Multivectored Suture Suspension

A Minimally Invasive Technique for Reanimation of the Paralyzed Face

James C. Alex, MD; Davis B. Nguyen, MD

Background: Despite advanced techniques for reanimation of the lower face, many patients opt for static suspension procedures, which are less invasive and have a relatively short recovery period. However, even static suspension procedures require general anesthesia, overnight hospital stay, and significant soft tissue manipulation. We present a minimally invasive technique, the multivectored suture suspension, which addresses these drawbacks.

Objectives: To study the technical feasibility and efficacy of the multivectored suture suspension technique in the paralyzed face.

Design: The study was carried out prospectively in 12 patients with House-Brackmann grade 6 facial paralysis. Nine patients presented within 6 months of tumor resection and 3 patients presented more than 1 year after surgery.

Main Outcome Measures: The parameters evaluated were (1) restoration of nasal breathing; (2) improvement of drooling; (3) restoration of normal speech; (4) cosmetic results; and (5) total surgical time.

Results: With an average follow-up of 14 months, patient evaluation of the outcome parameters was as follows: (1) 10 patients (83%) reported significant and 2 (17%) reported moderate restoration of nasal breathing; (2) 10 patients (83%) reported significant improvement and 2 (17%) reported modest drooling improvement; (3) 8 patients (66%) reported significant improvement and 4 (34%) reported modest improvement of speech; (4) 9 patients (75%) reported complete satisfaction and 3 (25%) reported moderate satisfaction with cosmesis. The average surgical time was 46 minutes. Three revisions were required for suture failure.

Conclusions: The multivectored suture suspension technique is a minimally invasive, reversible method of lower facial reanimation that provides improved cosmesis with restoration of nasal breathing. It can be performed under local anesthesia in an outpatient setting, thereby reducing morbidity and cost.

Arch Facial Plast Surg. 2004;6:197-201

FACIAL PARALYSIS LEADS NOT only to obvious cosmetic deformities but also to functional impairments such as keratitis, nasal valve collapse, dysarthria, and drooling. Reanimation of the paralyzed face falls into 2 broad categories, dynamic and static. The former includes primary facial grafting, cable nerve grafts, crossed nerve anastomoses, regional flaps, and microneurovascular free flaps.[1] The latter includes rhytidectomy, brow-lift, and facial suspension using materials such as an expanded form of polytetrafluoroethylene (Gore-Tex; Gore Co and Associates, Flagstaff, Ariz), or acellular dermal allograft (AlloDerm; LifeCell Corporation, Branchburg, NJ).[2,3]

Most surgeons would agree that successful dynamic reanimation provides the best reconstructive result. However, nerve grafting techniques require functional motor end plates, which are not present in many patients with long-standing facial paralysis. Nerve transfer procedures such as the hypoglossal-facial nerve anastomosis can lead to difficulties in speech, mastication, and swallowing. In addition, not only are advanced techniques such as cross-facial nerve grafting and neuromuscular free grafts technically challenging, they also involve a higher degree of morbidity associated with longer anesthesia time and hospital stay.[4]

When given options for facial reanimation, many older patients choose less aggressive static reanimation procedures over regional or microneurovascular flaps. Slings composed of fascia lata, Gore-Tex, and, more recently, AlloDerm are comparatively quick to perform and have a relatively low morbidity. Nonetheless, these techniques also involve general anesthesia, overnight hospital stay, and signifi-

From the Division of Facial Plastic and Reconstructive Surgery, Section of Otolaryngology, Yale University School of Medicine, New Haven, Conn. Dr Alex is now with the Lahey Clinic, Burlington, Mass.

Table 1. Patient Characteristics

Patient No./ Age, y/Sex	Lesion	Time of Presentation After Tumor Removal, mo
1/75/F	Mucoepidermoid carcinoma, parotid gland	60
2/67/F	Adenoid cystic carcinoma, parotid gland	3
3/71/F	Acoustic neuroma	2
4/48/F	Metastatic melanoma, parotid gland	1
5/56/M	Acoustic neuroma	2
6/74/M	Metastatic squamous cell carcinoma, parotid gland	12
7/88/M	Adenoid cystic carcinoma, parotid gland	4
8/53/M	Adenoid cystic carcinoma, parotid gland	5
9/81/F	Metastatic squamous cell carcinoma, parotid gland	0*
10/70/F	Acoustic neuroma	4
11/47/M	Acoustic neuroma	18
12/55/M	Adenoid cystic carcinoma, parotid gland	4

*A multivectored suture suspension procedure was performed immediately after tumor surgery during the same operation.

