Clinical Science

Modified partial superficial parotidectomy versus conventional superficial parotidectomy improves treatment of pleomorphic adenoma of the parotid gland

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Keywords:
Parotid gland; Pleomorphic adenoma; Parotidectomy; Postoperative complications; Frey’s syndrome; Surgical margin

Abstract

Background: Surgical treatment of pleomorphic adenoma of the parotid gland remains a subject of major debate. The investigators compared postoperative complications and surgical parameters between modified partial superficial parotidectomy and conventional superficial parotidectomy.

Methods: Clinical records of 129 patients were reviewed and analyzed for clinical characteristics.

Results: Compared with the conventional superficial parotidectomy group, the modified partial superficial parotidectomy group had significantly lower rates of auricular numbness, Frey’s syndrome, and obvious facial asymmetry (all P values < .05). The distance between the primary tumor capsule and satellite nodules ranged from .06 to 8.48 mm, and the greatest distance between the primary tumor capsule and satellite nodules was observed in tumors >4 cm. Furthermore, satellite nodules were more common in tumors >4 cm than in tumors <2 cm or tumors between 2 and 4 cm (all P values < .05).

Conclusions: Modified partial superficial parotidectomy compares favorably surgically and clinically with conventional superficial parotidectomy in certain patients.

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Pleomorphic adenoma (mixed tumor) is the most common benign parotid tumor. Surgical excision is an effective treatment for this lesion. The first case of parotid tumor resection was reported by Bernard in 1823. Later, parotid surgery was improved, primarily by Bailey. Surgical approaches for benign parotid surgery have evolved from simple enucleation to total or partial parotidectomy. However, which surgical approach to use is a subject of major debate.

In general, conventional superficial parotidectomy (CSP) is considered worldwide to be the reference standard for benign tumors localized in the superficial parotid lobe, which includes a shaped preauricular and submandibular incision, elevation of the skin flap to the anterior border of the parotid gland, and en bloc removal of the superficial lobe of the gland. However, with this method, a number of complications have been reported, including auricular lobule numbness, Frey’s syndrome (also called gustatory sweating syndrome), and facial contour disfigurement, which can reduce patients’ quality of life after parotidectomy. In recent years, some researchers have reported that partial superficial parotidectomy (PSP) preserves parotid gland function without increasing the risk for recurrence. However, PSP is not associated with lower rates of postoperative complications compared with CSP. Furthermore, the width of the tumor-free surgical margin required for successful PSP is unclear.

The aim of the present study was to compare recurrence rates, postoperative complications, and surgical parameters between CSP and a modified PSP (MPSP) procedure. In addition, we examined the histopathologic characteristics of pleomorphic adenoma of the parotid gland to define the safe surgical margin width.

Methods

Study patients

We reviewed the records of 302 patients with pleomorphic adenoma of the parotid gland, treated at our cancer hospital between 2004 and 2012. For this study, we included all patients with tumors located in the superficial lobe of the parotid gland and in whom the tumors were freely movable masses. Patients in whom the tumors were fixed to the adjacent tissues or located at the deep lobe of the parotid gland were excluded. Patients who had received any surgical treatment were also excluded. Therefore, a total of 129 patients with pleomorphic adenoma in the superficial lobe of the parotid gland were included for the final analysis. The study was approved by the Ethics Committee of Sichuan Cancer Hospital, and written informed consent was obtained from all study patients.

Histopathologic examination of tumor specimens

Before surgery, tumor size was assessed by computed tomography or ultrasonography, and tumors were classified as <2, 2 to 4, or >4 cm. After surgery, whole-organ sections in the parotid lobe with tumor were performed with 2 or 3 mm thick. Tumors were classified as cellular subtype, classic subtype, or stroma-rich subtype according to the criteria of Seifert et al. The incidence and extent of various tumor histopathologic characteristics (eg, incomplete capsule, capsular penetration, pseudocapsule, and satellite nodules) were estimated. Tumor sections were imaged using an Olympus imaging measurement system. The extent of shrinkage of tumors fixed in formalin was calculated. Shrinkage rate was calculated as follows: (length of resected specimen − length of specimen after specimen processing)/length of resected specimen.

