References

1. Tavel ME, Stein PD: Management of anticoagulants in a patient requiring major surgery. Chest 114:1756, 1998
2. Akhtar W, Reeves WC, Movahed A: Indications for anticoagulation in atrial fibrillation. Am Fam Physician 58:130, 1998
3. Jackson SL, Peterson GM, Vial JH, et al: Outcomes in the management of atrial fibrillation: Clinical trial results can apply in practice. Int Med J 31:329, 2001
4. Abdelhafiz AH: A review of anticoagulation with warfarin in patients with nonvalvular atrial fibrillation. Clin Ther 23:1628, 2001
5. Souto JC, Oliver A, Zuazu-Jausoro I, et al: Oral surgery in anticoagulated patients without reducing the dose of oral anticoagulant: A prospective randomized study. J Oral Maxillofac Surg 54:27, 1996
6. Fordyce A, Bailey BMW: Letter to the editor. Br J Oral Maxillofac Surg 37:150, 1999
7. Beirne OR, Koehler JR: Surgical management of patients on warfarin sodium. J Oral Maxillofac Surg 54:1115, 1996
8. Bandrowsky T, Vorono AA, Borris TJ, et al: Amoxicillin-related postextraction bleeding in an anticoagulated patient with tranexamic acid rinses. Oral Surg Oral Med Oral Pathol 82:610, 1996
9. Harenberg J, Schwarz F, Dietz R, et al: Anticoagulation with low molecular-weight heparin in patients with prosthetic heart valve replacements. Z Kardiol 76:284, 1987
10. Harenberg J, Huhle G, Piazolo L, et al: Long-term anticoagulation of outpatients with adverse events to oral anticoagulants using low-molecular-weight heparin. Semin Thromb Hemost 23:167, 1997
11. Harenberg J, Weuster B, Pfitzer M, et al: Prophylaxis of embolic events in patients with atrial fibrillation using low molecular weight heparin. Semin Thromb Hemost 93:116, 1993 (suppl 1)
12. Todd DW, Roman A: Outpatient use of low-molecular weight heparin in an anticoagulated patient requiring oral surgery: Case report. J Oral Maxillofac Surg 59:1090, 2001
13. Noble S, Spencer CM: Exoxaparin: A review of its clinical potential in the management of coronary artery disease. Drugs 56:259, 1998
14. Aventis Pharmaceuticals Products Inc: Lovenox (Enoxaparin Sodium) Injection, package insert. Bridgewater, NJ, Aventis Pharmaceuticals Products Inc, 2001
15. Harenberg J: Anticoagulation in patients with heart valve replacement in pregnancy. Z Kardiol 87:63, 1998 (suppl 4)
16. Manley HJ, Smith JA, Garris RE: Subcutaneous enoxaparin for outpatient anticoagulation therapy in a patient with an aortic valve replacement. Pharmacotherapy 18:408, 1998
17. O'Brien BJ, Willan A, Blackhouse G, et al: Will the use of low-molecular-weight heparin (enoxaparin) in patients with acute coronary syndrome save costs in Canada? Am Heart J 139:423, 2000
18. Bristol-Myers Squibb Co: Coumadin (Warfarin Sodium) Tablets, package insert. Princeton, NJ, Bristol-Myers Squibb Co, 2002
19. Bhatt V, Moss C: Antibiotics and anticoagulants: Beware when prescribing concurrently. Br J Oral Maxillofac Surg 39:163, 2001
20. Cook C, Callaway M: Low molecular weight heparin and the risk of haemorrhagia following percutaneous biopsy, despite a normal standard clotting screen. Eur Radiol 11:2536, 2001
21. Lev-Ran O, Kramer A, Gurevitch J, et al: Low-molecular-weight heparin for prosthetic heart valves: Treatment failure. Ann Thorac Surg 69:264, 2000

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62:103-107, 2004

The Tubed Walking Radial Forearm Flap for Salvaging the Flap- and Vessel-Depleted Head and Neck Cancer Patient

