



# Patient safety and quality improvements in parotid surgery

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## Abstract

Parotidectomy is the mainstay treatment for tumors of the parotid gland. In an effort to improve clinical outcomes, several modern surgical techniques and perioperative interventions have been evaluated and refined. This review discusses current and actively debated perioperative interventions aimed at improving patient safety and the quality of parotidectomy. Relevant high-impact literature pertaining to preoperative diagnostic modalities, intraoperative surgical techniques, and post-operative care will be described.

## KEYWORDS

parotid, parotidectomy, patient safety, surgical quality

## Key points

- Fine needle aspiration is a suitable diagnostic modality for parotid tumors but has important limitations.
- Extracapsular dissection is safe and effective for small superficial tumors away from the facial nerve.
- Nerve monitoring may reduce temporary facial weakness but does not replace robust surgical technique.
- Outpatient parotidectomy is safe and feasible for appropriately selected patients.

## INTRODUCTION

Salivary gland tumors account for 2%–10% of all head and neck neoplasms. Of those, approximately 80% occur in the parotid gland and 80% are benign.<sup>1–3</sup> The standard treatment for parotid lesions is surgical resection, but the term “parotidectomy” does not provide sufficient detail on the technique and approach used. Historically, a parotidectomy involved coring out tumor cells without the removal of the tumor capsule, that is, enucleation. However, this technique resulted in unacceptably high recurrence rates.<sup>4</sup>

Modern parotidectomy procedures differ by the extent of resection and include extracapsular dissection (ECD), partial

superficial parotidectomy (PSP), superficial parotidectomy (SP), and total parotidectomy (TP). The specific procedure used varies based on several tumor and patient factors. Common complications after parotidectomy include facial nerve paresis, recurrence, hematoma, seroma, sialocele/salivary fistula, and Frey's syndrome. As quality metrics and cost-effectiveness have become increasingly emphasized in healthcare, the utility and safety of preoperative diagnostic modalities, intraoperative decision-making, surgical techniques, and postoperative care are heavily debated.

The heterogeneity in the literature regarding parotidectomy techniques and outcomes has made it challenging to achieve consensus on the ideal techniques for certain clinical scenarios.

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When discussing safety and quality for parotidectomy, the focus is generally on rates of facial nerve paralysis, tumor recurrence, and other surgical complications. In this review, we discuss pertinent literature regarding perioperative care for improving the quality of care and safety of patients undergoing parotidectomy.

## DISCUSSION

### Preoperative considerations

The majority of parotid lesions are slow-growing and represent a benign salivary tumor or process related to the parotid lymph nodes. While malignancy involving the parotid gland may present with pain or facial nerve weakness, it can also present as a painless lump indistinguishable from a benign tumor. To aid in the presurgical diagnosis of salivary lesions, various imaging techniques and tissue sampling via fine needle aspiration with cytological assessment are commonly utilized. Currently, no universal protocol exists for the preoperative evaluation of parotid lesions.

### Fine needle aspiration cytology

Fine needle aspiration cytology (FNAC) is safe, cost-effective, and has the potential to differentiate benign from malignant neoplasms. It can provide surgeons the ability to risk-stratify patients and confirm suspected malignant cases. Despite these benefits, FNAC has faced numerous criticisms. It has been shown to have a relatively low sensitivity (approximately 33%–90%).<sup>5</sup> A negative result does not preclude the possibility of a malignant lesion in the face of convincing patient history and clinical picture. Conversely, the specificity of FNAC is substantially higher, ranging between 67% and 100%.<sup>6</sup>

Another limitation of FNAC is the heterogeneity of and morphological overlap between parotid lesions. To address this, the 2019 Milan System for Reporting Salivary Gland Cytopathology was developed; it includes six diagnostic categories: (1) nondiagnostic, (2) nonneoplastic, (3) atypia of undetermined significance, (4a) benign, (4b) salivary gland neoplasm of uncertain malignant potential, (5) suspicious for malignancy, and (6) malignancy.<sup>7</sup> A recent study reported the malignancy risk of each category as 25%, 5%, 20%, 4.4%, 33.3%, 85.7%, and 97.5%, respectively.<sup>8</sup> The Milan system aims to standardize reporting terminology and replace conventional, descriptive interpretations of salivary gland FNAC. It also optimizes communication between clinicians and institutions and guides diagnosis and management based on the purported risk of malignancy. The utility of FNA with the Milan system, however, should still be evaluated within the context of a specific patient scenario and imaging characteristics.