Surgical techniques

For CSP, excision of the parotid tumor began with a “lazy S” preauricular and submandibular incision, through the skin and subcutaneous tissues. The skin flap was turned over from the superficial flap of the parotidomasseteric fascia to the masseter surface, and the facial nerve was dissected in a retrograde fashion. The parotid duct was ligated, and the tumor and superficial lobe of the parotid gland were resected. The flap was sutured in place with layered stitching to directly cover the wound. Low-vacuum drainage was maintained at approximately 60 to 80 kPa negative pressure. The dressing was changed and drainage tubes were removed 3 to 5 days after the operation. The stitches were removed after 5 to 7 days. Pressure dressings were used for 2 weeks after the operation. Atropine was not used. Patients had no dietary restrictions after parotidectomy.

For MPSP, a preauricular incision was performed, winding underneath the ear lobe to the mastoid tip. The incision alternatively extended superiorly from the mastoid tip, along the postauricular sulcus, up to the occipital hairline and then descended just inside and parallel to this hairline (Fig. 1A). The length of the incision was dependent on the size of the area that needed to be exposed during the operation. Tumors in front of the tragus were exposed by extending the incision from the beginning of the root of the helix to inside the hairline of the pars temporalis. When exposure was not sufficient after extension of the incision, a draw hook was used to pull up the skin flap. Flap surgery was performed on the deep surface of the parotidomasseteric fascia, retaining the parotid gland fascia. The rest of the procedure was performed as shown in Fig. 1B–F: (1) The great auricular nerve branch was initially dissected, separated, and protected (Fig. 1B). (2) The facial nerve main stem and several branches were dissected in an antegrade fashion, nerve branches were selectively dissected according to the tumor location from the major facial nerve stem, the tumor and partial superficial parotid gland were resected from the normal parotid gland >1.0 cm away from the tumor, the residual glandular tissue was sutured, the main Stensen duct was actively

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retained, and the corresponding Stensen branch duct was ligated (Fig. 1C). (3) According to the extent of depression of the parotid area after excision, the sternocleidomastoid flap, measuring approximately 3 × 5 cm² to 4 × 6 cm², was rotated forward in the anterior-superior sternocleidomastoid to fill the earlobe defect (Fig. 1D). (4) While cutting the flap, care was taken not to harm the greater auricular nerve, accessory nerve, and occipital artery. After properly trimming acellular dermal matrix (ADM; Yantai Zhenghai Biotechnology, Inc, Shenzhen, China), the basement membrane surface was covered down to the residual parotid gland bed and sewn completely to cover the parotid bed (Fig. 1E). (5) The flap was reset and sutured, including the parotideomasseteric fascia, platysma, and subcutaneous tissue and skin, and a low-vacuum drainage tube was then placed (Fig. 1F). Postoperative manipulation was the same as for CSP, but a routine pressure bandage was not applied.

**Evaluation of recurrence, complications, and aesthetic outcomes after parotidectomy**

After parotidectomy, patients returned to the cancer hospital for follow-up visits. All patients were followed up after parotidectomy by consulting their medical records and by telephone. The mean follow-up period was 62 months (range, 15–98 months). Items assessed on follow-up included tumor recurrence, facial paralysis, facial appearance, local effusion or salivary fistula, Frey’s syndrome, and auricular numbness. Because of the absence of standard methods for evaluation of facial contour after parotidectomy, a
combination of questionnaire and objective measurement was adopted. For the subjective measurement of facial contour and numbness of the earlobe, patients completed uniform questionnaires about facial contour and sensation on both sides of the face. The extent of concavity in the area below the earlobe was measured as follows: With the lower jaw in the postural position, a line was drawn from the point of the mandible angle to the highest point of the mastoid surface. The greatest vertical distance from the bottom of the concavity of the auricular lobe to the line was measured using a standard ruler. The healthy side was regarded as the control. This distance was compared with the corresponding distance measured on the control side to determine the extent of the concavity deformity. If the difference between the value measured on the operated side and the value measured on the control side was ≤ .5 cm, the facial contour was considered symmetric, and the concavity was classified as inconspicuous. If the difference between the value measured on the operated side and the value measured on the control side was > .5 cm, the facial contour was considered asymmetric, and the concavity was classified as conspicuous.

The Minor test was performed to document Frey’s syndrome. The test involved brushing 3% ethanol solution with iodine on the facial skin. After drying, starch powder was spread over the face and sialagogue was administered, and the patient was given 3 to 5 slices of dried green apples. Thereafter, the presence or absence of sweating was observed, and blue discoloration of the white starch on the area was assessed, thus identifying the presence of Frey’s syndrome. The contralateral side served as the control. For the measurement of Frey’s syndrome, female patients were required to remove makeup before the Minor test, and male patients were required to shave before the test. The room temperature was maintained at 24°C during the test. Patients were asked to remain quiet, and the testing area was protected from external disturbances.