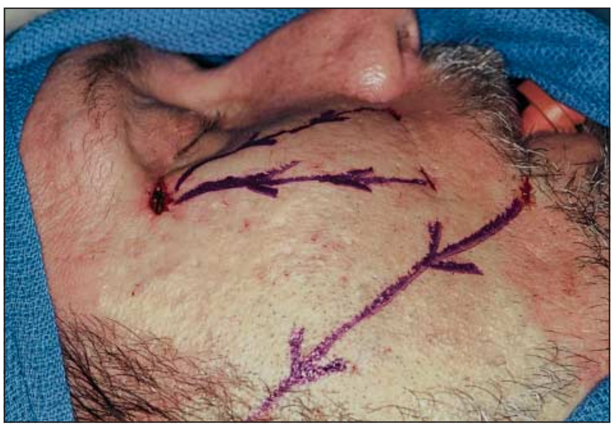

Figure 1. Three vectors for suture suspension are created through stab incisions in the lateral canthal region, melolabial crease, preauricular area, and inferior drool line.

cant soft tissue manipulation. We present a minimally invasive static sling approach that can be performed under local anesthesia in an outpatient setting. The multivectored suture suspension (MVSS) technique is easily performed and results in minimal bruising and rapid recovery.

METHODS

The MVSS technique was carried out in 12 patients, 6 men and 6 women, with House-Brackmann grade 6 facial paralysis, at Yale-New Haven Hospital from April 2001 to February 2002. Nine patients presented within 6 months of tumor resection and 3 presented more than 1 year after surgery. The average age of the patients was 65 years (range, 47-88 years). Patient characteristics are shown in **Table 1**. Informed consent was obtained from all patients.

Figure 2. Suture suspension from its anchor point in the malar eminence to the melolabial crease is achieved using a suture passer.

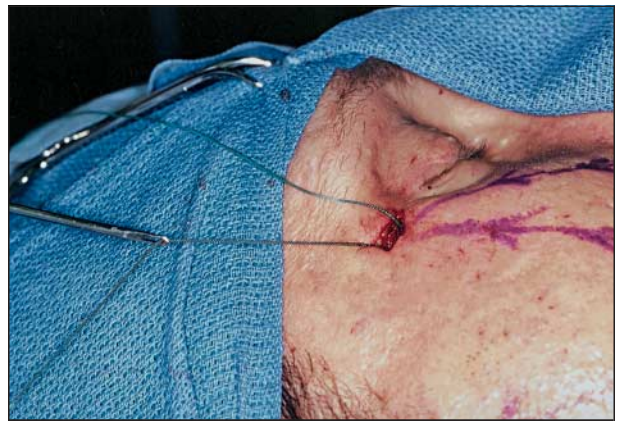

Figure 3. After asking the patient to move the functional side of the face, the proper amount of tension is determined and the suture is secured back at the anchor point.

The MVSS procedure was carried out as follows: the patient was evaluated for facial symmetry preoperatively, and vector lines of tension were marked on the skin with the patient in the upright position. After induction twilight anesthesia, the face was anesthesized with 1% lidocaine hydrochloride plus 1:100000 epinephrine. The patient was prepared and draped in sterile fashion. Three vectors were created through 5-mm stab incisions (**Figure 1**). An incision was made along the lateral canthal region overlying the lateral rim of the orbit. Dissection was carried to the level of the periosteum immediately posterior to the malar eminence. Three other stab incisions were made, 2 in the melolabial crease and 1 in the inferior drool line. Another incision was made in the preauricular area. Two 4-0 polypropylene sutures (Prolene; Ethicon Inc, Somerville, NJ) were passed from the lateral canthal region down to the melolabial fold region using a suture passer (**Figure 2**). Because the patients are awake they can be asked to move the functional side of their face, which allows fine adjustments to the suture tension. Each suture was secured with 8 square knots (**Figure 3**). In similar fashion, a suture was passed from the preauricular area down to the inferior lip at the drool line. To avoid skin puckering at the stab incision sites, undermining of skin was carried out around the incision. The stab incisions were closed with a 5-0 fast-absorbing suture. Then the lateral canthal and preauricular incisions were closed with a 4-0 chromic suture (deep layer) and a 5-0 fast-absorbing suture (skin layer).

