Pleomorphic adenoma of the parotid: formal parotidectomy or limited surgery?

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Abstract

BACKGROUND: Optimal surgery for pleomorphic adenoma of the parotid is controversial. In the present review, we discuss the advantages and disadvantages of the various approaches after addressing the surgical pathology of the parotid pleomorphic adenoma capsule and its influence on surgery.

DATA SOURCES: PubMed literature searches were performed to identify original studies.

CONCLUSIONS: Almost all pleomorphic adenomas can be effectively treated by formal parotidectomy, but the procedure is not mandatory. Extracapsular dissection is a minimal margin surgery; therefore, in the hands of a novice or occasional parotid surgeon, it may result in higher rates of recurrence. Partial superficial parotidectomy may be a good compromise. The tumor is removed with a greater cuff of healthy parotid tissue than in extracapsular dissection. This may minimize the recurrence rate. On the other hand, the removal of healthy parotid tissue compared with formal parotidectomy is limited, thus minimizing complications such as facial nerve dysfunction and Frey syndrome.

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in every age group and tend to grow slowly over prolonged time periods. The mean age at the initial diagnosis is 46 to 51 years,\textsuperscript{6–8} and women are affected more often than men.\textsuperscript{2,6} The surgical treatment of parotid PA has been debated over the past 100 years, but controversy remains with some endorsing formal parotidectomy (superficial or total parotidectomy) and others favoring limited surgery (partial superficial parotidectomy or extracapsular dissection [ECD]).

Total/superficial parotidectomy requires dissection of the full facial nerve. Whereas total parotidectomy removes the parotid tissue lateral and medial to the nerve, superficial parotidectomy removes the parotid tissue lateral to it. Partial superficial parotidectomy (PSP) dissects less than the full facial nerve; the tumor is removed with 2 cm of normal parotid tissue.\textsuperscript{10} In ECD, the facial nerve is not dissected at all; a 2- to 3-mm rim of healthy tissue is removed together with the tumor.\textsuperscript{11} In this review, we discuss the advantages and disadvantages of the various approaches after addressing the surgical pathology of the parotid PA capsule and its influence on surgery.

**Surgical Pathology of the Parotid Pleomorphic Adenoma Capsule**

The capsule is 1 of the 3 structural components of PA. The other 2 are parenchyma (tumor epithelial cells) and stroma (Fig. 1). The parenchymal:stromal ratio varies, and parenchyma-rich and stroma-rich variants have been recognized.\textsuperscript{12,13} It is not established whether the capsule is newly formed or reflects pre-existing connective tissue compressed by the growing tumor. Morphologically, the capsule consists of variably thick, dense, fibrous tissue that may be discontinuous or absent or become invaded and even penetrated by a tumor (Figs. 2–5). Subcapsular accumulation of myxoid stroma is a common feature of parotid PA, but small collections of tumor cells often remain attached to the capsular undersurface therein (Fig. 6). The capsule may contain elastic fibers and incorporate adipocytes or atrophic parotid elements that may be difficult to be distinguished from an invading tumor.

Attempts have been made to correlate capsular features with the parenchymal:stromal ratio or the location of the tumor. The capsule is 0.015- to 1.75-mm thick. It is thicker in parenchyma-rich tumors than in stroma-rich tumors.\textsuperscript{14–16} Tumors located in the deep lobe have a thicker capsule than those in the superficial lobe.\textsuperscript{17} Half to two thirds of stroma-rich tumors show a variable/focal absence of the capsule.\textsuperscript{15,18} Tumors bulge or grow through capsular breaches to extend to adjacent parotid or soft tissues (Fig. 7). The phenomenon is easily appreciated when adipose tissue is nearby and accounts for the characteristic bosselated gross appearance of many PAs. Where the capsule is absent, tumor invades adjacent parotid or adipose tissue either as a broad advancing front or as small mammillations bulging out from the main mass.