As previously reported by Wijers et al., patients were asked to use a linear visual analogue scale to describe the extent of dry mouth. Values ≤5 were regarded as indicating no or mild dry mouth; values >5 were regarded as indicating obvious dry mouth.

Results

Study patients

Among 302 patients with pleomorphic adenoma of the parotid gland who were treated at our cancer hospital from 2004 to 2012, only 129 with pleomorphic adenoma in the superficial lobe of the parotid gland met our inclusion criteria. Of these patients, 57 were male and 72 were female; the mean age was 40.8 years.

Unfavorable histopathologic characteristics by histopathologic subtype

The tumor histopathologic subtypes were distributed as follows: cellular subtype, 52 cases; classic subtype, 51 cases; and stroma-rich (myxoid) subtype, 26 cases (Table 1). The specimen shrinkage rate was 17.41 ± 1.39%. The rate of incomplete capsule (Fig. 2A) was higher for the stroma-rich subtype (53.8%) than for the cellular (21.2%) and classic (25.5%) subtypes. Capsule penetration (Fig. 2B) was significantly more common in the cellular (32.7%) and classic (27.5%) subtypes than in the stroma-rich subtype (3.8%). Pseudocapsule (Fig. 2C) was more common in the stroma-rich subtype (42.3%) than in the other subtypes. No correlation was observed between histologic subtype and the incidence of satellite nodules (Fig. 2D).

Unfavorable histopathologic characteristics by tumor size

The distance between the primary tumor capsule and satellite nodules ranged from .06 to 8.48 mm. The greatest distance between a satellite nodule and a tumor capsule was 8.48 mm and was detected in a patient with a tumor >4 cm. Satellite nodules were more common in tumors >4 cm than in tumors <2 cm or tumors between 2 and 4 cm (Table 2).

Comparison of conventional superficial parotidectomy and modified conventional superficial parotidectomy with respect to postoperative complications and surgical parameters

The CSP and MPSP groups were similar with respect to the incidences of tumor recurrence, transient or long-term

<table>
<thead>
<tr>
<th>Subtype</th>
<th>n</th>
<th>Incomplete capsule</th>
<th>Capsular penetration</th>
<th>Pseudocapsule</th>
<th>Satellite nodules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellular</td>
<td>52</td>
<td>11 (21.2%)</td>
<td>17 (32.7%)</td>
<td>7 (13.5%)</td>
<td>6 (11.5%)</td>
</tr>
<tr>
<td>Classic</td>
<td>51</td>
<td>13 (25.5%)</td>
<td>14 (27.5%)</td>
<td>10 (19.6%)</td>
<td>7 (13.7%)</td>
</tr>
<tr>
<td>Stroma-rich</td>
<td>26</td>
<td>14 (53.8%) *</td>
<td>1 (3.8%) *</td>
<td>11 (42.3%) *</td>
<td>3 (11.5%)</td>
</tr>
</tbody>
</table>

*P ≤ .05 compared with rates of cellular subtype and classic subtype (chi-square test).
facial nerve palsy, dry mouth, and salivary fistula (all \( P \) values > .05; Table 3). However, patients treated with CSP were more likely to have auricular numbness, Frey’s syndrome, and facial contour disfigurement than those treated with MPSP (all \( P \) values < .05; Table 3). Facial appearance is shown at 1 week (Fig. 1G) and 1 year (Fig. 1H) after MPSP, and facial appearance is shown at 1 year (Fig. 1I) after CSP.

Surgical parameters for CSP and MPSP are summarized in Table 3. There were no significant differences between CSP and MPSP in operation time, amount of bleeding, and length of postoperative hospital stay (all \( P \) values > .05).

**Comments**

In this study, we found that MPSP was associated with lower rates of postoperative complications than CSP. Our analysis of histopathologic factors indicates that MPSP can be adopted as an alternative to CSP in patients with tumors < 4 cm and in whom margins of \( \geq 10 \) mm can be achieved.

To determine the safe surgical margin for MPSP, we analyzed the histopathologic characteristics of resected tumors. We found that the stroma-rich subtype was associated with the highest incidence of incomplete capsule and that the cellular and classic subtypes had significantly higher rates of capsular penetration than the stroma-rich subtype.

