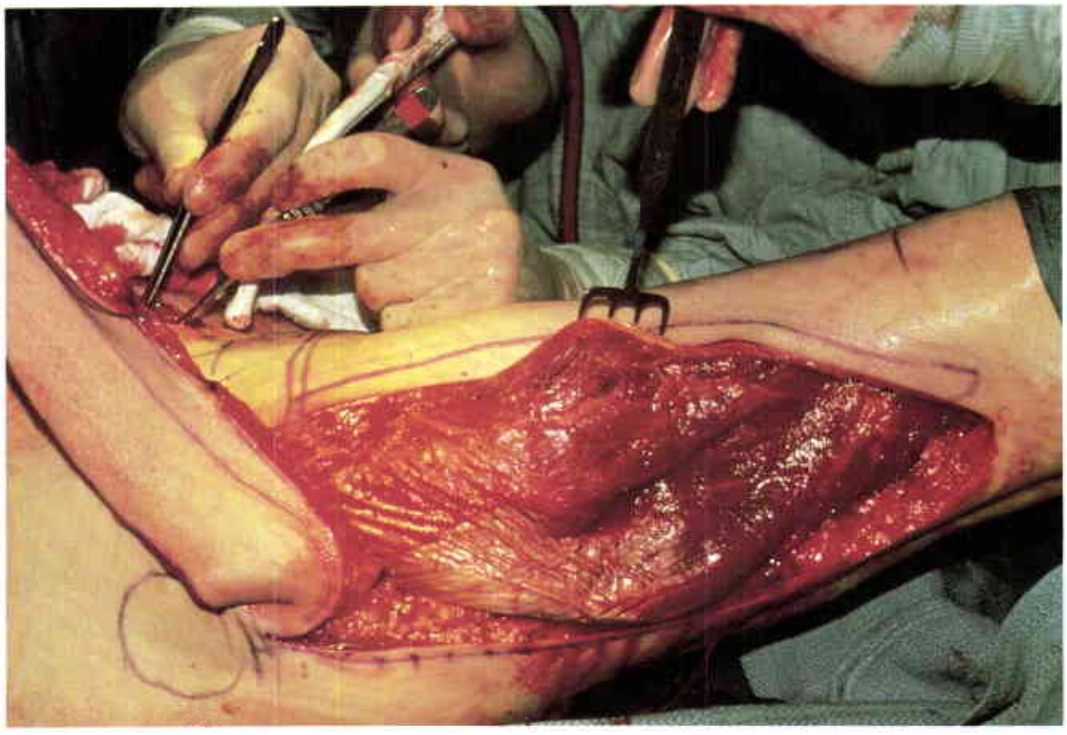


68

Four days following surgery, only the central portion of the myocutaneous flap was alive.

69

The necrotic margins of the flap skin were excised, and the exposed rectus femoris muscle was skin grafted. The flap loss could have been avoided by a better design and inset of the flap. Immediate acceptance of the flap failure and skin grafting of the rectus femoris muscle also could have yielded a primarily healed wound at the initial procedure.



70
Elevated TFL fasciocutaneous flap and vastus lateralis muscle flap to cover an infected Dacron® vascular graft in the groin. (Case of J.B. McCraw and R.T. Gregory, Jr.)

71
The vastus lateralis muscle was used to cover the area of the vascular ''pseudosheath'' excision which extended well above the inguinal ligament. The TFL flap was used for surface cover, rather than directly skin grafting the transposed vastus lateralis muscle flap. The fluorescein examination demonstrated three areas of probable non-viability of the skin flaps as outlined by the blue marking pen.

72
Anterior view of the groin at ten days. The pattern of skin loss predicted by the fluorescein test is precisely confirmed with time. Fluorescein is an excellent predictive test and should not be ignored. The basic mistake in this case was to use the TFL flap at all since a skin-grafted vastus lateralis muscle could have corrected this entire defect. The TFL flap was used to fulfill the old tenet of "replacing tissue with like tissue," but it resulted in a more extensive procedure and contributed to all of the wound healing problems.