Numerous techniques have also been proposed to address indeterminate FNAC results. If there is a disparity between FNAC findings and the clinical picture, close monitoring, rebiopsy or resection can be considered. Patients who undergo resection may also be candidates for intraoperative frozen section pathology.<sup>9</sup> In a large

retrospective review, Olsen et al.<sup>9</sup> demonstrated that 1119 out of 1339 parotid tumors showed no difference between frozen evaluation and permanent pathologic section. Of 220 patients with diagnostic discrepancies, only four cases would have resulted in a different intraoperative decision if the final pathology was known. Given its diagnostic accuracy, FNAC is a useful adjuvant for deciding the extent of surgery, particularly in equivocal cases. The choice of which gland tissue and/or nodes to evaluate is certainly an art and one that guides the utility of intraoperative, real-time frozen section sampling.

### Intraoperative considerations

#### Partial parotidectomy techniques for benign tumors

Partial parotidectomy techniques used to treat benign parotid lesions include ECD, PSP, and SP. ECD involves gross tumor dissection with a 2–3 mm margin with or without facial nerve dissection whereas PSP and SP necessitate nerve dissection.<sup>10</sup> Theorized benefits of partial parotid techniques include lower rates of transient facial palsy and Frey's syndrome as well as improved facial contour and cosmesis.<sup>1–3</sup> Of note, not all parotid surgery is done for benign parotid tumors.

Recurrence risk is perhaps the most common point noted by critics of partial parotidectomy techniques. Witt<sup>4</sup> found that among 60 parotid adenomas [PAs] treated equally with ECD, PSP, and TP, only one tumor had focal capsular exposure with no differences in rates of tumor rupture or recurrence. Thus, capsule exposure may not be a risk factor for recurrence like capsular rupture is. Four other meta-analyses also compared recurrence and complication rates between parotidectomy techniques. Xie et al.<sup>2</sup> found no difference in recurrence between ECD and SP (pooled risk ratio: 0.67–0.71;  $P > 0.05$ ) when pooling 14 European and Asian cohorts. This analysis was limited by follow-up periods of less than 5–7 years. Foresta et al.<sup>3</sup> included 19 studies comparing ECD to SP with follow-up periods of more than 5 years and found a lower risk of recurrence for ECD (0.2 vs. 2.3 cases per 1000 person-years). Notably, SP-treated tumors were larger and more often located near the facial nerve in the deep lobe. Albergotti et al.<sup>11</sup> included PAs less than 4 cm in the superficial lobe with a median follow-up of 12 years and reported no significant difference in recurrence between ECD and PSP/SP (1.5% vs. 2.4%;  $P < 0.05$ ). Finally, Colella et al.<sup>12</sup> found recurrence rates of 2.5% for SP, 3% for PSP, and 2.6% for ECD ( $P > 0.05$ ) among 16 studies with a median follow-up of 5 years. All meta-analyses alluded to the potential for selection bias, as tumor size, location, and indications for surgery were variable or not reported. Surgeons are more likely to perform SP over ECD when tumors are  $>4$  cm and closely involved with the facial nerve.<sup>13</sup> Recurrence risks could also be underestimated given follow-up periods of less than a decade.

Contrarily, two retrospective studies reported higher recurrence rates with ECD over SP.<sup>14,15</sup> Orabona et al.<sup>14</sup> reviewed 232 benign tumors with recurrence rates of 4.5% for ECD versus 3.4% for SP, although capsular rupture rates were also higher for ECD (3.6% vs. 1.8%). Kadletz et al.<sup>15</sup> studied 894 benign superficial tumors with

recurrence rates of 2.2% and 7.3% after SP and ECD, respectively, while noting a higher rate of negative margins with SP. Both studies highlight the importance of avoiding capsular rupture and positive margins, which other studies suggest can be achieved with surgical experience and appropriate tumor selection.<sup>2,3,11-13,16,17</sup> Tumors closely associated with the nerve may also necessitate a close margin with increased risk of pseudopod rupture regardless of the procedure.<sup>1</sup> Ghosh et al.<sup>18</sup> studied a cohort of 83 ECD- or SP-treated PAs with a mean follow-up of 12.5 years and found a recurrence rate of 17.6% when margins were positive versus 1.8% if the tumor was at least 1 mm from the margin.