We also found that the maximum depth of capsule infiltration was 6.6 times what Chen et al \(^1 \) reported. The study showed that 16 patients (12.4%) had satellite nodules, and no correlation was observed between histologic subtype and occurrence of satellite nodules. Zbaren and Staufer \(^1 \) analyzed the histopathologic characteristics of 218 cases of pleomorphic parotid adenoma and found that 73% of the tumors were associated with incomplete capsule, capsule penetration, pseudocapsule, or satellite nodules.

<table>
<thead>
<tr>
<th>Tumor size (cm)</th>
<th>n</th>
<th>Incomplete capsule</th>
<th>Capsular penetration</th>
<th>Pseudocapsule</th>
<th>Satellite nodules</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;2</td>
<td>34</td>
<td>7 (20.6%)</td>
<td>8 (23.5%)</td>
<td>6 (17.6%)</td>
<td>2 (5.9%)</td>
</tr>
<tr>
<td>2–4</td>
<td>77</td>
<td>25 (32.5%)</td>
<td>20 (26.0%)</td>
<td>18 (23.4%)</td>
<td>8 (10.4%)</td>
</tr>
<tr>
<td>&gt;4</td>
<td>18</td>
<td>6 (33.3%)</td>
<td>4 (22.2%)</td>
<td>4 (22.2%)</td>
<td>6 (33.3%)</td>
</tr>
</tbody>
</table>

* \( P \leq 0.05 \) compared with rates of tumor size < 2 and 2 to 4 cm (chi-square test).
nODULES, which were the main causes of postoperative tumor recurrence. These findings indicated that capsule-stripped tumor enucleation was associated with a high risk for postoperative tumor recurrence. Orita et al.16 reported that 4 patients (3.7%) with pleomorphic parotid adenoma had satellite nodules and that these nodules existed within 4 mm of the main masses and were difficult to recognize during surgery. In our study, satellite nodules were more significantly common in tumors >4 cm, and these nodules existed within 8.48 mm of tumor capsules. In our opinion, surgical margin width >10 mm and tumors <4 cm should be recommended as criteria for CSP. However, Wai and Yamashita17 considered the location of the tumor as a key factor in the selection of surgical technique for the parotid gland. Our study showed that tumor size played a significant part in determining the surgical technique. Our results agree with those of a study by Witt,18 which showed that recurrence of parotid pleomorphic adenoma <4 cm was not significantly associated with the different parotidectomy.

We found that our MPSP procedure offered several advantages over CSP, including better cosmetic results and a lower incidence of auricular lobule numbness. A visually prominent facial scar following parotid surgery can be distressing to patients. In MPSP, an improved facelift incision was designed at the edge of the tragus, the posterior parts of the earlobe groove, and the hairline to conceal the scar and offer a good appearance. However, this incision was not suitable for the resection of anterior border parotid glands and tumors and was not conducive to a retrograde facial nerve dissection. For anterior border parotid gland tumors, exposure can be achieved by extending the incision from the beginning of the helix to the hairline of the pars temporalis with retractors. Compared with the conventional anterior tragus incision, this improved incision used in MPSP not only was more difficult to see after recovery but also did not affect facial symmetry. The improved incision also helped expose the great auricular nerve. Protection of the great auricular nerve might significantly reduce the incidence of postoperative auricular sensory dysfunction.19,20 We found that the incidence of auricular lobule numbness was significantly lower in patients with MPSP than in those treated with CSP, in which protection of the great auricular nerve was customarily neglected. This finding also demonstrates that auricular lobule numbness can be effectively prevented by retaining the great auricular nerve.

In this study, the facial nerve was located according to a previously reported 3-point method.21 Nerve stem exposure was usually completed within 20 min. In addition, anterograde dissection of the facial nerve could be completed with a designed facelift incision with only slight trauma, avoiding the larger wound surface caused by retrograde dissection of the facial nerve, in which a flap is required to expose the anterior border of the parotid gland. CSP involved a large operative area and dissection of the majority of the facial nerve branches, and it was also time-consuming. The more the facial nerve branches were exposed, the more the nerve was damaged. Theoretically, the facial nerve is more susceptible to injury when it receives more mechanical and chemical stimuli. The study by Witt18 demonstrated that more complete parotidectomy produced higher rates of facial nerve dysfunction and Frey’s syndrome. In particular, transient mandibular branch injuries were common. In MPSP, the facial nerve branches were selectively dissected according to the tumor location, which contributed to less facial nerve dysfunction, a smaller anatomic range, less bleeding, and shorter surgical time. Selective facial nerve dissecting was also associated with the maintenance of perineural connective tissue and the blood supply of nerves, which was also a significant reason why operation time and amount of bleeding were