The MVSS technique was evaluated for length of operative time and, subjectively, for improvement in nasal breath-

Table 2. Functional and Cosmetic Results of the MVSS Procedure at 6 and 14 Months in 12 Patients*

	Improvement, No. (%) of Patients				
	At 6 mo		At 14 mo		
Feature Improved	Moderate	Substantial	Moderate	Substantial	*P* Value (at 6 and 14 mo)
Nasal breathing	0	12 (100)	2 (17)	10 (83)	<.01
Drooling	1 (8)	11 (92)	2 (17)	10 (83)	<.01
Speech	2 (17)	10 (89)	4 (34)	8 (66)	<.01
Cosmesis	5 (42)	7 (58)	3 (25)	9 (75)	<.05

Abbreviation: MVSS, multivectored suture suspension.
*No improvement was considered minimal at 6 or 14 months.

ing, drooling, speech, and cosmesis. All patients were interviewed over the telephone after an average follow-up of 14 months (range, 10-22 months). They were asked to report on a scale of 1 to 10. A score of 1 to 3 was categorized as minimal improvement; a score of 4 to 7 as moderate improvement; and a score of 8 to 10 as significant improvement. Patients were also asked to report the number of days to full recovery (ie, when they no longer needed pain medications and had achieved 80% of preoperative function).

The χ^2 test was used to assess the differences in patient responses.

RESULTS

Patient evaluation of the outcome measures at 14 months was as follows: (1) of the 12 patients, 10 (83%) reported significant improvement and 2 (17%) reported moderate improvement in nasal breathing ($P<.01$); (2) 10 (83%) reported significant improvement and 2 (17%) reported moderate improvement with drooling ($P<.01$); (3) 8 (66%) reported significant and 4 (34%) reported moderate speech improvement ($P<.01$); and (4) 9 (75%) reported complete satisfaction and 3 (25%) reported moderate satisfaction with cosmetic results ($P<.05$) (**Table 2**).

Nine procedures were carried out under local anesthesia and 3 were performed under general anesthesia. In the latter 3 cases, the patients were asked to move the functional side of their face preoperatively. The average surgical time was 46 minutes. The average time to full recovery was 3.1 days. Three revisions were required for suture failure.

COMMENT

There are numerous techniques for reanimation of the paralyzed face, each with distinct advantages and drawbacks. Nerve grafting and microneurovascular techniques, when successful, afford the best functional and cosmetic result because a natural dynamic effect is achieved. The gracillus, latissimus dorsi, and pectoralis minor muscles have been used.[5-8] However, these techniques are lengthy, require intricate microsurgical skill, and are associated with increased morbidity and longer hospital stay.[9] With hypoglossal-facial nerve grafting, difficulties can specifically occur in swallowing, speech, and mastication.[10] Regional muscle transfer using temporalis and masseter muscles has also been described.[6,7,11-13] Yet, even regional flaps require general anesthesia and extended operative time and hospitalization.

Figure 4. Vascular pledgets are used to prevent suture slippage.

Depending on the procedure, patients will often have marked local bruising, swelling, and facial discomfort. In addition, some surgeons also feel that nerve repairs in older individuals may be less successful, particularly if they undergo postoperative radiation treatment. When faced with these considerations, older patients often choose less-involved static sling procedures.[14] These procedures are also excellent options for many younger patients in whom return of nerve function is expected within 6 to 12 months and who desire only a minimally invasive temporizing measure.

Static reanimation procedures have several drawbacks. Fascia lata slings require a separate incision in the leg; Gore-Tex slings run the risk of infection and extrusion; and the lifting effect of slings composed of AlloDerm lasts typically 6 months at best.[3] A disadvantage of all these slings is that they pull in only 1 vector, whereas the face moves along several vectors based on the underlying facial musculature. Additionally, all these procedures still require general anesthesia and usually an overnight hospital stay.