The incidence of postoperative complications also appears to be lower or similar after ECD relative to other parotidectomy techniques.<sup>1-7,10,11,13,14</sup> One prospective cohort study found a lower incidence of temporary facial weakness (6.3%), no permanent weakness, and shorter OR times with ECD compared to PSP/SP/TP.<sup>19</sup> Several retrospective studies<sup>14,17,20,21</sup> and three meta-analyses<sup>2,3,11</sup> concluded that rates of transient and permanent facial paralysis, as well as Frey's syndrome, were lower or similar for ECD compared to SP. Witt et al.<sup>4</sup> had congruent findings except for a higher rate of permanent paralysis for ECD (1.2%) compared to PSP; however, the permanent paralysis rate after PSP was unusually low (0.2%). Only one retrospective study reported a higher rate of permanent paralysis with ECD.<sup>15</sup> Again, tumor characteristics were often not controlled and other key factors were not reported in these studies. This data should be interpreted while acknowledging selection bias and importance of appropriate patient selection.

The European Salivary Gland Society (ESGS) has proposed two related systems to address study heterogeneity and standardize indications for partial parotidectomy techniques given no guidelines exist. The anatomical system separates the parotid gland into five levels: I (superficial superior), II (superficial inferior), III (deep inferior), IV (deep superior), and V (accessory).<sup>22</sup> This may be helpful when describing the extent of resection and disease burden. The surgical system involves four categories: I ( $\leq 3$  cm, mobile, superficial, peripheral), II ( $\leq 3$  cm, deep), III ( $> 3$  cm,  $\leq 2$  levels), and IV ( $> 3$  cm,  $> 2$  levels). In this model, categories I, II, III, and IV tumors should usually be adequately resected with ECD, PSP, SP, and TP, respectively.<sup>16</sup>

Two studies have used these classification schemes. In a cohort of 98 PAs, all but one ECD-treated tumor was category I/II, 40% of category II/III tumors were treated with SP, and only six patients underwent PSP. ECD afforded a lower risk of facial nerve paralysis compared to PSP and other techniques overall. Higher ESGS category was associated with an increased risk of temporary/permanent weakness and Frey's syndrome, but not recurrence.<sup>17</sup> Auger et al.<sup>20</sup> studied 51 tumors treated by ECD with limited dissection of encountered nerve branches; 77.1% of tumors were category I/II and ESGS category was not associated with the incidence of sialocele, seroma, or nerve palsy. The variability in technique performed for each category is likely multifactorial and based on surgeon experience and preference as well as tumor-nerve proximity. Future prospective trials in which operative treatment is based on ESGS category are necessary to determine whether these classifications can stratify risk and standardize indications for parotidectomy.

These outcomes should be considered in the appropriate clinical context. It is the belief of the present authors that ECD is a viable treatment option for experienced surgeons faced with benign, mobile, superficial, and small ( $< 3$  cm) parotid neoplasms distinct from the facial nerve. Additionally, a partial parotid technique, such as an ECD or PSP, may be a viable treatment option for larger benign tumors in more challenging locations.

## Intraoperative facial nerve monitoring

Facial weakness is a significant cause of morbidity after parotidectomy usually attributable to nerve retraction. However, nerve compression, thermal injury, and transection are also possible causes. A mere 6% stretch can cause perineural tears, leading to edema and disruption of intrafascicular homeostasis despite a grossly normal-appearing nerve.<sup>23</sup> Risk factors for postoperative facial weakness may include age, tumor size, location, malignancy, operative duration, the extent of resection, inflammatory disease, and reoperation.<sup>19,23-30</sup> Temporary facial nerve paresis may cause ocular complications, impact appearance and ability to display emotion, and affect the quality of life.<sup>31</sup>

As a result, approximately 60% of otolaryngologists use facial nerve monitoring (FNM) during all or some of their parotidectomies based on a recent survey.<sup>32</sup> FNM modalities include direct stimulation with gross visualization and/or palpation of muscle contraction with or without continuous electromyography (EMG).<sup>19,24,25,33</sup> The NIM-Neuro 3.0 (Medtronic) is one commonly used system that utilizes direct current, constant-voltage stimulation with continuous EMG software that provides visual and audible feedback to warn surgeons about potential nerve injury.<sup>24,33</sup> However, there are concerns about nerve fatigue and damage from overstimulation as well as false negatives due to low current from high nerve resistance.<sup>33</sup>