Appreciating capsular features in PA naturally leads to consideration of the so-called tumor satellites. On the histologic section examined, satellites are perceived as variably sized tumor nodules of a variable parenchymal:stromal ratio, which appear separated by normal glandular, fibrous, or adipose tissue from the variably encapsulated, main mass\textsuperscript{15,16,18–23} (Figs. 8–10). The distance between the latter and satellites varies. The growing of a tumor through capsular breaches and/or capsular invasion/penetration would account for most of the satellites, particularly those of small size and at short distances from the main mass (Fig. 8). Thus, satellites would correspond with section profiles of extracapsular tumor extension; continuity with the main mass is outside of the plane of that section. Along with various authorities, we support this view. Eneroth\textsuperscript{24} observed that 50% of presumed satellites were continuous with the main tumor on serial histologic sectioning. Very occasionally, large satellites at an increased distance from the main tumor may be seen. These may be alternatively attributed to the multifocal/multicentric origin of PAs. The notion of a multicentric PA has been criticized. Nevertheless, envisaging separately arising tumor nodules that may eventually merge via continuous growth could explain the marked

![Figure 1](image.png)  

Figure 1  Structural components of variously bosselated PAs (Pa). T, tumor parenchyma; *, stroma; C, capsule. The capsule in A is thicker than in B. Pairs of arrowheads are used so that the difference in the capsular thickness is appreciated. Unless otherwise specified, the photomicrographs in this article are from sections of routinely processed tissue, which were stained with hematoxylin-eosin. It was not deemed necessary to give objective magnifications. Zooming on the electronic format of the photomicrographs would allow appreciation of the detail, which is difficult to see on prints.
lobulation of some PAs (Fig. 11A). Such configuration also characterizes recurrent PAs (Fig. 11B), but a history of previous surgery would allow distinction. There has been considerable variation regarding the occurrence of tumor satellites in parotid PAs. Methodology, including serial histologic sectioning, and the mode of origin should be considered while assessing these data.

Historic Survey of Surgical Treatment of Pleomorphic Adenoma

During the first half of the 20th century, parotid surgery was more concerned about damaging the facial nerve trunk/branches than recurrence. Although publications do not often detail the technique, incision of the PA capsule and enucleation of the contents (intracapsular enucleation, Fig. 12A) were often practiced to avoid exposure of the nerve. Except for intracapsular enucleation, enucleation at the level of loose connective tissue situated between the tumor and adjacent parotid (extracapsular enucleation, Fig. 12B) or removal of the tumor together with a margin of surrounding salivary tissue (ECD, Fig. 12C) had been considered. Recurrence was high after intracapsular enucleation, and postoperative irradiation was given in an attempt to decrease it. The radioresistance of PAs was eventually appreciated, and removal of the tumor capsule (extracapsular enucleation) was advocated to decrease recurrence.

In the early 1950s, Martin and, in the late 1950s, Patey and Thackray combined surgical and histologic observations to recommend the use of superficial parotidectomy for PAs of the superficial lobe on the grounds that tumor satellites may be missed during enucleation. This was widely endorsed, and even total parotidectomy has been advocated. In the ensuing decades, superficial or total parotidectomy was established as the standard treatment of parotid PA and affected a dramatic decrease in recurrence. However, undesired complications were experienced, and it was gradually appreciated that 50% to 60% of the tumors were in contact with 1 or more branches. 

Figure 2 A thin capsule (C) separates a stroma-rich tumor (T) from parotid lobules in the lower right. A collecting duct (arrow) has been incorporated within the capsule.

Figure 3 A dense fibrous capsule (C) surrounds a parenchyma-rich tumor (T). An aggregate of packed lymphoid cells (asterisk) is associated with the capsule. Such aggregates are not uncommon in PA.

Figure 4 A nonencapsulated, stroma-rich tumor (T) extends to the adjacent parotid acini (A).

Figure 5 A tumor of an equal parenchymal:stromal ratio (T) penetrates the thick capsule (C). Penetration is in the form of a spur-like projection (arrowhead). The linear segment corresponds to the thickness of the capsule. Compare with Figure 2.
of the facial nerve. In order to preserve the nerve, dissection at the interface between nerve branches and the tumor has to be minimal; hence, superficial or total parotidectomy virtually corresponded to extracapsular enucleation in regards to the tumor part lying on branches of the facial nerve. This would explain why 40% to 80% of parotid PAs in recent series are regarded as partially enucleated.

Postoperative complications in conjunction with the appreciation that superficial or total parotidectomy partially corresponds to extracapsular enucleation led to rethinking. The original ECD was reappraised, whereas other authors suggested PSP. Recent results suggest that recurrence after ECD/PSP is not higher than those after superficial or total parotidectomy (see later). Nevertheless, many specialists remain convinced that superficial parotidectomy is the minimal surgery for PA.

Diagnosis of Pleomorphic Adenoma

PA is a slowly growing, usually demarcated, and mobile tumor located in the superficial parotid lobe in 80% to 87% of cases. About 80% of PAs in the superficial lobe are localized in the parotid tail. At the time of surgery, the majority of PAs are smaller than 4 cm. In a series of 280 tumors, only 6% were larger than 4 cm.