By comparison, the MVSS procedure requires small incisions and can be easily performed under local anesthesia. It involves minimal discomfort and has a quick postoperative healing time of approximately 3 days. Although suture suspension has been previously used for nasal valve stenosis, cosmetic malar fat pad elevation, neck suspension, alar cartilage mobilization, prevention of ectropion, and brow elevation,[15-20] it has not been described for cases of facial paralysis. The MVSS technique was designed to

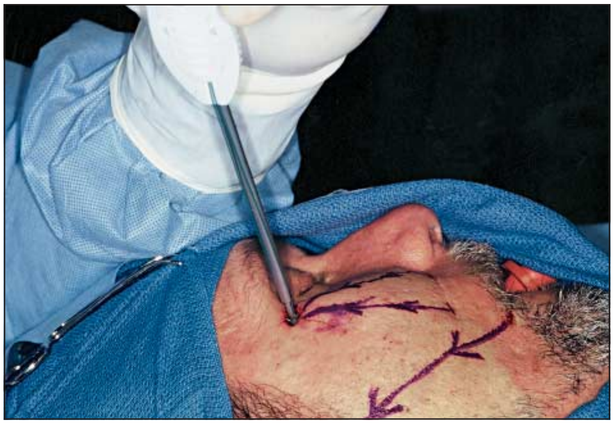

Figure 5. A Mitek screw (Mitek, a division of Ethicon [a Johnson & Johnson Company], Norwood, Mass) allows adaptation in evolution.

Figure 6. A Mitek screw (Mitek, a division of Ethicon [a Johnson & Johnson Company], Norwood, Mass) is drilled into the malar eminence anchor point to avoid suture slippage issues.

