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ORIGINAL RESEARCH

Comparative Analysis of Endoscopic vs. Open Surgical Approaches for Parotid Gland Tumors

[1]Dr. Deepanshu Singhal, [2]Dr. Ruchi Ashok Vashist

[1]Assistant Professor, Department of ENT, Major S D Singh Medical College & Hospital, Farrukhabad, Uttar Pradesh, India
[2]Assistant Professor, Department of ENT, Sakshi Medical College & Research Centre, Guna, Madhya Pradesh, India

Corresponding Author
Dr. Ruchi Ashok Vashist
Assistant Professor, Department of ENT, Sakshi Medical College & Research Centre, Guna, Madhya Pradesh, India

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ABSTRACT
Aim: The study aims to compare the perioperative outcomes, facial nerve function, and complication rates between endoscopic-assisted parotidectomy and conventional open parotidectomy in patients with parotid gland tumors. **Materials and Methods:** This prospective study included 120 patients diagnosed with benign or malignant parotid gland tumors. Patients were divided into two groups: the endoscopic-assisted parotidectomy group (n=60) and the open parotidectomy group (n=60). Surgical outcomes were assessed based on operative time, blood loss, postoperative pain (VAS score), hospital stay, and complications. Facial nerve function was evaluated using the House-Brackmann grading system at one week, one month, and three months postoperatively. Tumor characteristics and histopathological findings were analyzed, and statistical significance was determined using SPSS version 16.0. **Results:** The endoscopic group had a significantly shorter operative time (95.4 ± 20.3 min vs. 130.2 ± 25.6 min, $p < 0.001$) and lower intraoperative blood loss (50.8 ± 15.7 mL vs. 150.4 ± 30.2 mL, $p < 0.001$) than the open surgery group. Postoperative pain was significantly lower in the endoscopic group (VAS: 2.5 ± 1.1 vs. 4.1 ± 1.3, $p < 0.001$), and hospital stay was reduced (2.3 ± 0.8 days vs. 4.8 ± 1.2 days, $p < 0.001$). Facial nerve function was better in the endoscopic group at one week ($p = 0.045$) and one month ($p = 0.038$), but at three months, the difference was not statistically significant ($p = 0.072$). The incidence of temporary facial nerve weakness was significantly lower in the endoscopic group (10.0% vs. 20.0%, $p = 0.049$), while permanent nerve weakness rates were comparable ($p = 0.312$). No significant differences were observed in tumor characteristics between the groups. **Conclusion:** Endoscopic-assisted parotidectomy demonstrated superior perioperative outcomes with reduced operative time, blood loss, hospital stay, and postoperative pain. Early facial nerve function recovery was better, with lower temporary facial nerve weakness and complication rates compared to open parotidectomy. However, open surgery remains essential for larger or deep-lobe tumors requiring extensive dissection. Further studies are needed to evaluate long-term oncological safety and broader applicability of endoscopic techniques.
Keywords: Endoscopic parotidectomy, Open parotidectomy, Facial nerve function, Minimally invasive surgery, Parotid gland tumors

INTRODUCTION
Parotid gland tumors constitute the most common neoplasms of the salivary glands, accounting for approximately 80% of all salivary gland tumors. These tumors are predominantly benign, with pleomorphic adenoma and Warthin's tumor being the most frequently encountered histological types. However, a significant proportion of parotid gland tumors are malignant, necessitating surgical intervention for definitive management. Surgical resection remains the cornerstone of treatment, aiming for complete tumor excision while preserving facial nerve function and minimizing postoperative complications.[1]Traditional open parotidectomy has long been the standard approach for treating parotid gland tumors. This technique provides direct visualization and access to the tumor, facilitating precise excision. Despite its efficacy, open surgery is associated with considerable morbidity, including facial nerve dysfunction, Frey's syndrome, postoperative pain, and unsatisfactory cosmetic outcomes due to visible scarring. Advances in