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Until the 1980s, the workhorses of full-thickness skin transfer were tubed thoracic and abdominal skin flaps.[1,2] These flaps provided for reliable coverage of cutaneous defects throughout the body. Unfortunately, they required multiple stages over a period of months to complete the reconstruction. Although these flaps were associated with an ultimate success rate of 85% to 95%, they have been relegated to a minor role in extremity reconstruction and have had no recent role in head and neck reconstruction.[3] This is in large part attributable to the fact that more reliable axial pattern flaps and microvascular free flaps have been developed that allow for single-stage transfer of large amounts of skin, muscle, and/or bone, shortening postoperative hospitalization and expediting ultimate recovery.

Microvascular free tissue transfer of the radial forearm fasciocutaneous flap was first described by Yang et al in 1981.[4] Subsequently, this flap has become the reconstructive modality of choice when a surgeon is faced with a head and neck defect requiring thin soft

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0278-2391/04/6201-0020$30.00/0
doi:10.1016/j.joms.2003.04.007

FIGURE 1. Composite resection involving anterior mandibular arch, floor of mouth, and anterior third of tongue.

tissue coverage in a patient in whom local and regional flaps are either not available or not suitable.[5-9] It provides a large amount of thin, pliable skin with an excellent blood supply based on the radial artery and its venae comitantes or one of the superficial veins of the forearm. Due to its rich vascularity, it is quite pliable and may be folded upon itself if required. Its transfer as a composite flap incorporating bone of the radius has in large part been abandoned due to the potential significant donor site morbidity, limited bone stock available, and broad utilization of other donor sites without these limitations.[10]

Successful free tissue transfer is predicated on adequate donor and recipient vessel availability to complete the anastomosis. Occasionally, adequate recipient vessels are not available, and thus vein grafting or cephalic vein transposition may be used.[11] Although useful in the vessel-depleted head and neck cancer patient, they do add to the length and complexity of the surgical reconstruction. The vessel-depleted head and neck cancer patient has often undergone multiple surgical resections and reconstructions and may have, in addition, developed wound complications related to chemoirradiation and surgery. Minimizing the length of surgery and not extensively reopening a radiated previously operated neck in this subset of head and neck cancer patients are often advantageous.

In this article, the particularly difficult case of a vessel- and flap–depleted patient is salvaged with a previously not described pedicled tubed radial forearm flap incorporating the radial artery and its venae comitantes.

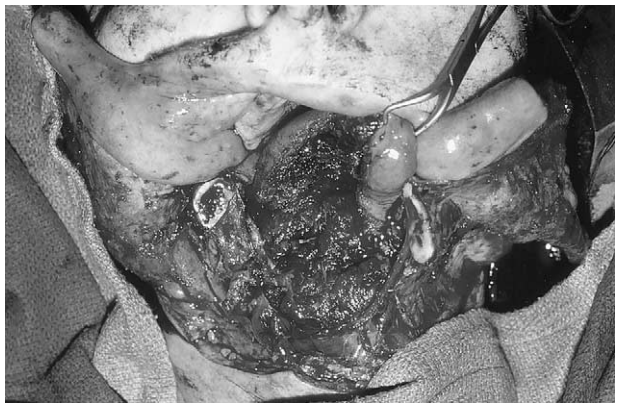

FIGURE 2. Oral cavity defect after surgical extirpation of tumor was reconstructed with bilateral pedicled nasolabial flaps for the anterior tongue defect and a pedicled pectoralis myocutaneous flap to provide for intraoral plate coverage.

FIGURE 3. Delayed plate exposure.

Report of a Case

The patient presented for evaluation of 2 persistent tracheoesophageal fistulas that had developed after she underwent laryngopharyngectomy and bilateral radical neck dissections performed elsewhere 3 years earlier. On further evaluation, this 89-lb, 65-year-old Caucasian woman with a history of peripheral vascular disease and smoking was noted to have a new floor of mouth squamous cell carcinoma with overt involvement of the anterior mandibular arch. Formal panendoscopy and computed tomography

FIGURE 4. Resulting cutaneous defect of mentum after debridement to free bleeding margin.