<table>
<thead>
<tr>
<th>Variable</th>
<th>CSP (n = 71)</th>
<th>MPSP (n = 58)</th>
<th>P*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tumor recurrence</td>
<td>2 (2.8%)</td>
<td>3 (5.2%)</td>
<td>.805</td>
</tr>
<tr>
<td>Auricular numbness</td>
<td>45 (63.4%)</td>
<td>20 (34.5%)</td>
<td>.001</td>
</tr>
<tr>
<td>Salivary fistula</td>
<td>7 (9.9%)</td>
<td>8 (13.8%)</td>
<td>.488</td>
</tr>
<tr>
<td>Minor test</td>
<td>22 (31.0%)</td>
<td>4 (6.9%)</td>
<td>.001</td>
</tr>
<tr>
<td>VAS score &gt; 5</td>
<td>3 (4.2%)</td>
<td>0 (0%)</td>
<td>.319</td>
</tr>
<tr>
<td>Facial nerve palsy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 6 mo</td>
<td>11 (15.5%)</td>
<td>6 (10.3%)</td>
<td>.204</td>
</tr>
<tr>
<td>≥ 6 mo</td>
<td>2 (2.8%)</td>
<td>0 (0%)</td>
<td></td>
</tr>
<tr>
<td>Asymmetric facial contour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By questionnaire</td>
<td>28 (39.4%)</td>
<td>4 (6.9%)</td>
<td>.000</td>
</tr>
<tr>
<td>By objective measurement</td>
<td>33 (46.5%)</td>
<td>5 (8.6%)</td>
<td>.000</td>
</tr>
<tr>
<td>Surgical parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>82.7 ± 23.7</td>
<td>86.0 ± 20.9</td>
<td>.413</td>
</tr>
<tr>
<td>Bleeding (mL)</td>
<td>48.2 ± 14.5</td>
<td>45.4 ± 14.5</td>
<td>.255</td>
</tr>
<tr>
<td>Length of postoperative stay (d)</td>
<td>5.4 ± 1.2</td>
<td>5.5 ± 1.2</td>
<td>.516</td>
</tr>
</tbody>
</table>

CSP = conventional superficial parotidectomy; MPSP = modified partial superficial parotidectomy; VAS = visual analogue scale.

*Chi-square tests for comparisons of postoperative complications; t tests for comparisons of surgical parameters.
not significantly increased, even though reconstruction of the sternocleidomastoid flap and ADM implantation were added in MPSP.

Compared with the CSP group, the MPSP group did not have increased rates of subcutaneous fluid, salivary fistula, and dry mouth. In this study, because of the surgical removal of the partial superficial gland in the MPSP group, with no parotid main duct ligation, with careful suturing of residual gland and with postoperative full-vacuum drainage, the incidence of subcutaneous fluid and salivary fistula did not differ significantly from those in the CSP group, nor did the length of postoperative hospital stay. Obvious dry mouth was rare in both groups, and the difference in visual analogue scale scores was not significant between the 2 groups. This might be related to postoperative functional compensation from the gland on the healthy side and low sensitivity of the assessment method.

In the MPSP procedure, ADM combined with a sternocleidomastoid flap was applied to relieve Frey’s syndrome and facial contour disfigurement. Frey’s syndrome is a common complication of parotidectomy. 5,6,22,23 Effective methods of reducing or preventing Frey’s syndrome include the implantation of autologous tissue or foreign tissue between the parotid fascia and residual parotid gland to form a mechanical barrier and block nerve dislocation and regeneration. In the MPSP, sternocleidomastoid flaps were applied to fill the concavity in the infra-auricular area and relieve facial contour disfigurement. The incidence of facial contour disfigurement was significantly lower in the MPSP than in the CSP group by both subjective reporting and objective assessment. How-

References

1. Bernard M. Extirpation de la Parotide. Memoires Observations Extra-

its 1823;2:60–66.
4. Silvoniemi A, Pulkkinnen J, Grénman R. Parotidectomy in the treat-

8. Allison GR, Rappaport I. Prevention of Frey’s syndrome with superfi-

12. Seifert G, Langrock I, Donath KA. Pathological classification of pleo-