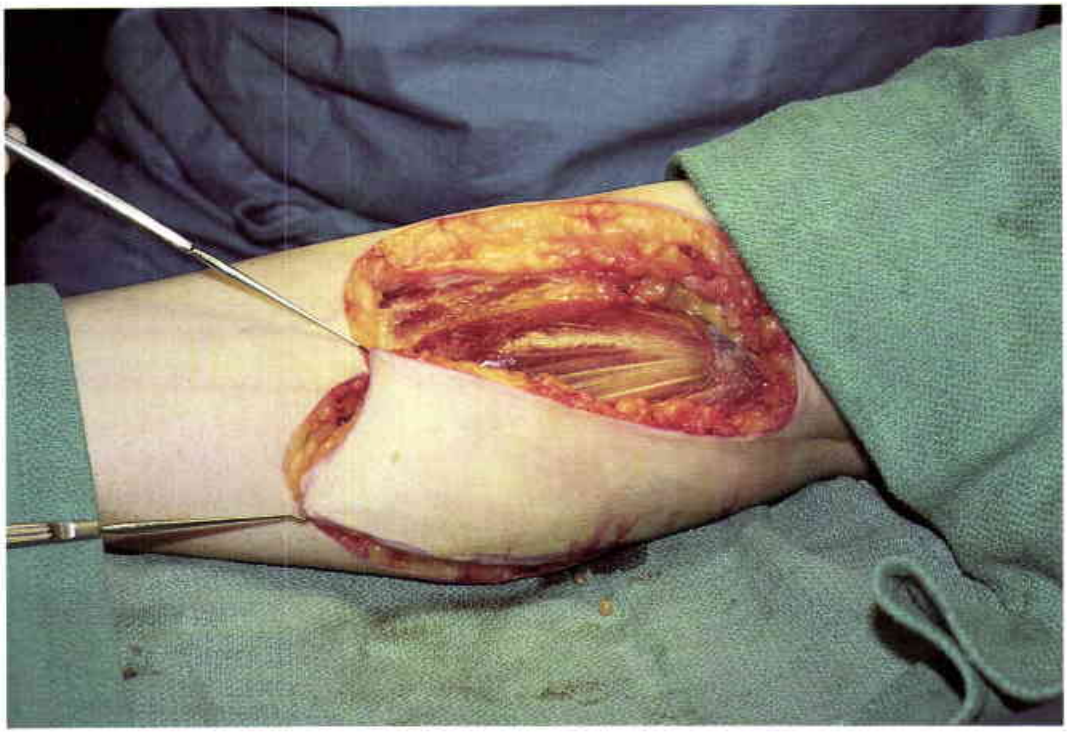
73
Fortunately, the areas of flap necrosis were covered by the transposed vastus lateralis muscle and could be skin grafted. The vastus lateralis muscle flap did save the vascular graft so the Second Law of Vasconez (all of the flap survived except . . .) missed.

74
Infected abdominoperineal wound, ten days following a total colectomy for inflammatory bowel disease. (Case of P.G. Arnold)

75
The perineal wound was closed with a left gracilis "island" myocutaneous flap. At five days it was apparent that the majority of the cutaneous segment was lost. Tension on the vascular pedicle resulted in vascular "spasm" and the subsequent necrosis of the flap. The entire gracilis muscle survived.

76
Posterior view of the skin-grafted gracilis muscle at two weeks. The skin graft provided a satisfactory closure.

77
Appearance three years following surgery. The functional result is excellent. The grafted gracilis muscle is even less bulky than a gracilis myocutaneous flap.