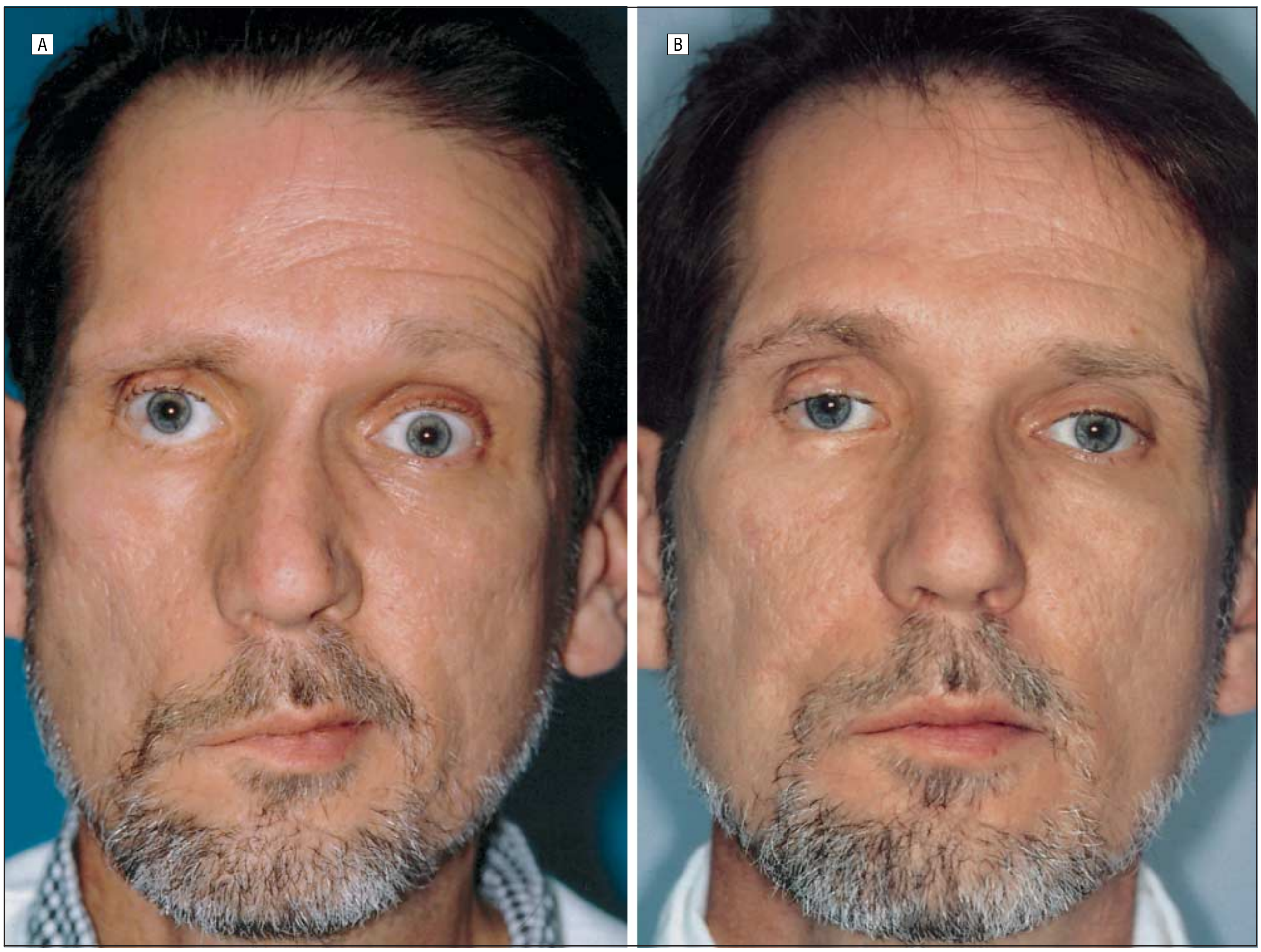

Figure 7. A, Preoperative view; B, view of the patient 18 months after undergoing the multivectored suture suspension procedure.

mimic the natural vectors of the underlying facial musculature, and it allows for a more natural lifting of paralyzed tissues. Because, in most cases, the patient is awake and can move his or her face during the procedure, the surgeon can adjust each suture with precision, thereby improving overall symmetry. Even though it is only minimally invasive, the MVSS procedure has demonstrated excellent results with regards to nasal breathing, speech, and drooling. The comestic results were good, but not as significant as the functional measures. This may be in part due to the subjective nature of cosmesis. Table 2 compares the results at 6 months and at 14 months. At longer follow-up, the overall results were not as good but were still acceptable. Of note, some surgeons may find the 6-month results appealing because they may only desire a temporizing intervention. For patients who eventually recover facial function, the MVSS procedure is easily reversible through the original small stab incisions. The knotted ends of the sutures are cut and the sutures removed. In this study, 9 (75%) of 12 patients presented within 6 months of oncologic surgery and had a cable graft performed during the initial tumor removal (Table 1). These patients opted for MVSS as a temporizing intervention. One downside of the procedure was seen in 3 patients who required revisions because of suture breakage and pull-through. This is a reasonable complication rate (25%) given the infancy of MVSS. The complications occurred in the first 3 patients of the study, and with further experience there were no other complications. To prevent suture breakage, we now use polypropylene sutures not less than 3.0 and vascular pledgets (**Figure 4**). There were no problems with infections. Although we used propylene sutures, other suture materials have been used.[15-20] One other step in surgical evolution is the use of a Mitek screw (Mitek, a division of Ethicon [a Johnson & Johnson Company], Norwood, Mass) with a 3-0 Ethibond suture (Ethicon Inc, Somerville, NJ) drilled into the malar eminence as an anchor point (**Figure 5** and **Figure 6**).

Only 1 of the 8 patients receiving radiation therapy required revision. Given that most of the patients in our study had both radiation therapy and uncomplicated MVSS procedures, radiation therapy does not appear to be a contraindication to the procedure.

The MVSS can be successfully performed under local anesthesia, which is a distinct advantage over other modalities. Two of the 3 procedures that required general anesthesia were performed in conjunction with other procedures such as browplasty, gold weight placement, and lower-lid wedge resection. The other procedure requiring general anesthesia was performed immediately after the tumor resection during the same operative session.

Another advantage of the MVSS procedure is its relatively quick surgical time (an average of 46 minutes in our study). Additionally, in this small pilot study, it was well tolerated and provided high overall patient satisfaction (**Figure 7**).

In conclusion, the MVSS is a minimally invasive, reversible technique of lower facial reanimation that provides cosmetic results with restoration of nasal breathing. It is easily performed under local anesthesia in an outpatient setting with a rapid recovery time, thereby reducing morbidity and cost.

Accepted for publication December 3, 2003.