It is imprudent to attempt establishing a diagnosis of PA on clinical features alone because 50% to 70% of parotid carcinomas are asymptomatic, T1/T2 tumors that may appear demarcated. If superficial parotidectomy is accepted as the minimal surgery for a small, nodular tumor, it does not seem necessary to establish preoperatively whether it is malignant or benign. In this context, the value of fine-needle aspiration cytology (FNAC) can be questioned.

However, the need for preoperatively establishing the benign or malignant nature of a small mobile tumor becomes obvious if more limited surgery (PSP/ECD) is to be considered. To achieve this, ultrasound (US) examination and FNAC, alone or in combination (US-guided FNAC), have been used. US morphology of various parotid tumors has been compared with histopathology. US alone may detect malignancy with 72% sensitivity and 86% specificity and PAs with 80% sensitivity, 86% specificity, and 84% accuracy. The reported criteria to consider a malignant lesion were irregular shape, ill-defined and irregular margins, and inhomogeneous internal structure.

Although FNAC aims at a preoperative diagnosis of malignancy so that inadequate limited surgery is avoided, it often fails to type primary salivary carcinomas. Regarding benign tumors, FNAC can support the use of limited surgery, whereas in the case of inflammatory processes it helps in avoiding unnecessary surgery. A number of studies reported 86% to 93% sensitivity, 92% to 100% specificity, and 90% to 98% accuracy of FNAC in detecting parotid malignancy.

False-negative diagnosis seems to be the drawback of FNAC. In 2 series of 169 and 228 parotid tumors preoperatively assessed by FNAC, 78 and 97 were, respectively, diagnosed as PAs. Three of the 78 (4%) and 7 of the 97 (7%) cases were postoperatively proven by histopathology to be primary parotid carcinomas (ie, false-negative). Carcinomas ex-PA (Cas ex PA) are especially liable to false-negative diagnosis by FNAC. This is attributable to sampling errors, but US-guided FNAC is being increasingly used to decrease it. Regarding the diagnosis of PAs by FNAC, 97% sensitivity and 98% specificity have been reported. In experienced hands, available diagnostic procedures often allow accurate preoperative detection of malignancy and thus ensure their adequate surgical treatment.

Recurrence

A recurrent parotid PA is almost always multifocal (Fig. 11B). Multiple tumor nodules are increasingly found with each episode of recurrence. Their distribution
is often widespread. Hypotheses to explain recurrence include a multicentric origin of the tumor, capsular features, accidental tumor rupture, and surgical procedure.

During the first half of the 20th century, a multicentric origin had been the favored explanation. The hypothesis was questioned by Foote and Frazell, who examined 447 PAs and could not confirm a single case of initial multicentricity. As noted previously, initial multicentricity in PA appears to be a rare phenomenon, and Batsakis could find only a single possible example out of 240 cases.

It has already been mentioned that a high percentage of PAs, particularly stroma-rich tumors, show focal absence of the capsule and the formation of satellite nodules. During enucleation, the nodules may escape unnoticed and be left behind. The significance of accidental capsule rupture may have been overestimated. Certainly, when parotid PA was usually treated by intracapsular enucleation, recurrence was 22% to 43%. However, recent studies suggest that differences in recurrence between patients with or without intraoperative capsular rupture (7% to 8% vs 2.5% to 4%, respectively) are not statistically significant. Other authors suggested that microscopically positive margins are associated with an increased recurrence, whereas intraoperative tumor spillage is not. Nevertheless, spillage occasionally accounts for tumor implantation.

A significant factor is the surgical procedure. Even before the era of endorsing formal parotidectomy, recurrence rates of less than 10% were reported, but in these series PAs were apparently not removed by enucleation but rather by operative, surgical, or local excision. Witt surveyed the literature to record recurrence in relation to the extent of surgery. While comparing recurrence rates of different surgical procedures, a selection bias should be considered. Patients undergoing limited surgical procedures (PSP or ECD) may present with more accessible mobile and circumscribed tumors probably less prone to recurrence than patients undergoing formal parotidectomy. For instance, Klintworth et al performed ECD in only 40% of patients with benign parotid tumors. Recurrence amounted to 1.8% after total parotidectomy (9 analyzed articles, 828 PAs), 2.6% after lateral parotidectomy (23 articles, 2,366 PAs), 0.3% after PSP (5 articles, 340 PAs), and 2.6% after ECD (11 articles, 1,113 PAs). Only after enucleation (intracapsular/extracapsular) was the recurrence high (25%) (14 articles, 797 PAs). It is noted that recurrence after PSP/ECD was not, as might have been expected, higher than after superficial/total parotidectomy.

