Meta-analysis of Surgical Techniques for Preventing Parotidectomy Sequelae

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Objective: To conduct a meta-analysis of the literature on surgical methods for the prevention of Frey syndrome and concave facial deformity after parotidectomy.

Methods: A PubMed search through February 2008 identified more than 60 English-language studies involving surgical techniques for prevention of these parameters. Analyzed works included 15 retrospective or prospective controlled studies reporting quantitative data for all included participants for 1 or more of the measured parameters in patients who had undergone parotidectomy. Report quality was assessed by the strength of taxonomy recommendation (SORT) score. Data were directly extracted from reports and dichotomized into positive and negative outcomes. The statistical significance was then calculated.

Results: The mean SORT score for all studies was 2.34, and the mean SORT score for all the analyzed studies was 1.88. Meta-analysis for multiple techniques to prevent symptomatic Frey syndrome, positive starch-iodine test results, and contour deformity favored intervention with a cumulative odds ratio (OR) of 3.88 (95% confidence interval [CI], 2.81-5.34); OR, 3.66 (95% CI; 2.32-5.77); and OR, 5.25 (95% CI, 3.57-7.72), respectively.

Conclusion: Meta-analysis of operative techniques to prevent symptomatic Frey syndrome, positive starch-iodine test results, and facial asymmetry suggests that such methods are likely to reduce the incidence of these complications after parotidectomy.

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Although overall quality of life is unlikely to decline after superficial parotidectomy if facial nerve function is preserved, most patients have 1 or more postoperative sequelae, including Frey syndrome, concave facial contour at the operative site after healing, auricular numbness, and an unsightly scar. A great variety of techniques for preventing these sequelae have been described, yet inconsistent outcomes are reported for many published methods, and the value of added operative time and risk remains in question.

Frey syndrome includes some combination of sweating, redness, and warmth in the preauricular region while eating. Most series have found that about 40% of patients have 1 or more symptoms, and about 80% have positive starch-iodine test results for Frey syndrome, although many reports reflect a greater incidence. This phenomenon is believed to be caused by the aberrant regrowth of parasympathetic nerve endings of the auriculotemporal nerve into sweat glands overlying the surgical bed. Medical treatments, such as botulinum toxin injection or topical anticholinergics, have been used. Surgical methods rely on interposing a barrier between the regenerating nerve endings and the eccrine glands. Numerous reports have been published describing a variety of techniques used to prevent this syndrome, and many are also used to prevent the concave facial deformity that commonly occurs. Techniques such as sternocleidomastoid (SCM) muscle flaps, superficial musculoaponeurotic system (SMAS) interposition, and artificial implants have been described with varying degrees of success. This work is a meta-analysis of published studies of proposed methods for minimizing facial contour defects and Frey syndrome after superficial parotidectomy.

Methods

Design and Study Selection

The null hypotheses were that no published effort to reduce Frey syndrome and/or to minimize facial asymmetry had a better-than-even chance of success. Parameters used for assessment of the prevention of Frey syndrome included both clinical symptoms of Frey syndrome and the results of the Minor starch-iodine test. Parameters for facial symmetry included reported aesthetician evaluation, clinical appearance, and/or patient survey.

A PubMed search was conducted through February 2008, using the terms parotidectomy, Frey’s syndrome, and facial symmetry. These articles, and the references within, were used, yield-
**Table. Average Results of All Studies Using Interventions to Prevent Parotidectomy Sequelae**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Frey Syndrome</th>
<th>Asymmetry</th>
<th>Mean Strength of Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCM[3,4,8]</td>
<td>0.19 (0.17)</td>
<td>0.23 (0.19)</td>
<td>2.09</td>
</tr>
<tr>
<td>SMAS[10,14,20,21]</td>
<td>0.08 (0.16)</td>
<td>0.09 (0.10)</td>
<td>2.50</td>
</tr>
<tr>
<td>Fat[27,12,34]</td>
<td>0.07 (0.06)</td>
<td>0.34 (0.44)</td>
<td>2.70</td>
</tr>
<tr>
<td>Implants[5,6,9,35,36]</td>
<td>0.04 (0.04)</td>
<td>0</td>
<td>2.00</td>
</tr>
<tr>
<td>Dura[8]</td>
<td>0.07</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>ePTFE[8]</td>
<td>0</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Vicryl[6,8,35]</td>
<td>0</td>
<td>0.06 (0.05)</td>
<td></td>
</tr>
<tr>
<td>Alloderm[0.1]</td>
<td>0.06 (0.05)</td>
<td>0.22 (0.32)</td>
<td>2.50</td>
</tr>
<tr>
<td>Other[22,37,43]</td>
<td>0.06 (0.09)</td>
<td>0.22 (0.32)</td>
<td></td>
</tr>
<tr>
<td>Parotid gland fascia[38]</td>
<td>0.17</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>TPF only[40]</td>
<td>0</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>TPF/SMAS[37]</td>
<td>0.04</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>TPF/SCM/digastric[41]</td>
<td>0.02</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Platysma/SMAS/SCM[37]</td>
<td>0.22</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Other[2,12,37-43]</td>
<td>0.03</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Fascia lata[42,43]</td>
<td>0</td>
<td>0.14</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; ePTFE, expanded polytetrafluoroethylene; NA, not applicable; SCM, sternocleidomastoid muscle; SMAS, superficial muscular aponeurotic system; TPF, temporoparietal fascial.

a Data represent percentage developing reported sequelae. Methods without a standard deviation or 95% CI are those that were performed in only 1 study or did not report a difference that could be quantified and calculated (eg, a case report without specific data); thus there are no data to average.

b The mean strength of the studies was calculated based on a scale of 1 to 3, with 1 being the most consistent, patient-oriented evidence.

c LifeCell Corp, Woodlands, Texas.

d Ethicon Inc, Somerville, New Jersey.

e The mean strength of the studies was calculated based on a scale of 1 to 3, with 1 being the most consistent, patient-oriented evidence.