78
Twenty-four-year-old female following the excision of a Level II melanoma from the medial aspect of the upper calf. A fasciocutaneous flap was raised from the posterior calf in an effort to provide a more durable closure for the pretibial area. (Case of J.B. McCraw)

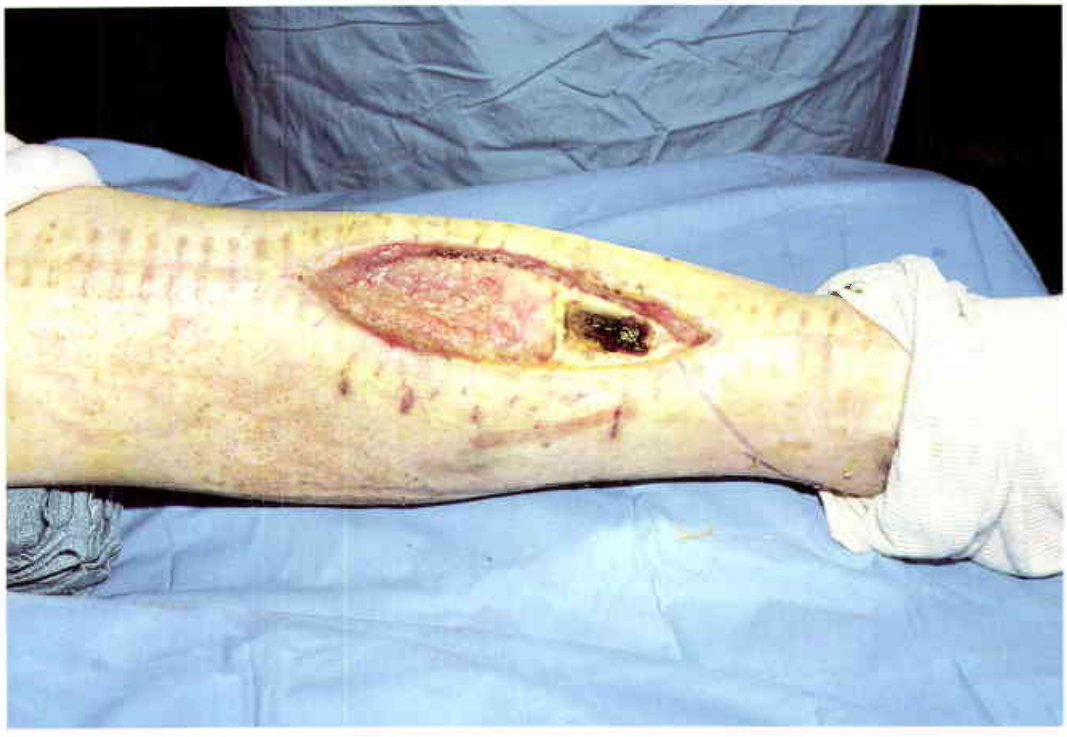
79
The transposed flap was closed under moderate tension. The distal five centimeters of the flap did not fluoresce well after transposition. A small skin graft was placed on the posterior thigh donor site.

80

As predicted by the fluorescein examination, the distal portion of the flap was lost. At this juncture a healed primary skin graft on the area of excision would have looked better than the ulcers which required many months to heal.