FIGURE 5. Radial forearm flap has been raised and remains attached to the radial artery and its venae comitantes to the bifurcation of the brachial artery. Note inclusion of proximal forearm skin in continuity with the proposed skin paddle to allow for tubing of this portion.

scans of the neck, chest, and abdomen were negative for any other synchronous or metastatic disease. Preoperative angiography of her lower extremities revealed the presence of 3-vessel runoff bilaterally with significant evidence of atherosclerosis. The patient was thus brought to the operating room for closure of her multiple stomal region tracheocutaneous fistulas with a pedicled tubed right deltopectoral flap. She underwent segmental mandibulectomy of the anterior arch in continuity with the floor of the mouth and anterior glossectomy (Fig 1). The surgical margins were clear. She underwent reconstruction with a locking screw plate (Stryker Leibinger, Kalamazoo, MI) for stabilization of the osteotomized segments of the mandible (Fig 2). At this point, bilateral meticulous search of the anterolateral necks down to the clavicles was made to identify recipient vessels to allow for fibula microvascular free tissue transfer. Because the patient had had previous bilateral radical neck dissections, radiation (6,500 Gy) to both necks, chemotherapy, and chronic low-grade inflammation/infection secondary to her fistulas, we were unable to find adequate recipient vessels. Not only were there no adequate veins present as a result of previous bilateral internal jugular vein sacrifice, but also no adequate arterial supply was found. The patient's external carotid had been sacrificed previously on the right side and was completely obliterated from atheromas on the left as evidenced on arterotomy of this vessel inraoperatively. We thought that there was a lack of appropriate arterial and venous recipient vasculature to warrant microvascular free tissue transfer.

Thus, the patient underwent reconstruction of the glossectomy defect with bilateral pedicled nasolabial flaps and plate coverage intraorally with a right pectoralis major myocutaneous flap.[12] The patient had had a previous left pectoralis flap performed to reconstruct her pharyngeal defect after laryngopharyngectomy. Unfortunately, a relaxing inci-

FIGURE 6. Radial forearm flap has been inset into its recipient site at the mentum.

FIGURE 7. Upper extremity cast with steel rod retainers to prevent flap avulsion.

FIGURE 8. Pedicled tubed radial forearm flap before division of pedicle.

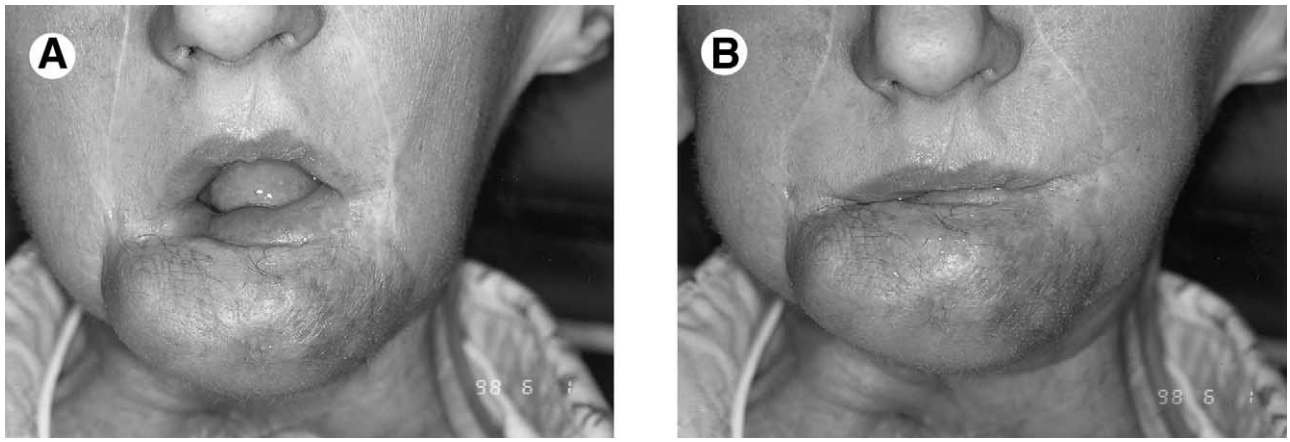

FIGURE 9. *A* and *B*, Postoperative result at 6 months demonstrating adequate restoration of form and lip competence.

