Sternocleidomastoid muscle flap reconstruction during parotidectomy to prevent Frey’s syndrome and facial contour deformity

Korhan Asal, MD; Ahmet Köybaşıoğlu, MD; Erdogan Inal, MD; Ahmet Ural, MD; S. Sabri Uslu, MD; Alper Ceylan, MD; Fikret Ileri, MD

Abstract
We studied the incidence of Frey’s syndrome and facial contour deformity in two groups of patients who had undergone superficial parotidectomy. One group was made up of 12 patients who were randomized to undergo reconstruction of the surgical defect with a sternocleidomastoid muscle flap; the other 12 patients did not receive a flap. All 24 patients were evaluated via a short questionnaire, the starch-iodine test, and a visual examination. On the questionnaire, none of the 24 patients said they experienced abnormal facial sweating, flushing, or warmth while eating, although 6 of the 12 patients in the nonflap group had a mildly positive starch-iodine test. No patient in the flap group had a positive test. The difference between the two groups was statistically significant (p < 0.05). No statistically significant difference was seen between the two groups with respect to cosmetic results.

Introduction
Two possible consequences of parotidectomy are Frey’s syndrome and facial contour deformity:

- Frey’s syndrome is generally believed to be caused by an aberration in the regrowth of the postganglionic parasympathetic fibers that normally supply the parotid gland. This aberration results in their innervation of the sweat glands of the skin. The reported incidence of Frey’s syndrome following parotidectomy has varied greatly among different studies; when no preventive steps were taken, the incidence has been reported to be as low as 6% and as high as 96%.
- Facial contour deformity frequently occurs as a result of a surgically created mild depression in the pre- and infraauricular area.

Several intraoperative techniques have been used in an attempt to prevent both of these consequences. Among them are thick skin flap elevation, fascia lata grafts, dermal-fat grafts, sternocleidomastoid muscle (SCM) flaps, superficial musculoaponeurotic system (SMAS) flaps, and temporoparietal fascia flaps.

We conducted a study to test the effectiveness of SCM flap reconstruction in preventing Frey’s syndrome and facial contour deformities in patients who underwent superficial parotidectomy.

Patients and methods
This prospective study was conducted on 24 patients who had benign lesions of the parotid gland. Twelve patients were randomly selected to undergo superficial parotidectomy with SCM flap reconstruction and 12 without reconstruction.

The flap group was made up of 7 men and 5 women aged 34 to 65 years (mean: 49), and the nonflap group included 7 women and 5 men aged 29 to 71 years (mean: 50).

Following the parotidectomy, the length of the surgical defect that required reconstruction was measured from the mastoid tip. Superior SCM flaps were raised to a distance approximately one-third the width of the muscle and one-third to one-half of its length. Caution was exercised to avoid injuring the accessory nerve during mobilization of the SCM. The elevated flap was brought to the surgical area and sutured to the edge of the SMAS that covered the facial nerve. We intended to leave no area uncovered in the surgical bed.

Postoperative follow-up ranged from 9 to 32 months in the flap group (mean: 15.4) and 10 to 48 months in the nonflap group (mean: 26.2). At follow-up, all patients...
completed a short questionnaire survey and underwent a starch-iodine test. The survey was made up of two primary questions:

- Do you experience abnormal sweating, flushing, or facial warmth while eating?
- Are you pleased with the cosmetic outcome of the surgery?

The questionnaire contained one secondary inquiry: Do you have trouble with the movement of your neck or shoulder?

In addition, all patients were evaluated for Frey’s syndrome via the starch-iodine test. This test was performed on both sides of the face, the nonoperated side serving as a control. The pre- and infraauricular areas were painted with 10% iodine solution and left to dry. Afterward, cornstarch was spread over the painted areas. Patients were then given lemon candy to suck, and the results were visually evaluated by an otolaryngologist who was blinded to the type of surgery. Positivity for Frey’s syndrome on the starch-iodine test was classified as either mild, moderate, or strong according to criteria established by Taylor et al.\(^\text{1,2,4-6,8,9,11}\) The presence of a punctate discoloration of the parotid region was considered mildly positive, a patch of discoloration 2 cm\(^2\) or smaller was classified as moderately positive, and a patch larger than 2 cm\(^2\) indicated a strongly positive result.