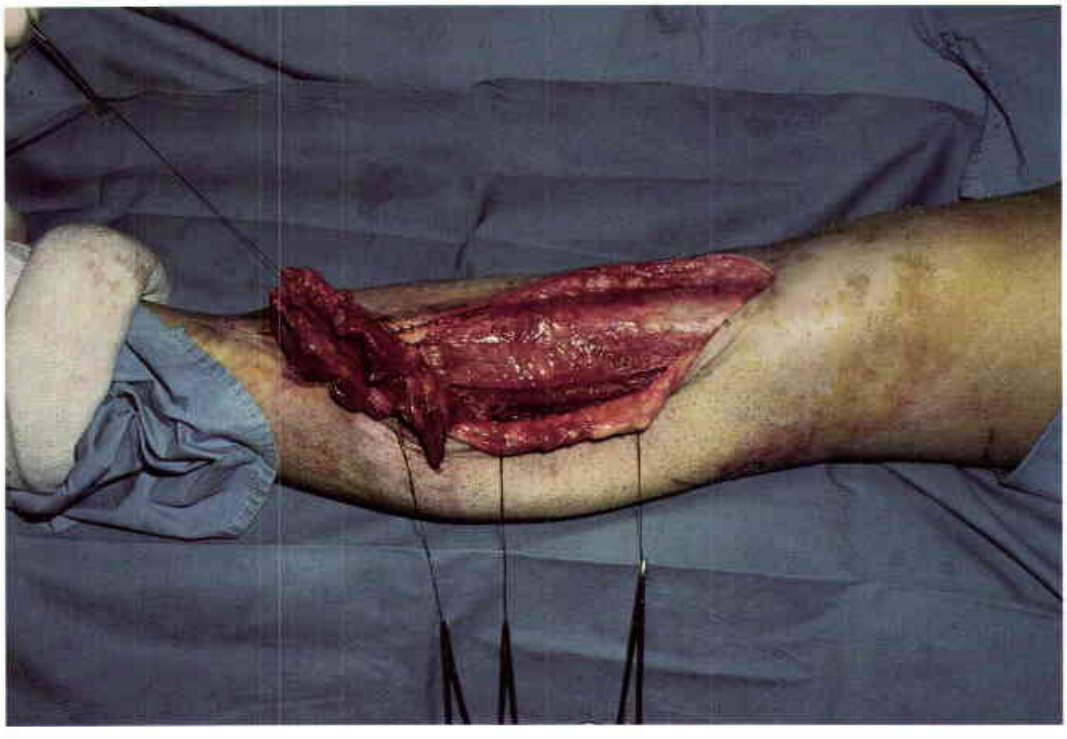
81

It is unclear what the technical error was in this case, but it is obvious that the elevation of the fasciocutaneous flap away from the gastrocnemius muscle and the tense flap closure were poorly tolerated. Even the properly designed fasciocutaneous flap must be treated with care. We are also wary of the notion that fasciocutaneous flaps can be raised virtually "anywhere."