sion had been extended vertically, precluding future deltopectoral flap harvest from this side. Postoperatively, the patient healed at the level of the oral cavity and underwent successful closure of her tracheocutaneous fistulas. Unfortunately, she developed delayed plate exposure externally at the mentum 2 months postoperatively (Fig 3) that was unresponsive to hyperbaric oxygen therapy, local wound care, and systemic antibiotics. Thus, she was brought to the operating room for further secondary reconstruction. The cutaneous mentum was debrided to a fresh bleeding margin. This resulted in a 12- × 6-cm defect (Fig 4). Preoperative Allen test was normal in this right-hand–dominant patient. Under tourniquet control to 250 mm Hg, the left radial forearm flap, based on the radial artery with its venae comitantes, was harvested. The planned cutaneous paddle was extended to the distal aspect of the antecubital fossa, rather than the usual relaxing incision used in free tissue transfer, to allow for tubing of the proximal end of the flap (Fig 5). The pedicle was traced between the flexor carpi radialis and brachioradialis muscles to the takeoff of the ulnar artery from the brachial artery. After tourniquet release, excellent flap vascularity was noted. The total flap harvest time was 16 minutes. The proximal portion of the flap was tubed, and the distal cutaneous paddle was inset into the recipient site at the mentum (Fig 6). An upper extremity plaster cast with retention steel rods stabilizing a plaster head cap was then used to prevent flap avulsion (Fig 7). Three weeks later, the patient underwent release of her flap. The proximal tubed portion of the radial forearm flap was returned to the recipient site (Fig 8). The patient has done well with no further evidence of breakdown or fistula formation at the 2-year follow-up. Her mandibular contour, excursion, and her lip competence allowed her to resume a soft diet orally (Fig 9).

Discussion

Short tubed skin flaps can be raised reliably along any axis from the anterolateral abdominal wall or chest. Longer flaps should be harvested along axial patterns of flow from vessels nourishing the subcutaneous tissue such as the intercostal, superficial epigastric, and thoracoacromial axis vessels. Flaps longer than 25 cm have a failure rate of 22%.[3] Typically, a tube is formed at the donor site from the abdominal or chest wall skin. Three weeks later it is transferred to the recipient site if it is accessible or to an intermediate site before final transfer if it cannot reach the final destination directly. Three weeks subsequent to initial transfer, the flap is divided and inset. The wrist has been used as a convenient intermediate carrier of abdominal tubed skin flaps to the head and neck. Its use as the source of the tubed skin based on the radial artery should allow one to harvest most of the forearm skin safely as it has a well-defined vascular territory supplied by the radial artery.[13] Theoretically, this should improve its reliability. In addition, it represents a more expeditious skin transfer technique than traditional abdominal or thoracic flaps because only a single stage is required to reach the recipient site, which could be located anywhere in the head and neck region, followed by flap division and inset. As with traditional tubed flaps, once the tubed portion becomes soft and there is evidence of early healing along the margins of the recipient site, the flap is ready to be divided. This neovascularization phase generally requires 3 weeks.

One of the other benefits of this flap is its use in the absence of microvascular anastomisis. Thus, it may be used successfully by surgeons without training or facilities supporting free tissue transfer. The use of the tubed pedicled radial forearm flap is not without potential pitfalls. Although it appears to be robust, its connection to the forearm donor site needs to be maintained. This was carried out in the case described herein with the use of an upper extremity plaster cast stabilized to the head with a series of stainless steel retaining bars. This contraption is inconvenient and uncomfortable for the patient to tolerate. This particular patient had difficulty with mobilization during the casting period due to her overall frailty and the weight of the cast. In retrospect, fiberglass casting may have been better tolerated due to its improved

resilience and lighter weight compared with plaster casting.

