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Medical Progress

Advances in Plastic Surgery

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Recent progress in plastic surgery has been rapid and many new techniques have been developed. Reconstructive procedures have been advanced by a better understanding of the anatomy of the blood supply to skin and muscle, with the subsequent development of the use of axial flaps, musculocutaneous flaps and neurosensory flaps. Burn treatment has advanced greatly, making it possible to successfully treat larger and more complicated burns. The development of microsurgery has made possible free-flap transfer and replantation of amputated parts. Advances in surgical procedures on the hands include a realization that primary repair of lacerated tendons and nerves will give good results. Replacement joints have been developed that can be used in hands for joints destroyed by arthritis or trauma. Craniofacial surgery is a new field of endeavor in plastic surgery, involving new techniques that can be used to treat exophthalmos of Graves' disease and the facial deformities resulting from gigantism and acromegaly. Head and neck procedures have advanced, with the emphasis on immediate reconstruction using new flaps. Techniques for treating cleft lip and palate have been refined. Encouraging results have been reported in the treatment of nevus flammeus with argon lasers. In aesthetic surgical procedures, the aim is for safety and consistent long-lasting results. Improved understanding of the physiology and treatment of radionecrosis has evolved.

PLASTIC SURGERY is the use of surgical procedures to achieve appearance and function that is as near to normal as possible. The areas of interest of plastic surgeons include congenital anomalies such as facial clefts, craniofacial dysostosis, microtia, extensive nevi, hemangiomas, congenital bands and cysts, and syndactylism. Treatment of traumatic defects; malignant conditions of the extremities, neck and trunk; facial fractures, and burns, as well as aesthetic surgery, are all parts of a plastic surgeon's concern. The purpose of this article is to identify some of the recent advances in plastic surgery, discuss them and point out their usefulness in treating some of the problems physicians encounter.

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Reconstructive Plastic Surgery

Extensive study of the minute anatomy of the blood supply of tissues in the body has resulted in recent discoveries that enable us to transfer blocks of tissue—procedures that heretofore would not have been possible. The basis for trans-

fer of tissue in the classical sense in plastic surgery was the random-pattern flap. The amount of tissue that could be safely moved at any one time was limited by the blood supply to the tissue; it was known that this could be increased by depriving the tissue of some of its blood supply or delaying the transfer of the tissue. The use of flaps to reconstruct defects was somewhat complicated by the fact that in some cases multiple operative procedures were required to "migrate" the tissue to the designated area. Daniel and Williams[1] pointed out the importance of the skin's blood supply in the planning of a skin flap. They noted that the earlier method of flaps was based on the assurance of a blood supply that came through the underlying muscle tissue by a perforator artery to supply the dermal-subdermal plexus and thereby the skin. This was the basis of the random-pattern flap.

Daniel and Williams also pointed out that in some areas of the body there is a direct blood supply to the skin through a cutaneous artery. Flaps based on a direct artery are called axial-pattern flaps. It was noted that it is not necessary to delay these flaps in order to transfer a relatively large amount of tissue along the long axis of the supplying vessel. Two examples of this type of flap are the deltopectoral flap, described by Bakamjian,[2] and the groin flap, described by McGregor and Jackson.[3]

Vasconez and colleagues,[4-6] McGraw,[4-9] Mathes[5,6] and others have contributed to the rapid advancement of knowledge about the blood supply of individual muscles and its usefulness in reconstruction. The awareness that there is a vascular dominance to muscles in the body, and that skin could be transferred intact with underlying muscle contributed substantially to the development of the new myocutaneous flaps, which have revolutionized reconstructive plastic surgery. We can now transfer in one stage large amounts of skin, or skin and muscle, or skin, muscle and bone in the local area of the donor, or these tissues can be transferred to remote sites away from the donor area by dissecting them free on their vascular pedicle and transferring them as microvascular free flaps.