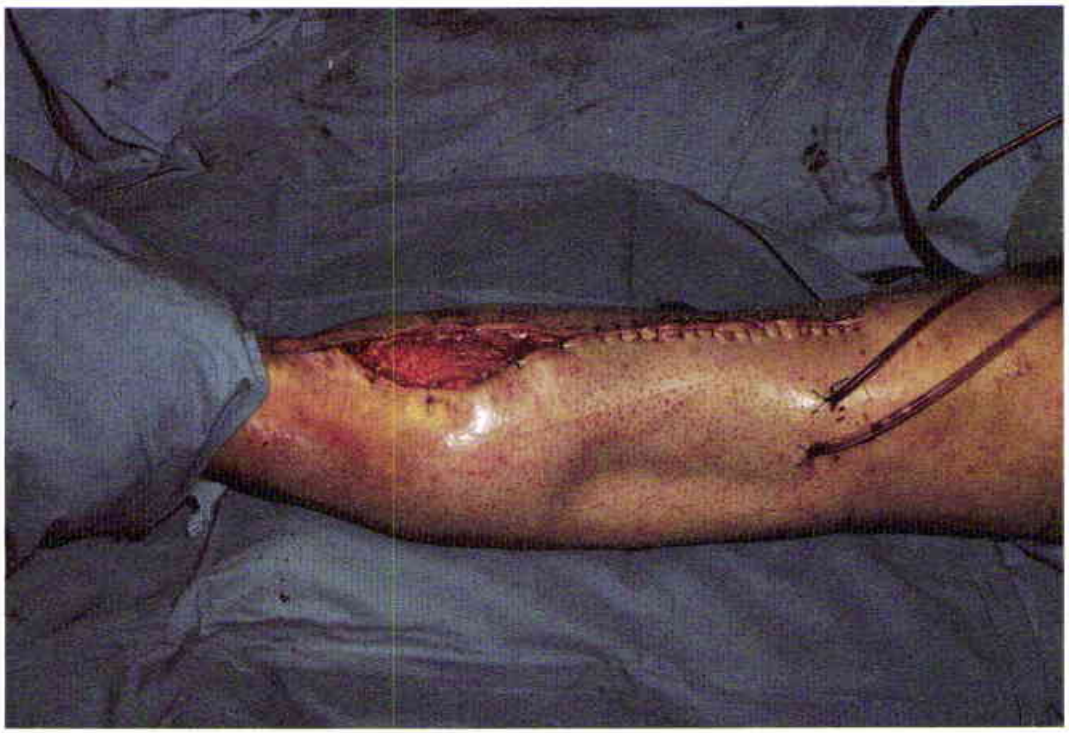
82

Twenty-seven-year-old male who presented with an acute osteomyelitis in an open tibial fracture. The tibial fracture was primarily covered with a proximal soleus muscle flap. Both the initial debridement and the size of the soleus muscle flap were inadequate to correct the problem. (Case of P.G. Arnold)



83

A further debridement was performed, and the EDC muscle was mobilized on its distal blood supply.

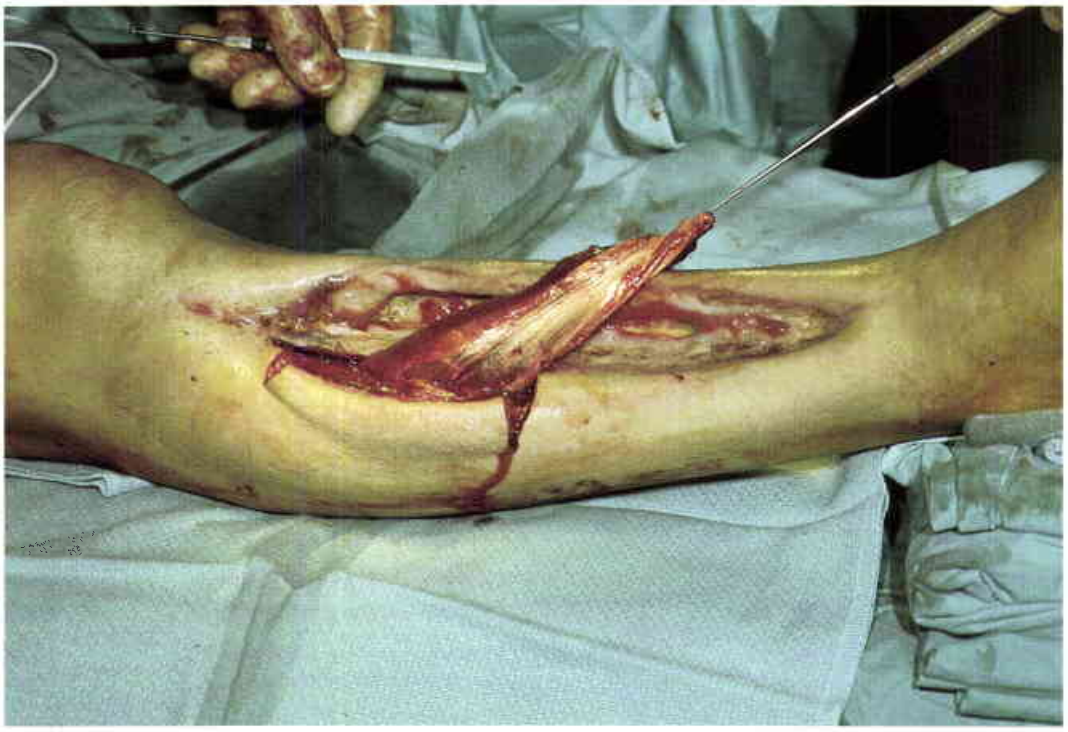


84
The EDC muscle flap was transposed into the distal tibial defect and skin grafted forty-eight hours later.

85
One year following the EDC muscle flap closure the distal tibial wound is stable. A return to the basic principles could have prevented the need for a second operation. One should feel completely comfortable with the initial debridement or it should be repeated prior to the definitive flap closure. Equally as important is the realistic assessment the "zone of injury" and the acceptance of the limitations of the soleus muscle in the distal third of the leg.