This study was presented at the Annual Meeting of the American Academy of Facial Plastic and Reconstructive Surgery; September 19, 2002; San Diego, Calif.

Corresponding author and reprints: James C. Alex, MD, Lahey Clinic, 41 Mall Rd, Burlington, MA 01805 (e-mail: james_c_alex@lahey.org).

REFERENCES

1. Sood S, Anthony R, Homer JJ, Van Hille P, Fenwick JD. Hypoglossal-facial nerve anastomosis: assessment of clinical results and patient benefit for facial nerve palsy following acoustic neuroma excision. *Clin Otolaryngol.* 2000;25:219-226.
2. Hammerschlag PE. Facial reanimation with jump interpositional graft hypoglossal facial anastomosis and hypoglossal facial anastomosis: evolution in management of facial paralysis. *Laryngoscope.* 1999;109(2 pt 2, suppl 90):1-23.
3. Winslow CP, Wang TD, Wax MK. Static reanimation of the paralyzed face with an acellular dermal allograft sling. *Arch Facial Plast Surg.* 2001;3:55-57.
4. Yoleri L, Songur E, Mavioglu H, Yoleri O. Cross-facial nerve grafting as an adjunct to hypoglossal-facial nerve crossover in reanimation of early facial paralysis: clinical and electrophysiological evaluation. *Ann Plast Surg.* 2001;46:301-307.
5. Fine NA, Pribaz JJ, Orgill DP. Use of the innervated platysma flap in facial reanimation. *Ann Plast Surg.* 1995;34:326-331.
6. Labbe D, Huault M. Lengthening temporalis myoplasty and lip reanimation. *Plast Reconstr Surg.* 2000;105:1289-1297.
7. Maegawa J, Saijo M, Murasawa S. Muscle bow traction method for dynamic facial reanimation. *Ann Plast Surg.* 1999;43:354-359.
8. Wei W, Zuoliang Q, Xiaoxi L, et al. Free split and segmental latissimus dorsi muscle transfer in one stage for facial reanimation. *Plast Reconstr Surg.* 1999;103:473-480.
9. Magliulo G, D'Amico R, Forino M. Results and complications of facial reanimation following cerebellopontine angle surgery. *Eur Arch Otorhinolaryngol.* 2001;258:45-48.
10. Atlas, MD, Lowinger DS. A new technique for hypoglossal-facial nerve repair. *Laryngoscope.* 1997;107:984-990.
11. Croxson GR, Quinn MJ, Coulson SE. Temporalis muscle transfer for facial paralysis: a further refinement. *Facial Plast Surg.* 2000;16:351-356.
12. May M, Drucker C. Temporalis muscle for facial reanimation: a 13-year experience with 224 procedures. *Arch Otolaryngol Head Neck Surg.* 1993;119:378-382.
13. Chuang DC, Wei FC, Noordhoff MS. "Smile" reconstruction in facial paralysis. *Ann Plast Surg.* 1989;23:56-65.
14. Cheney ML, McKenna MJ, Nath R, Healy C, Bartlett SP. Facial nerve reconstruction and facial reanimation following oncologic surgery. *Head Neck.* 1999;21:276-284.
15. Lee DS, Glasgold AI. Correction of nasal valve stenosis with lateral suture suspension. *Arch Facial Plast Surg.* 2001;3:237-240.
16. Collawn S, Vasconez LO, Gamboa M, Guzman-Stein G, Carriquiry C. Subcutaneous approach for elevation of the malar fat pad through a prehairline incision. *Plast Reconstr Surg.* 1996;97:836-841.
17. Ramirez OM. Cervicoplasty: nonexcisional anterior approach. *Plast Reconstr Surg.* 1997;99:1576-1585.
18. Uhm KI, Hwang SH, Choi BG. Cleft lip nose correction with onlay calvarial bone graft and suture suspension in oriental patients. *Plast Reconstr Surg.* 2000;105:499-503.
19. Hudson DA, Quarmby C, Ndobe E. A suture suspension technique to prevent ectropion after flap transposition from the neck to the face. *Plast Reconstr Surg.* 2001;108:1692-1695.
20. Byrd HS, Burt JD. Achieving aesthetic balance in the brow, eyelids, and midface. *Plast Reconstr Surg.* 2002;110:926-932.