Breast Reconstruction

New and more satisfactory techniques for reconstruction of breasts following mastectomy have evolved rapidly over the recent past. Using knowledge of the blood supply to skin and muscle, it is possible to reconstruct a breast in most cases of mastectomy regardless of how radical the surgical removal was. The use of a thoracoepigastric flap[10] from the epigastric area to the chest area can provide tissue to reconstruct a breast mound. If a large amount of tissue was removed by the surgical procedure we can transfer tissue from the back by moving the latissimus dorsi muscle[11] with overlying skin to the anterior chest and effect a satisfactory and safe coverage for a prosthesis. In classical radical mastectomy where the clavicular head of the pectoralis muscle has been excised, one can move the insertion of the latissimus dorsi from the posterior aspect of the humerus around to the stump of the pectoralis major muscle on the anterior aspect of the humerus, thereby eliminating the postsurgical hollow.

After an adequate breast mound has been reconstructed one can reconstruct the nipple areola complex using a variety of tissues. In the usual reconstructive procedure the pigmented skin on the medial aspect of the upper thigh is used for the areola,[12] sharing a portion of either the opposite nipple or an ear lobe[13] to reconstruct the nipple.

Pressure Sores

Treatment of pressure sores has been aided by new knowledge and techniques in plastic surgery. Dibbell[14] showed that it is possible to move innervated tissue to denervated areas of the body and thereby provide protective sensation to neurologically impaired persons such as paraplegic and meningomyelocele patients. Using this technique it is possible to give a neurologically impaired patient the ability to sense pressure and thereby prevent recurrent pressure ulcers. The mainstay of treatment of these decubitus ulcers continues to be prevention but, with the use of innervated flaps, muscle[15] and muscle-skin[16,17] flaps for additional padding with a good blood supply, it is possible to care for these patients in a more satisfactory way.

Burns

The management of burns has been considerably improved by new techniques. Immediate cooling of the area of burn has been shown to have a beneficial effect on the microcirculation.[18] It has been discovered that the condition of a badly burned patient in shock can be greatly improved by the rapid and immediate infusion of fluids to prevent the complications of burn shock.[19] With

the ability to get the patient through the initial burn shock, the next problem encountered is that of burn-wound sepsis. Our ability to handle burn-wound sepsis has been greatly enhanced by the development of new topical antibiotics. Historically, silver nitrate solution was an effective topical antibacterial agent; however, it had certain disadvantages, one being that it stained everything with which it came in contact. Other agents needed to be developed. As a result mafenide acetate (Sulfamylon), silver sulfadiazine (Silvadene) and povidone-iodine (Betadine) have emerged as effective topical antibacterial agents. The use of biological dressings such as allografts (also called homografts) and pigskin xenografts (heterografts) has enhanced our ability to conserve the patients' fluids and keep them comfortable during burn treatment. Tangential excision[20] and enzymatic debriding agents have been developed that aid in the rapid debridement of the burn wound in preparation for grafting. Sutilains ointment (Travase)[21] is one of the agents that has been used successfully.

There is a growing realization that pulmonary injury substantially complicates the extent of trauma and the treatment of a burn.[22] Many people who are subjected to fires die from the pulmonary injury before they reach the hospital. Usually there is direct injury of the tracheobronchial tree from the poisonous components of the smoke inhaled at the site of the fire. Recognition and early treatment of pulmonary injuries has saved many patients' lives.

Hyperalimentation has helped burn patients survive the massive demands for calories brought on by the burn.[23] Advances have been made in the rehabilitation of postburn patients by the early use of splinting and range-of-motion exercises during the treatment of the burn. The early post-grafting application of pressure garments has helped to control the amount of scarring that may result from a burn.[24]