The Checkpoint stimulator (Checkpoint<sup>®</sup> Nerve Monitor; Checkpoint Surgical) is a new biphasic, current-controlled probe that prevents charge buildup from repetitive stimulation and high currents. This may prevent iatrogenic nerve damage and fatigue.<sup>33,34</sup> Burchhardt et al.<sup>34</sup> used the Checkpoint device in 69 patients undergoing thyroid and parathyroid surgery and used laryngeal muscle palpation to confirm stimulation. All patients with identified recurrent laryngeal nerves and a full response at 2 mA just before case completion had normal postoperative vocal fold mobility whereas those with a weak or absent response had impaired mobility. Lawson et al.<sup>33</sup> found that the Checkpoint stimulator in combination with continuous EMG was noninferior to and as safe as the NIMS system among 15 thyroidectomy/parathyroidectomy patients. Future prospective studies are needed to understand its potential benefits for parotidectomy.

Numerous studies have also assessed whether FNM reduces the incidence and severity of facial paralysis after parotidectomy. Sood et al.<sup>35</sup> consolidated seven controlled studies and found a lower rate of immediate (22.5% vs. 34.2%;  $P = 0.001$ ) but not permanent weakness (3.9% vs. 7.1%;  $P = 0.18$ ) with FNM. No differences were

seen when looking only at SP- or TP-treated patients, likely due to study heterogeneity and a wide range of reported incidences of paralysis. A meta-analysis by Chiesa-Estomba et al.<sup>26</sup> reviewed 10 controlled studies, including any histology and extent of resection, and found lower overall rates of immediate and permanent weakness with FNM (23.4% vs. 38.4% and 5.7% vs. 13.6%, respectively;  $P < 0.001$  for both). When only prospective trials were included, no significant differences were found.<sup>27,28</sup> They concluded that no consensus could be made and called for more high-quality studies. Graciano et al.<sup>28</sup> however, found a higher average severity of immediate dysfunction on the regional Sunnybrook scale in their control group as well as a better facial disability index social well-being subscore with FNM. Uniquely, Haring et al.<sup>25</sup> reported that a postoperative stimulation threshold  $>0.25$  milliamps with  $>8$  intraoperative mechanical events had a sensitivity  $<50\%$ , positive predictive value of 77%, and specificity of 96% for immediate facial weakness.

Facial nerve stimulation is currently standard practice to help identify the facial nerve during benign parotid surgery. Usually, this is done with direct visualization although continuous EMG is also often used. Proponents of FNM argue that it detects unwanted nerve stimulation, reduces mechanical nerve trauma, allows for early nerve identification, aids difficult dissection during infectious/inflammatory and recurrent cases, and offers prognostic information about nerve integrity after completing resection.<sup>23-26,30,36,37</sup> Ultimately, it is difficult to define FNM's role during parotidectomy given the lack of high-quality studies and study heterogeneity. The integrity of the facial nerve is a primary focus of parotid surgery, and it is the opinion of the authors that FNM may reduce the incidence and severity of temporary facial paralysis without impacting long-term outcomes. Regardless, FNM does not replace excellent surgical technique and anatomical knowledge.

## Postoperative considerations

### Corticosteroids for reducing postoperative facial weakness

Rates of transient paralysis after parotidectomy range from 10% to over 50% whereas permanent paralysis is less common at 0%–8%.<sup>31,38</sup> Paralysis rates may vary by tumor size and the indications for surgery, only some of which are modifiable. Given their success in treating Bell's Palsy, steroids have been theorized to reduce postparotidectomy facial weakness by reducing peripheral nerve inflammation.<sup>39</sup>