More recent studies confirmed low recurrence rates after PSP and ECD. However, the mean follow-up in the series with ECD was 194, 61, and 60 months, respectively. In a further recent literature survey by Witt...
and Rejto,\textsuperscript{104} the recurrence rates of ECD and PSP were compared. Recurrence occurred in 36 of 1,183 (3\%) ECD cases and in 1 of 340 PSP (0.3\%) cases ($P < .05$).\textsuperscript{104} The recurrence rate was lower after PSP than after ECD.

The widespread distribution of recurrent tumor nodules precludes radical surgery. This increases the risk of further recurrence and permanent facial nerve paralysis (see later). Estimated rates are 21\% to 31\% and 15\% to 31\%, respectively.\textsuperscript{6,8,85,87,105,106} The chance of a second recurrence after 1, 2, 5, 10, and 15 years was estimated at 16\%, 23\%, 42\%, 60\%, and 75\%, respectively.\textsuperscript{107} Therefore, adequate initial treatment of PAs is mandatory to minimize recurrence.

**Carcinoma ex Pleomorphic Adenoma**

In Ca ex PA, epithelial malignancy develops in association with a primary PA or at the site of a previous one.\textsuperscript{108} The proportion of benign versus malignant components can be quite variable; therefore, the preoperative diagnosis of a Ca ex PA may be difficult.\textsuperscript{80} Approximately 50\% can be identified by FNAC.\textsuperscript{80,82} Information on pathogenesis is elusive. The tumor may be malignant from the onset or when carcinomatous transformation occurs.\textsuperscript{109} Investigation of molecular events may be enlightening, but such events are outside the scope of this review. Ca ex PA comprises 5\% to 25\% of primary parotid carcinomas.\textsuperscript{1,63,108,110–113} Based on a series of 623 tumors, Eneroth et al\textsuperscript{114} showed a positive relationship between preoperative duration and the risk of developing Ca ex PA. While only 1.6\% of tumors present for 0 to 4 years developed carcinoma, the percentage rose to 2.4\% in tumors lasting 5 to 9 years, 5.9\% in tumors lasting 10 to 14 years, and 9.4\% in tumors older than 15 years.\textsuperscript{114} Thackray and Lucas\textsuperscript{115} estimated that 25\% of parotid PAs may undergo malignant transformation if left untreated. Regarding recurrent PAs, the rate of

![Figure 11](image1)

\textbf{Figure 11} (A) A markedly lobulated PA of the parotid. Compare with Figure 1 and with recurrent PA. (B) Although most of the recurrent tumor consists of variously confluent stroma-rich nodules (asterisk), 1 nodule is parenchyma rich (arrow).

![Figure 12](image2)

\textbf{Figure 12} Diagrammatic representations outlining (A) intracapsular enucleation, (B) extracapsular enucleation, and (C) extracapsular dissection.
carcinoma ranges from 7% to 16%. The increased development of carcinoma in recurrent PAs is another reason why surgery should be ab initio optimized.

Complications of Parotid Surgery

Again, while comparing recurrence or complication rates of different surgical procedures, the selection bias should be considered that patients undergoing more limited surgical procedures may present with more accessible mobile and circumscribed tumors than patients undergoing formal parotidectomies. The main complication is facial nerve dysfunction because facial nerve paralysis compromises quality of life (QOL). Although 11% to 65% of patients experience temporary facial nerve dysfunction after superficial or total parotidectomy, permanent paralysis is seen in 0% to 19%. Various studies showed a positive relationship between the extent of parotid surgery and postoperative facial nerve function. Temporary facial nerve paralysis occurred in 38.4% of total parotidectomies and 25.6% of superficial parotidectomies but only in 5.9% of PSPs. Permanent facial nerve dysfunction followed 3.1% of total parotidectomies and 7.7% of superficial parotidectomies but did not occur after PSP. With ECD, temporary facial nerve paralysis followed in 3% to 12% and permanent dysfunction in 0% to 2.12%. In summary, the risk of temporary/permanent facial nerve paralysis is lower after PSP/ECD than after superficial/total parotidectomy.

Another complication is Frey syndrome/gustatory sweating. Clinically manifested Frey syndrome was seen in 18% and 43% of retrospectively and prospectively analyzed groups, respectively; the starch-iodine test was positive in all patients of both groups. After superficial and total parotidectomy, the syndrome is seen in 2% to 40% of patients but in only 0% to 5% after ECD; hence, it is positively related to the extent of parotid surgery. Surgical procedures to avoid Frey syndrome after superficial or total parotidectomy have been proposed.