Microsurgery

Microsurgical techniques were developed in the laboratory by such pioneers as Buncke.[25,26] The development of microsurgery into a clinical tool in plastic surgery was made possible by advances in the manufacture of optics, fine instruments and fine sutures that made them readily available. Using microsurgical techniques it is now possible to move large blocks of tissue from one location of the body to another in one operation, making it feasible to more easily reconstruct damaged parts of the body. For example, it is now possible to move a toe to the hand to make a new thumb.[27] Skin with its cutaneous nerve can be moved from one area to another and a microvascular and microneural repair carried out, thus establishing coverage with protective sensation.[28] Microvascular free flaps of skin,[29] skin and muscle,[30] and of skin and bone[31] are now possible. Using microsurgical techniques it is now possible to reimplant amputated parts such as fingers, hands[32] and other parts of the body with a very high degree of success. Results are better in clean amputations and decrease as the amount of crush and avulsion increase. The amputated part should be placed in saline in a plastic bag and placed on ice for transport to a replant center.

Hand Surgery

A new consensus on the primary repair of lacerated flexor tendons is emerging. Kleinert[33] and Verdan[34] feel that if a flexor tendon is lacerated in the area between the distal palmar crease and the proximal interphalangeal joint, and the wound is clean, the tendons should be repaired primarily. Their results using primary repair of flexor tendons have been good. It is important, however, that the repair be carried out by a surgeon experienced in surgical procedures on the hand.

Primary repair of lacerated peripheral nerves in the upper extremity has yielded improved results through the use of magnification, fine instruments and fine sutures, making possible very accurate anatomic approximation of the lacerated nerve.[35] In a sharp laceration involving the nerve, most surgeons now feel that the earlier and the more accurate the repair, the better the eventual outcome.[36] Treatment of fractures of the small bones of the hand has been improved by the use of the small fragment fixation set developed in Switzerland.[37] Using this technique it is possible to get very accurate reduction and rigid fixation of the fracture resulting in less deformity and better function following treatment of the fracture than has been the case in the past.

The team approach is very helpful in the treatment of rheumatoid arthritis. A team consisting of a physician, a hand surgeon, an orthopedic surgeon and a therapist seems to offer the patient the best opportunity for treatment of this disease. Early synovectomy with balancing operations have been helpful in treating a patient with rheumatoid

arthritis of the hand.[38] In advanced cases, silastic-implant arthroplasties have been helpful in restoring function.[39] Silastic joint implants may also be useful in joints destroyed by trauma. The emergence of specialized hand therapists has helped improve the outcome of most hand problems.

Craniofacial Surgery

Craniofacial surgery is one of the dynamic new surgical disciplines in the field of plastic surgery. Dr. Paul Tessier[40] of Paris found that one could safely free the soft tissue off the underlying craniofacial skeleton, and move the bones freely. This included moving both orbits. By combining the techniques of plastic and neurosurgery, he showed that one could correct the deformities of the cranium, the orbit and the face in one stage. Craniofacial surgical techniques have been used to correct hypertelorism,[41] the increased distance between the orbits, by moving the orbits closer together without interfering with vision.

These techniques have also been used to correct the craniofacial deformities of Apert's and Crouzon's diseases,[42] which consist of synostosis of the coronal suture and at times other sutures of the skull. The synostosis results in a flattened forehead, bulging eyes and a retrusive midface. The trend is increasingly toward surgical intervention early in life to help prevent the sequelae of cranial stenosis and make it possible for patients afflicted with this condition to have a relatively normal appearance as children. Hoffman[43] developed a new technique in releasing cranial stenosis in which he advances a rim of supraorbital bone to allow the frontal lobe to move forward, releasing the trapped brain for normal growth. The craniofacial approaches that were developed initially by Tessier and advanced by others have been successfully used in the correction of the severe deformities seen in craniofacial fractures[44] and in the treatment of craniofacial tumors. The exophthalmos of Graves' disease can be successfully treated using these techniques to expand the orbit.[45] The facial deformities seen with gigantism and acromegaly can also be treated using these newer surgical techniques.