Results

**Frey’s syndrome.** According to the questionnaire responses, none of the 24 patients experienced abnormal facial sweating, flushing, or warmth while eating. However, the starch-iodine test on the operated side was mildly positive in 6 of the 12 patients (50%) in the nonflap group, whereas none of the patients in the flap group had a positive result. This was despite the fact that an otolaryngologist who had been blinded to the type of surgery observed a mild pre- and infraauricular depression in 6 patients (50%) in the flap group and 7 (58%) in the nonflap group.

No patient reported any functional impairment on the questionnaire, and no postoperative complication related to facial nerve or accessory nerve function was observed in any patient.

Discussion

**Prevention of Frey’s syndrome.** Several procedures have been attempted as a means of preventing Frey’s syndrome during parotidectomy.\(^\text{1,2,4-6,8,9,11}\) In all of them, the surgeon creates a barrier between the exposed postganglionic parasympathetic nerve fibers and the sweat glands of the overlying skin flap. In addition to preventing Frey’s syndrome, some of these procedures help preserve the facial contour by filling the surgical defect.

The use of the SMAS flap for the prevention of Frey’s syndrome has been widely reported in the literature. Allison and Rappaport compared 112 patients who underwent SMAS interposition with a control group of 44 patients who did not.\(^\text{10}\) They found that the incidence of Frey’s syndrome was 0.8% in the SMAS group and 83% in the control group.

In a retrospective review of parotidectomy results in 21 patients, Kim and Mathog compared the traditional technique with the rotation and advancement of a combined platysma muscle–cervical fascia–sternocleidomastoid flap (PCS flap).\(^\text{15}\) They observed symptoms of Frey’s syndrome in 22% of the PCS flap patients and 50% of the nonflap patients. They also found that the PCS flap prevented deformity.

In a study of 160 patients who had undergone total or subtotal parotidectomy with an SMAS flap, Bonanno et al reported that the incidence of Frey’s syndrome was 0% according to starch-iodine testing.\(^\text{16}\) They recommended that the SMAS flap be considered the standard of care for preventing Frey’s syndrome in postparotidectomy patients.

Taylor et al studied Frey’s syndrome after superficial parotidectomy by comparing patients who had undergone subcutaneous or sub-SMAS elevation.\(^\text{14}\) They reported no significant difference in the incidence of Frey’s syndrome, in the amount of elapsed time until the development of symptoms, and in the severity of symptoms in the two groups. Singleton and Cassisi pointed out the importance of using a thick skin flap during parotidectomy as a means of preventing Frey’s syndrome.\(^\text{7}\)

Anatomically, the SMAS lies directly over the parotid fascia, and it is therefore usually resected along with the parotid gland. Therefore, the SMAS flap technique is not advisable when preservation of the SMAS may compromise the margins of the parotidectomy resection, as occurs when large or anterior neoplasms of the gland are present.\(^\text{10}\) On the other hand, the use of the SMAS flap does not prevent facial contour deformity.

The interposition of a vascularized temporoparietal fascia flap between the parotid bed and the overlying skin following superficial parotidectomy has been used to prevent both Frey’s syndrome and facial contour defects.\(^\text{12,13}\)

Ahmed and Kolhe used a double-layer superficial temporal artery fascia flap, made up of the temporoparietal fascia and the fascia over the temporalis muscle, for the prevention of Frey’s syndrome and contour defect.\(^\text{17}\) They reported that the incidence of Frey’s syndrome was sig-
nificantly lower and the volume deficit was less noticeable in these patients than in those who did not undergo flap reconstruction.

The advantages of the temporoparietal fascia flap are its thinness, pliability, and good vascularity. However, this technique does pose a risk of injury to the frontal branch of the facial nerve because the nerve travels within the plane adjacent to the temporoparietal fascia flap. Another complication of this procedure is scalp alopecia.