The tubed radial forearm flap appears to represent a viable option in head and neck reconstruction. Its excellent vascularity, ease and rapidity of harvest with minimal donor site morbidity, and its ability to provide for large amounts of thin, pliable skin make it a suitable alternative in the vessel- and flap-depleted head and neck cancer or severe burn patient population.

References

1. Pollock WJ, Bitseff EL, Ryan RF: Rapid transfer of thoracoacromial flaps to the face and neck. Plast Reconstr Surg 50:433, 1972
2. Didolkar MS, Baffi RR, Bakamjian VY: Use of a tubed thoracoepigastric flap to cover the defect from a hindquarter amputation. Plast Reconstr Surg 61:112, 1978
3. Stranc MF, Stranc WE: Tubed abdominal and chest skin flaps, *in* Encyclopedia of Flaps. Boston, MA, Little, Brown, 1990, pp 456-459
4. Yang G, Chen B, Gao Y, et al: Forearm free skin flap transplantation. Natl Med J China 61:139, 1981
5. Song R, Gao Y, Song Y, et al: The forearm flap. Clin Plast Surg 9:21, 1982
6. Soutar DS, Scheker LR, Tanner NSB, et al: The radial forearm flap: A versatile method for intraoral reconstruction. Br J Plast Surg 36:1, 1983
7. Tahara S, Susuki T: Eye socket reconstruction with free radial forearm flap. Ann Plast Surg 23:112, 1989
8. Takada K, Sugata T, Yoshiga K, et al: Total upper lip reconstruction using a free radial forearm flap incorporating the brachioradialis muscle: Report of a case. J Oral Maxillofac Surg 45:959, 1987
9. Vaughan ED: The radial forearm free flap in orofacial reconstruction. J Craniomaxillofac Surg 18:2, 1990
10. Soutar DS, Widdowson WP: Immediate reconstruction of the mandible using a vascularized segment of radius. Head Neck 8:232, 1986
11. Vuillemin T, Imola MJ: Modified procedure for cephalic vein transposition for free flap salvage: Report of a case. J Oral Maxillofac Surg 55:1171, 1997
12. Ducic Y, Burye M: Nasolabial flap reconstruction of oral cavity defects: A report of 18 cases. J Oral Maxillofac Surg 58:1104, 2000
13. Cormack GC, Duncan MJ, Lamberty BG: The blood supply of the bone component of the compound osteocutaneous radial artery forearm flap: An anatomic study. Br J Plast Surg 39:173, 1986

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62:107-111, 2004

Gas Phenomenon in the Superior Space of the Temporomandibular Joint: Report of a Case

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Gas collection in a closed joint space is common and is called a vacuum phenomenon in the field of orthopedics.[1-3] However, few reports concerning the vacuum phenomenon in the temporomandibular joint (TMJ) have been published in the past.

Hayashi et al[4] reported the computed tomography (CT) findings of gas collection in the inferior space of the TMJ in 3 patients with temporomandibular disorders (TMDs).

We also observed gas in the TMJ of a patient with TMD and report the case of this patient here.

Report of a Case

A 67-year-old woman was referred to Kyushu University Dental Hospital with the chief complaints of the limited mouth opening and severe bilateral TMJ pain. She had no history of other joint diseases or injury of the maxillofacial region. Maximum mouth opening was 20 mm. She had bilateral masseter muscle stiffness, bilateral TMJ pain, and left TMJ clicking when she opened or closed the jaw. Transcranial radiographs (Fig 1) showed sclerotic bone change of the right condylar head. She was treated with a

Received from the Faculty of Dental Science, Kyushu University, Fukuoka, Japan.

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0278-2391/04/6201-0021$30.00/0
doi:10.1016/j.joms.2002.12.003