Head and Neck Surgery

The use of computerized tomography has improved the ability to evaluate the extent of tumors in the head and neck area, thereby enabling physicians to more accurately plan the treatment of the tumor. A close working relationship has developed among surgeons, chemotherapists and radiation therapists in the treatment of malignant conditions of the head and neck. It is generally accepted that in patients with tumors of moderate to advanced severity the survival rate is enhanced by the use of surgical procedures combined with radiation or chemotherapy (or both). Immediate reconstruction in head and neck cancer patients has been improved by the development of new techniques for using muscle and musculocutaneous flaps around the neck and upper thorax. These flaps are very helpful in covering surgical defects or in treating complications of radiation therapy. The most effective flaps for use in the treatment of defects in this area are the pectoralis major,[46] trapezius,[47] sternomastoid[48] and latissimus dorsi[49] flaps. The muscle can be based on its individual artery, and can be used to carry skin or skin and bone with it. The use of these newer flaps has reduced the period of disability, the discomfort and the length of hospital stay for patients by making it possible to carry out the reconstruction in one stage.

Congenital Defects

Cleft Lip and Cleft Palate

The treatment of cleft lip and cleft palate was considerably advanced by the realization that the muscles in both a cleft lip[50,51] and cleft palate[52] are abnormally inserted and that by freeing them from their abnormal insertion and joining them in a normal way, a much more functional and aesthetic result can be achieved from the repair. It has been noted that 90 percent to 100 percent of infants with cleft palate will have fluid behind the eardrum, so that it is important to have an otologist on the team when treating patients with cleft palates. The insertion of tubes or buttons in the eardrum, when necessary, has substantially reduced the incidence of permanent hearing loss in patients with cleft palates.[53] Bone grafting of the cleft palate early in the child's life has been shown to interfere with growth of the midface, and there is now a trend to postpone this procedure until a later age.[54] We have also noted an improvement in the methods of correction of late deformities of cleft palates and lips, notably facial bone osteotomies to improve facial symmetry and dental occlusion.

Vascular Lesions

The realization that many of the hemangiomas present in childhood will regress and almost com-

pletely disappear by the age of six has greatly improved the long-term results in these lesions.[55] Once the diagnosis of involuting hemangioma has been made, the most important treatment is that of reassurance to the parents that patience is the best course.

Treatment of a port-wine stain, or nevus flammeus, with argon laser has shown some encouraging results.[56] Laser treatment substantially lightens the color of the lesion in about 60 percent to 70 percent of patients, and may flatten the cobblestone texture noted in these lesions in adulthood. Treatment has been more successful in head and neck lesions than in trunk and extremity ones. As with all modes of treatment some difficulties have been noted, particularly scarring and especially scarring in the area around the mouth.

Aesthetic Surgery

The emerging philosophy in aesthetic surgery is to aim for safety—that is, to obtain the best possible results with a minimum of risk to the patient and with minimal scarring as a result of operation. Recently plastic surgeons have been striving for longer lasting results in facelift surgery by manipulating the platysma muscle and the superficial musculoaponeurotic layer.[57] The trend in rhinoplasty procedures is to do less but with meticulous attention to detail, attempting to balance the appearance of the nose with the face of the patient.[58]

Breast reduction in women with very large breasts results in some of the happiest patients seen by plastic surgeons. The surgical reduction of the weight of the breast can dramatically reduce the discomfort in the upper back and shoulders suffered by some of these patients for years. The trend in augmentation mammoplasty is to improve the safety and long-term results of the operation. Innovations in this operation include the development of improved prosthetic implants, and placement of the implant beneath the pectoralis major muscle in selected patients.

"Radionecrotic Ulcers"

With increasing therapeutic use of radiation therapy, a number of patients are seen with hypoxic ulcers caused by the irradiation. If the ulceration involves the underlying bone, an even more challenging wound occurs—an osteoradionecrosis.

The basic pathological feature of these ulcerations is a considerable decrease in the blood supply to the tissues, resulting in relative cellular hypoxia. This decrease in blood supply is the direct result of irradiation on the blood vessel wall and of fibrosis of the surrounding tissues.