**Treatment of Frey’s syndrome.** Once Frey’s syndrome is present, it can be treated either medically or surgically. Medical treatment includes topical anticholinergic or antiperspirant creams and lotions. However, these treatments are sometimes unsatisfactory because (1) they provide only temporary relief, (2) they are visible when applied, (3) they are less effective in the hairy temporal area, and (4) they cause various side effects, including local irritation of the skin and the sweat duct epithelium. Moreover, although topical anticholinergics have been shown to be effective in controlling gustatory sweating, they can be absorbed systemically and cause blurred vision, dry mouth, urinary retention, tachycardia, and allergy. Botulinum A toxin has also been reported to be useful in the treatment of Frey’s syndrome.

Surgical treatment of Frey’s syndrome with tympanic neurectomy is aimed at interrupting the parasympathetic fibers as they cross the tympanic promontory. Tympanic neurectomy has been reported to be successful in approximately 80% of cases, but its use is limited because it requires a secondary intervention.

Several implant materials (e.g., lyophilized dura mater, polyglactin 910/polydioxanone, and expanded polytetrafluoroethylene) have been used as a mechanical barrier to prevent postoperative Frey’s syndrome; Dulguerov et al reported that these implants lowered the incidence of Frey’s syndrome to 3%. Fascia lata has been interposed successfully as a barrier, but it is not as effective in correcting volume defects.

**Prevention of facial contour deformity.** Free abdominal dermal-fat grafts have been used to prevent facial contour deformities. This type of graft not only results in a good cosmetic result, it also serves as a barrier to regenerating neurons. The disadvantages of this procedure are that it requires another incision and it poses a risk of fat resorption.

**SCM flaps.** The sternocleidomastoid muscle receives its blood supply superiorly from the superior occipital artery, in the midportion from the superior thyroid artery, and inferiorly from the transverse cervical artery. This distribution allows the muscle to be used as a superiorly or inferiorly based flap. Such a procedure poses a theoretical intraoperative risk of injury to the facial nerve and spinal accessory nerve during mobilization of the SCM flap; no such case has ever been reported.
Several studies of the use of the SCM muscle flap during parotidectomy have produced varying results. This variability can be attributed to differences in the thickness of the skin flaps and in the techniques used for flap rotation. In 1974, Kornblut et al reported the use of a superiorly based SCM flap to prevent Frey’s syndrome. They compared parotidectomy outcomes in 35 patients who underwent flap rotation and 35 who did not. They found no difference in the incidence of Frey’s syndrome between the two groups. They did not evaluate facial contour deformity. In contrast, Sood et al reported a statistically significant difference in the incidence of Frey’s deformity. Linder et al reported no difference in the incidence of Frey’s syndrome in the two groups. They did not evaluate facial contour deformity. In contrast, Sood et al reported a statistically significant difference in the incidence of Frey’s syndrome between an SCM flap rotation group (18%) and a nonflap group (81.8%).

Casler and Conley assessed postoperative Frey’s syndrome in three groups of patients: an SCM flap group, an SMAS plication group, and a control group in which no surgical preventive measures were taken. They found that the incidence of Frey’s syndrome was 47.1% in the control group, 12.5% in the SCM flap group, and 0% in SMAS plication group. The difference between the SCM flap group and the SMAS plication group was not statistically significant.

In our study, the incidence of aberrant cross-innervation determined objectively by the starch-iodine test was 0% in the SCM flap group and 10% in the nonflap group—a statistically significant difference ($p < 0.05$). Hann and Suen have posulated that the incidence of Frey’s syndrome would be higher that what is generally reported if clinicians would actively search for it by asking patients direct symptom-specific questions. In our study, no patient reported any symptoms related to the aberrant cross-innervation on our questionnaire, even though some of them had a positive starch-iodine test.

All patients in our study were pleased with the cosmetic outcome, even those who had mild deformities. Finally, we observed no postoperative complications.

In conclusion, we believe that SCM flap reconstruction during parotid surgery is an effective method of covering the surgical defect and possibly preventing Frey’s syndrome. The rotated flap must cover the entire surgical bed so that no distal branch of the facial nerve is exposed. Close attention to this surgical detail will result in a more successful outcome.

Although the only significant difference between our two groups of patients involved reinnervation patterns rather than self-reported manifestations of Frey’s syndrome, we maintain that SCM flap reconstruction is still advantageous because it does have the potential to prevent Frey’s syndrome. Moreover, it is an easy procedure to perform, it is not time-consuming, and it does not require any additional incisions.

References