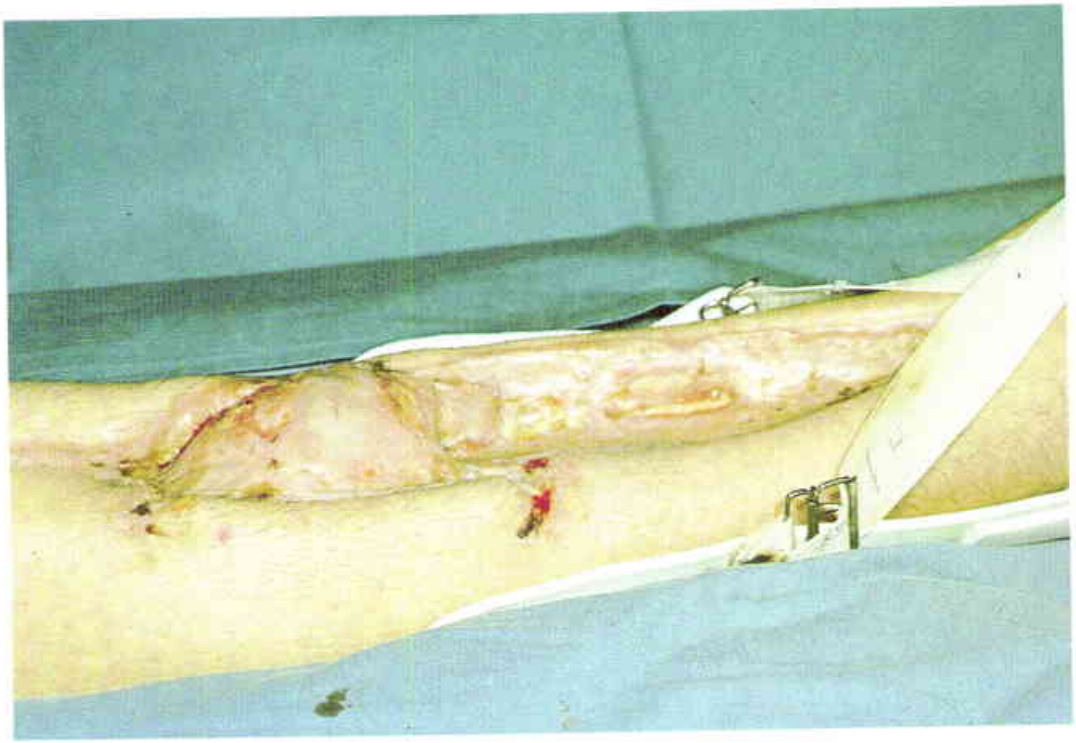
86

This fifty-nine-year-old patient had a long history of osteomyelitis which encompassed the middle portion of the tibia. The posterior two-thirds of the tibial cortex was desiccated, and the marrow had been lost. The peripheral pulses were palpable, but the patient was a diabetic and a smoker. This 1973 case predates our modern "free" flap capabilities. (Case of J.B. McCraw)



87

A proximal soleus muscle flap was passed through the interosseous membrane to gain better access to the lower tibial wound. This pitiful single muscle flap was obviously incapable of completely obliterating the huge pretibial dead space. This was a "Shirley Temple" solution to an "atomic bomb" problem.



88

The soleus muscle was skin grafted and healed completely, but it had no effect on the osteomyelitis of the distal tibia. This type of "tubular" osteomyelitis is virtually incurable unless the dead bone is totally excised and completely covered with either a "free" muscle flap or multiple local muscle flaps. If this cannot be done an immediate amputation should be considered. Our lack of experience in 1973 was our sole excuse for this wasted operation. The disease has not changed.