The lumen of the blood vessels decreases in diameter due to thickening of the arterial wall caused by proliferation of the intima and hypertrophy of the media. There is also an extrinsic pressure on the blood vessel wall from fibrosis of the surrounding tissue, which further narrows the lumen. A relatively minor trauma will then result in an ulceration that is very prone to infection from surface bacteria, and the result is a self-perpetuating ulcer. The treatment of anoxic radiation ulcers consists of meticulous asepsis and the use of topical antibacterials, such as silver sulfadiazine or povidone-iodine. If the ulceration is small, it may heal over a relatively long time. Skin grafts are only rarely successful.

For large established postradiation ulcers, the treatment advocated by Blair and Brown in 1948 consists of total excision of the ulceration, including the surrounding irradiated tissue beyond the area of the telangiectasia. The rather large defect is then covered with tissue that brings in its own blood supply. This is best done by the transfer of myocutaneous omental flaps. Muscle in particular brings in a considerable volume of new blood to this relatively hypoxic area.

This principle is applied to the treatment of patients with osteoradionecrosis of the mandible. It is now possible to cover the exposed mandible, avoiding mandibulectomy, with the pectoralis or trapezius musculocutaneous flap. The wound usually heals and the patient is relieved of the pain and misery associated with this condition.

In the chest, painful ulcers over the sternum, clavicle and axilla resulting from radiation therapy for carcinoma of the breast are excised, including the underlying bones and ribs. The chest cage is stabilized by using polypropylene mesh, which is then covered with omentum and skin graft. Omentum is another tissue that is quite malleable and contains an abundant blood supply. Smaller defects over the chest, shoulder and axilla may also be covered by a latissimus dorsi myocutaneous flap.

Radiation ulcers over the pubis resulting from therapy for carcinoma of the cervix can be excised and the defect covered with the rectus or the tensor fascia lata musculocutaneous flap. These ulcera-

tions that in the past were almost untreatable can now be handled with considerable ease.

Agonizing sacral ulcers from external radiation treatment for carcinoma of the prostate or cervix can now be successfully treated by excision and coverage with the superior half of the gluteus maximus myocutaneous flap from one or both sides.

This principle is applicable anywhere in the body where a postradiation ulcer due to anoxia is excised and the defect is covered by muscle alone, omentum or a musculocutaneous flap.

REFERENCES

1. Daniel RK, Williams HB: The free transfer of skin flaps of microvascular anastomosis. Plast Reconstr Surg 52:16-31, 1973

2. Bakamjian VY: A technique for primary reconstruction of the palate after radical maxillectomy for cancer. Plast Reconstr Surg 31:103-117, 1963

3. McGregor IA, Jackson IT: The groin flap. Brit J Plast Surg 25:3-16, 1972

4. Vasconez L, Bostwick J III, McGraw JB: Coverage of exposed bone by muscle transposition and skin grafting. Plast Reconstr Surg 53:526-530, 1974

5. Mathes S, McGraw JB, Vasconez L: Muscle transposition flaps for coverage of lower extremity defects: Anatomic considerations. Surg Clin North Am 54:1337-1354, 1974

6. Mathes S, Vasconez L, Jurkiewicz MJ: Extensions and further applications of muscle flap transposition. Plast Reconstr Surg 60:6-13, 1977

7. McGraw JB, Massey FM, Shanklin KD, et al: Vaginal reconstruction with gracilis myocutaneous flaps. Plast Reconstr Surg 58:176-183, 1976

8. McGraw JB, Dibbell DG: Experimental definition of independent myocutaneous vascular territories. Plast Reconstr Surg 60:212-220, 1977

9. McGraw JB, Dibbell DG, Carroway JH: Clinical definition of independent myocutaneous vascular territories. Plast Reconstr Surg 60:341-352, 1977