Two prospective, randomized, placebo-controlled trials have been conducted on this topic. Roh et al.<sup>39</sup> randomized 45 patients with postoperative facial weakness to receive either oral prednisolone or placebo and evaluated them with the House-Brackman scale for 6 months. Weakness severity, tumor characteristics, and demographics were similar between groups. Overall recovery rates at 3 and 6 months were 84% and 97.7%, respectively, with no

difference between groups. Lee et al.<sup>40</sup> randomized 49 patients undergoing SP or TP to receive three doses of low- or high-dose IV dexamethasone or placebo every 8 h beginning immediately preoperatively. Facial weakness was subjectively assessed on a scale of 0%–100% for a year. High-dose steroids fared worse than low-dose steroids (mean function: 63.9% vs. 74.7%) and steroids overall fared worse than placebo (69.5% vs. 81.3%), although not statistically significant. Dexamethasone-treated patients also regained facial function slower than controls (median recovery time: 60 vs. 150 days). Retrospective studies have also concluded that steroids may not play a role in the recovery of facial weakness.<sup>38,41</sup>

Current literature suggests parotidectomy-related facial function and recovery is likely not influenced by perioperative steroids. However, both aforementioned trials included small sample sizes, distinct patient populations, and different routes of administration and dosing regimens. Nevertheless, their findings may be explained by the fact that postparotidectomy facial paresis is usually a result of stretch injury, leading to neuronal degeneration in addition to edema whereas Bell's Palsy is due to inflammatory edema within a bony canal.<sup>31</sup> At these authors' institution, perioperative steroids are not routinely used perioperatively for parotidectomy.

### Outpatient parotidectomy

Historically, parotidectomies have required at least a night in the hospital postoperatively. With an emphasis to reduce healthcare costs and decrease nosocomial morbidity, there has been increased interest in outpatient parotidectomies in selected patient populations. Outpatient parotidectomies were described in 1991 by Steckler et al.<sup>42</sup> in a series of 54 patients. To date, there are 16 articles including data for patients undergoing outpatient parotidectomy with or without an inpatient cohort for comparison.<sup>36-51</sup> By far the largest of these is a study by Siddiqui et al.<sup>45</sup> that utilized the National Surgical Quality Improvement Program (NSQIP) database to compare 1352 outpatient parotidectomies to 1352 propensity-matched inpatient parotidectomies. Surgical complication (3.1 vs. 1.8%,  $P = 0.033$ ), medical complication (1.8% vs. 0.8%;  $P = 0.028$ ), pneumonia (0.5% vs. 0.0%;  $P = 0.016$ ), and overall complication rates (4.5% vs. 2.6%;  $P = 0.009$ ) were all higher in the inpatient group. Though the NSQIP data set allows large cohorts to be compared, it is limited in that it does not include parotidectomy-specific complications.

A recent systematic review and meta-analysis by Benito et al.<sup>52</sup> showed that outpatient parotidectomy patients were not at increased risk for overall complications (risk ratio [RR]: 0.74;  $P = 0.16$ ), seroma/sialocele (RR: 0.84;  $P = 0.73$ ), salivary leak/fistula (RR: 0.88;  $P = 0.82$ ), or surgical site infections (RR: 1.40;  $P = 0.55$ ). These studies are limited in that they are for the most part retrospective and are all nonrandomized. Patients are much more likely to undergo outpatient parotidectomies if they have benign, superficial disease, have few comorbidities, and do not receive a drain intraoperatively. What these studies do demonstrate, however, is that outpatient parotidectomy is safe in carefully selected patient populations.

## CONCLUSION

Perioperative management of parotid surgery has led to improvements in patient safety and surgical quality through refinements in cytological evaluation, surgical techniques, and postoperative management.

## AUTHOR CONTRIBUTIONS

Vidit Talati contributed by developing the topic of this review, performing the literature review, synthesizing relevant literature, writing significant portions of the manuscript, and revising the manuscript. Hannah Brown contributed by performing the literature review, synthesizing relevant literature, and writing significant portions of the manuscript. Tasher Losenegger contributed by performing the literature review, synthesizing relevant literature, and writing significant portions of the manuscript. Peter Revenaugh contributed by developing the topic of this state-of-the-art review and revising the manuscript. Samer Al-Khudari contributed by developing the topic of this review, performing the literature review, synthesizing relevant literature, and revising the manuscript.

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## CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

## DATA AVAILABILITY STATEMENT

The data that supports the conclusions of this review are available on request from internationally recognized journals. The published manuscripts cited in this review are publicly available through the reader's institution.

## ETHICS STATEMENT

This study is exempt from Institutional Review Board approval, as it is a state-of-the-art review using only previously published work and individualized human subjects data. This study was conducted in accordance with the ethical guidelines for medical and health research involving human subjects.

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