The Table presents a summary of the studies for the evaluated modalities. Analysis revealed that the reported incidence of Frey syndrome for all study groups ranged from 0% to 22% for the different interventions, with a mean (SD) of 8.8% (6.0%). The 95% CI for the standard error of the proportion was 3.5% to 14.1%, which does not encompass the 50% likelihood of occurring from pure chance. The reported incidence of facial asymmetry across all interventions ranged from 9% to 34%, with a mean (SD) of 21.9% (9.9%). The 95% CI for the standard error was 13.2% to 30.6%, which does not encompass the 50% likelihood of occurring from pure chance. The mean strength of the studies was calculated based on the SORT criteria (on a scale of 1 to 3, with 1 being the most consistent patient-oriented evidence). The mean SORT score for all the included studies was 2.33.

The meta-analysis for all techniques gave ORs of 3.88 (95% CI, 2.81-5.34) for prevention of clinical symptoms of Frey syndrome, and 3.66 (95% CI, 2.32-5.77) for prevention of a positive starch-iodine test result (Figure 1 and Figure 2). Multiple techniques were included in the analysis for prevention of facial asymmetry, with the overall OR for all techniques reported in controlled studies being 5.25 (95% CI, 3.57-7.72) in favor of treatment (Figure 3).
Meta-analysis of multiple surgical techniques suggests that the use of these techniques decreases the likelihood of symptoms of Frey syndrome and/or a positive starch-iodine test result. Similarly, meta-analysis favored multiple treatment methods for facial asymmetry after parotidectomy (Figure 1 and Figure 2). Although many treatment methods have been studied, only a limited number of these studies (ie, only those with control groups) were selected for meta-analysis. Although success has been reported with each of the reported methods, the analysis also suggests that total prevention is unlikely to be achieved with any technique because Frey syndrome or facial asymmetry is found to some degree in all treated sample groups (although perhaps not in each individual study).
There are more published studies of the SCM flap than any other individual method, and the reported effect of this technique for the prevention of Frey syndrome and cosmetic impact varies widely. Accordingly, when assessed as an independent factor, the ORs and z scores reflect favor benefit but suggest that benefit may not be statistically significant (Figure 1 and Figure 2). Kornblut et al reviewed their experience with 610 patients who had undergone parotidectomy, 391 of whom had an SCM flap, and found no statistical decrease in the rate of Frey syndrome compared with those without a flap. Yet, Casler and Conley reported a statistically significant decrease in the incidence of Frey syndrome for their variation of the technique, which was attributed to creation of a complete barrier between the surgical bed and the skin flap. This difference may be explained by a presumed correlation between the degree of aberrant reinnervation and symptoms. If the interposed layer provides an incomplete barrier, it could be expected that some patients would develop clinical or subclinical Frey syndrome. An SCM flap might be ineffective if the muscle is not used to create a complete barrier or if it atrophies prior to completion of the neural regeneration process. Other barriers, such as the SMAS, may also be only partially successful if the layer is incomplete or perforated.

Techniques for use of the SMAS layer vary but may be divided broadly into 2 groups: those that elevate a single, combined cutaneous SMAS flap and those that elevate a subcutaneous skin flap and then the SMAS layer separately. When elevated separately, the SMAS can be plicated, redraped, and/or combined with other flaps. Casler and Conley and Allison and Rappaport reported an extremely low incidence of Frey syndrome (0%-1%) with such techniques. Interestingly, 1 prospective study recently found a statistically significant difference between an SMAS interposition group and a non-reconstructed control group at 23 months after surgery (43% vs 0%) but no statistically significant difference at later follow-up (56% vs 41% at 78 months after surgery). Nevertheless, they did identify improved cosmetic satisfaction in the SMAS group.

The temporoparietal fascial (TPF) flap has also been used for prevention of Frey syndrome and asymmetry. Ahmed and Kolhe reported effective use of the TPF flap to prevent both Frey syndrome and facial contour deformity. It provides a broad, well-vascularized flap that can be accessed by extension of the incision into the temporal scalp. An added advantage of this technique is that the flap is completely separate from the parotid bed and so, unlike the SMAS, no portions are likely to be resected during extirpation. The primary risks of this flap are injury to the frontal branch of the facial nerve, alopecia, atrophy of the temporalis, and some fullness over the zygomatic arch can accentuate the facial defect. Cestelyn et al reported a cohort of 146 patients treated with TPF flap and SMAS plication, in which the incidence of Frey syndrome was 4% (with a 33% incidence in a control group). There were no frontal branch injuries reported. Analysis favored this technique for prevention of both Frey syndrome and asymmetry.

Dulguerov et al and others have reviewed their experience with various implants, including expanded polytetrafluoroethylene, polygalactin-910 mesh, lyophilized dura, and acellular human dermis. Wound complications may be more frequent with implants; for example, with acellular dermis (Alloderm; LifeCell Corp, Woodlands, Texas) local complications were reported in approximately 25%. Kornblut emphasized the risk of operative site scarring and its potential to increase the risks of reoperation. Finally, fat grafting has also been used. We previously described the effective use of small fat grafts to fill superficial parotidectomy defects with successful prevention of Frey syndrome and cosmetic deformity.

In conclusion, meta-analysis of various techniques for preventing Frey syndrome and the concave facial deformity following superficial parotidectomy favors treatment. Further studies are necessary to stratify differences among the various available techniques.