10. Cronin TD, Upton J, McDonough JM: Reconstruction of the breast after mastectomy. Plast Reconstr Surg 59:1-14, 1977

11. Bostwick J III, Vasconez L, Jurkiewicz MJ: Breast reconstruction after radical mastectomy. Plast Reconstr Surg 61:682-693, 1978

12. Broadbent TR, Woolf RH, Metz PS: Restoring the mammary areola by a skin graft from the upper inner thigh. Brit J Plast Surg 30:220-222, 1977

13. Brent B, Bostwick J III: Nipple-areola reconstruction with auricular tissues. Plast Reconstr Surg 60:353-361, 1977

14. Dibbell DG: Use of a long island flap to bring sensation to the sacral area in young paraplegics. Plast Reconstr Surg 54:220-223, 1974

15. Ger R: The surgical management of decubitus ulcers by muscle transposition. Surgery 69:106-110, 1971

16. Minami RT, Mills R, Pardoe, R: Gluteus maximus myocutaneous flaps for repair of pressure sores. Plast Reconstr Surg 60:242-249, 1977

17. Minami RT, Hertz VR, Vistnes LM: Use of vastus lateralis muscle flap for repair of trochanteric pressure sores. Plast Reconstr Surg 60:364-368, 1977

18. DeCamera-Robson ML: Plastic surgical forum. Presented at the annual meeting of the American Society of Plastic and Reconstructive Surgeons, New Orleans, 1980

19. Baxter CR: Crystalloid resuscitation of burn shock, *In* Stone H, Polk HA (Eds): Contemporary Burn Management. Boston, Little Brown and Company, 1971, pp 7-32

20. Janzekovic A: A new concept in the early excision and grafting of burns. J Trauma 10:1103-1108, 1970

21. Pennisi VR, Capozzi A, Friedman G: Travase, an effective enzyme for burn debridement. Plast Reconstr Surg 51:371-376, Apr 1973

22. Achauer BM, Allyn PA, Furnas DW, et al: Pulmonary complications of burns: The major threat to the burned patient. Ann Surg 177:311-319, 1973

23. Wilmore DW: Nutrition and metabolism following thermal injury. Clin Plast Surg 1:603-619, 1974

24. Larson DL, Abston S, Evans EB, et al: Techniques for decreasing scar formation in the burned patient. J Trauma 11: 807-823, 1971

25. Buncke HJ Jr, Schulz WP: Total ear reimplantation in the rabbit utilising microminiature vascular anastomoses. Brit J Plast Surg 19:15-22, 1966

26. Buncke HJ Jr, Buncke CM, Schulz WP: Immediate Nicoladoni procedure in the Rhesus monkey, or hallux-to-hand transplantation, utilising microminiature vascular anastomoses. Brit J Plast Surg 19:332-337, Oct 1966

27. Cobbett JR: Free digital transfer: Report of a case of transfer of a great toe to replace an amputated thumb. J Bone Joint Surg [Br] 51:677-679, 1969

28. Daniel RK, Terzis J, Medgley RD: Restoration of sensation to the anesthetic hand by free neurovascular flap from the foot. Plast Reconstr Surg 57:275-280, 1976

29. Daniel RK, Taylor GI: Distant transfer of an island flap by microvascular anastomoses. Plast Reconstr Surg 52:111-117, 1973

30. Maxwell GP, Stueber K, Hoopes JE: A free latissimus dorsi myocutaneous flap. Plast Reconstr Surg 62:462-466, 1978

31. Buncke HJ Jr, Furnas DW, Gordon L, et al: Free osteocutaneous flap from a rib to the tibia. Plast Reconstr Surg 59: 799-811, 1977

32. Kleinert HE, Serafin D, Kutz JE, et al: Reimplantation of amputated digits and hands. Orthop Clin North Am 4:957-967, Oct 1973

33. Kleinert HE, Kutz JE, Atasoy E, et al: Primary repair of flexor tendons. Orthop Clin North Am 4:865-876, Oct 1973

34. Verdan CE: Primary and secondary repair of flexor and extensor tendon injuries, *In* Flynn JE (Ed): Hand Surgery, 2nd Ed. Baltimore, Williams and Wilkins, 1975, pp 144-176