A further unwanted sequela of superficial or total parotidectomy is a sensory deficit in the area of the great auricular nerve (skin overlying the parotid gland and the mastoid, the posteroinferior surface of the auricle, the ear lobe, and the concha). If the nerve is sacrificed during the procedures, almost all patients exhibit the symptom. The deficit does not markedly affect QOL, and preservation of the posterior branch of the great auricular nerve appears to diminish the deficit and improve recovery chances. Patients treated by PSP often present with a sensory deficit. It is less often observed after ECD because this procedure preserves most branches of the great auricular nerve.

A prospective randomized study recorded a lower occurrence of facial nerve paralysis, Frey syndrome, and auricular dysesthesia after limited partial parotidectomy than after superficial or total parotidectomy; some of the differences were statistically significant. A recent prospective study using the core quality of life questionnaire (QLQ-C30) in conjunction with the Head and Neck cancer-specific questionnaire module (QLQ-H&N35) of the European Organization for Research and Treatment of Cancer (EORTC) evaluating the global QOL indicated that it is not negatively affected by superficial parotidectomy.

Summation of Advantages/Disadvantages of Formal Parotidectomy

For several decades, superficial and total parotidectomy was successfully used to treat PAs, with an average recurrence rate below 2%. Because the majority of benign salivary gland tumors are located in the superficial lobe of the parotid, surgeons in training have the opportunity to practice straightforward, superficial parotidectomy therein and acquire skills that will enable them to deal with more challenging approaches. Technical advances, such as facial nerve monitoring and microscope-guided surgery, may contribute to the decrease in the risk of permanent facial nerve paralysis. On the other hand, many PAs contact branches of the facial nerve and should be dissected along the capsule to preserve these branches; thus, the surgeon focally performs extracapsular enucleation. After formal parotidectomy, comparatively many patients develop Frey syndrome and auricular dysesthesia, tissue defects may lead to cosmetic problems, and QOL may be affected. In the event of recurrence after formal parotidectomy, the risks of further recurrence and facial nerve paralysis are increased. Given the multifocal nature of recurrent PAs, radicality of surgery is difficult to achieve, furthermore the facial nerve trunk/branches become embedded in scar tissue because of exposure during the first operation.

Summation of Advantages/Disadvantages of More Limited Surgery

Recurrence after PSP or ECD is not higher than that after formal parotidectomy in carefully selected patients with experienced surgeons. PAs located in the tail of the parotid are easily accessed by limited surgery. The risk of permanent facial nerve paralysis, Frey syndrome, or cosmetic problems is low for both PSP and ECD. Facial nerve trunk/branches are not (ECD) or only partly (PSP) embedded in scar tissue, which decreases the risk of permanent paralysis after surgery for recurrence. Limited approaches are more technically demanding and the prerogative of experienced surgeons. The preoperative use of US/FNAC is mandatory to avoid inappropriate limited surgery for malignant neoplasms.

Conclusions

Both formal parotidectomy and more limited surgery serve a legitimate purpose, and their domains do not overlap.
Almost all PAs can be effectively treated by formal parotidectomy, but the procedure is not mandatory. Small, mobile PAs located in the superficial lobe/tail of the parotid gland can be removed by limited surgery with few complications. The preoperative use of US/FNAC decreases the risk of applying limited surgery to remove a malignant neoplasm.

In the first half of the 20th century, surgeons were concerned about injuring the facial nerve. Therefore, they operated only on or within the PA capsule. As a consequence, recurrence was high and up to 45%. Based on cumulative experience and technical advances, contemporary parotid and facial nerve surgeons are conscious of the technical demands of limited surgery and are not inhibited by unwarranted fear of the facial nerve branching, thus preventing the quality of PA treatment from declining to the level of the first half of the 20th century.

ECD is a minimal margin surgery. Therefore, in the hands of a novice or occasional parotid surgeon, it may result in higher rates of recurrence. PSP may be a good compromise. On the one hand, surgeons in training have the opportunity to acquire skills of standard parotid surgery (facial nerve dissection), and the tumor is removed with a greater cuff of healthy parotid tissue than in ECD. This may minimize the recurrence rate. On the other hand, the removal of healthy parotid tissue compared with formal parotidectomy is limited, thus minimizing complications such as facial nerve dysfunction and Frey syndrome. A multicenter randomised study may be helpful in deciding the optimal treatment of PAs; however, conducting such a study may be difficult.

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