35. Smith JW: Microsurgery of peripheral nerves. Plast Reconstr Surg 33:317-329, 1964

36. Grabb WC: Median and ulnar nerve suture—Experimental study comparing primary and secondary repair in monkeys. J Bone Joint Surg [Am] 50:964-972, 1978

37. Heim U, Pfeiffer KM: Small Fragment Set Manual. New York, Springer-Verlag, 1974

38. Barron JN: Assessment of suitability for surgery in general timing of operation. Ann Rheum Dis 28:74-76, 1969

39. Swanson AB: Flexible implant arthroplasty for arthritic finger joints: Rationale, technique, and results of treatment. J Bone Joint Surg [Am] 54A:435-455, Apr 1972

40: Tessier P: Relationship of craniostenoses to craniofacial dysostoses, and to faciostenoses: A study with therapeutic implications. Plast Reconstr Surg 48:224-237, Sep 1971

41. Tessier P, Guiot G, Derome P: Orbital hypertelorism: Definite treatment of orbital hypertelorism by craniofacial or by extracranial osteotomies. Scand J Plast Reconstr Surg 7:39-58, 1973

42. Tessier P: The definitive plastic surgical treatment of the severe facial deformities of craniofacial dysostosis. Plast Reconstr Surg 48:419-442, Nov 1971

43. Hoffman HJ, Mohr G: Lateral canthal advancement of the supraorbital margin. J Neurosurg 45:376-381, 1976

44. Tessier P: Total osteotomy of the middle third of the face for faciostenosis or for sequelae of LeFort III fractures. Plast Reconstr Surg 48:533-541, 1971

45. Wolfe SA: Modified three-wall orbital expansion to correct persistent exophthalmos or exorbitism. Plast Reconstr Surg 64: 448-455, 1979

46. Ariyan S: The pectoralis major myocutaneous flap—A versatile flap for reconstruction in the head and neck. Plast Reconstr Surg 63:73-81, 1979

47. McGraw JB, Dibbell DG, Carraway JH: Clinical definition of independent myocutaneous vascular territories. Plast Reconstr Surg 60:341-352, 1977

48. Owens NA: A compound neck pedicle designed for the repair of massive facial defects: Formation, development and application. Plast Reconstr Surg 15:369-389, 1955

49. Quillen CG: Latissimus dorsi myocutaneous flaps in head and neck reconstruction. Plast Reconstr Surg 63:644-670, May 1979

50. Fara M, Smahel J: Postoperative followup of restitution procedures in the orbicularis oris muscle after operation for complete bilateral cleft of the lip. Plast Reconstr Surg 40:13-21, 1967

51. Pennisi VR, Shadish WR, Klabunde EH: Orbicularis oris muscle in the cleft lip repair. Cleft Palate J 6:141-153, 1969

52. Kriens O: Anatomy of the velopharyngeal area in cleft palate. Clin Plast Surg 2:261-283, 1975

53. Stool S, Randall P: Unexpected ear disease in cleft palate patients. Cleft Palate J 4:99-103, 1967

54. Johanssen B: Lessons learned from experience in bone grafting clefts. Presented at the annual meeting of the American Society of Plastic and Reconstructive Surgeons, New Orleans, 1980

55. Blackfield HM, Torrey FA, Morris WJ, et al: Management of visible hemangiomas. Am J Surg 94:313-320, 1957

56. Apfelberg DB, Maser MR, Lash H: Argon laser treatment of cutaneous vascular abnormalities: Progress report. Ann Plast Surg 1:14-18, 1978

57. Owsley JQ Jr: Platysma-fascial rhytidectomy: A preliminary report. Plast Reconstr Surg 60:843-850, Dec 1977

58. Rees TD: Current concepts in rhinoplasty. Clin Plast Surg 4:131-144, 1977