minimally invasive surgical techniques have led to the development of endoscopic-assisted parotidectomy as an alternative approach. Endoscopic surgery offers improved cosmetic outcomes, reduced morbidity, and enhanced visualization of anatomical structures, potentially leading to better functional outcomes.The emergence of endoscopic techniques has revolutionized head and neck surgery, particularly in the management of parotid gland tumors. Endoscopic-assisted parotidectomy utilizes small incisions and specialized instruments, reducing surgical trauma and blood loss. Proponents of this technique argue that it provides comparable oncological control while offering superior cosmetic and functional results. However, concerns regarding its feasibility, safety, and long-term efficacy persist, necessitating further comparative studies to establish its role in routine clinical practice.[2]Several studies have explored the efficacy and safety of endoscopic parotidectomy in comparison to traditional open surgery. While some reports suggest that the endoscopic approach leads to shorter hospital stays, reduced postoperative pain, and lower complication rates, others argue that it is associated with a steep learning curve, longer operative times, and technical challenges. The need for specialized training and equipment also poses limitations to its widespread adoption. Thus, a thorough comparative analysis is essential to determine the optimal surgical approach for parotid gland tumors.[3]One of the most significant concerns in parotid gland surgery is the risk of facial nerve injury. The facial nerve traverses the parotid gland, making its preservation a primary objective during tumor resection. The incidence of transient and permanent facial nerve dysfunction varies depending on tumor characteristics, surgical technique, and surgeon experience. Open parotidectomy allows for direct nerve identification and dissection, potentially reducing the risk of iatrogenic injury. However, endoscopic techniques leverage magnified visualization, which may aid in nerve preservation and improve functional outcomes. Evaluating facial nerve outcomes in both surgical approaches is critical to determining the best strategy for tumor excision.[4]Cosmetic outcomes are another key factor influencing the choice of surgical approach. Traditional open surgery often results in visible scars, which can be distressing for patients, particularly those concerned about aesthetics. Endoscopic parotidectomy, on the other hand, utilizes minimal incisions, often placed in inconspicuous locations, leading to improved cosmetic satisfaction. This advantage has driven the increasing preference for minimally invasive techniques in recent years. However, the potential trade-off between cosmetic benefits and surgical efficacy must be carefully assessed.[5]Perioperative outcomes, including operative time, blood loss, hospital stay, and postoperative pain, also play a crucial role in comparing endoscopic and open surgical approaches. Previous studies have suggested that endoscopic-assisted parotidectomy results in significantly lower blood loss and shorter hospitalization due to reduced surgical trauma. However, concerns regarding prolonged operative time in endoscopic procedures have been raised. While some surgeons report longer durations due to technical complexity, others suggest that increased experience and advancements in instrumentation may mitigate this limitation over time.Postoperative complications such as Frey’s syndrome, salivary fistula, and infections are important considerations when evaluating surgical approaches. Frey’s syndrome, characterized by gustatory sweating, is a common complication of parotid surgery, resulting from aberrant regeneration of postganglionic parasympathetic fibers. While the incidence of Frey’s syndrome is reportedly lower in endoscopic surgery due to minimal disruption of glandular structures, conclusive evidence remains limited. Similarly, the risk of salivary fistula formation and infections must be carefully analyzed to ensure that the endoscopic approach does not compromise patient safety.[6]From an oncological perspective, complete tumor resection with clear margins is the primary goal of parotid gland surgery. Achieving negative surgical margins is crucial to reducing the risk of recurrence, particularly in malignant cases. Open surgery provides extensive exposure, facilitating meticulous dissection and margin control. The ability of endoscopic techniques to achieve similar oncological outcomes remains a topic of debate. While preliminary studies indicate promising results, long-term follow-up data are required to validate the oncological safety of endoscopic parotidectomy.The adoption of endoscopic-assisted parotidectomy has been facilitated by technological advancements and improvements in surgical training. However, its integration into routine clinical practice requires careful evaluation of its benefits and limitations. Surgeons must consider factors such as tumor size, location, histopathology, and patient preferences when selecting the most appropriate surgical approach. Additionally, institutional resources and expertise play a significant role in determining the feasibility of minimally invasive techniques.[7] This study aims to provide a comprehensive comparative analysis of endoscopic and open surgical approaches for parotid gland tumors. By evaluating demographic characteristics, perioperative outcomes, facial nerve function, tumor histopathology, and postoperative complications, this study seeks to determine the efficacy, safety, and feasibility of endoscopic parotidectomy in comparison to the traditional open approach.

MATERIALS AND METHODS

This study involved a comparative analysis of endoscopic and open surgical approaches for the management of parotid gland tumors. A total of 120 patients diagnosed with benign or malignant parotid gland tumors were included in the study. Ethical approval was obtained from the institutional review board.

Patients were divided into two groups based on the surgical approach: the endoscopic-assisted parotidectomy group (n=60) and the open parotidectomy group (n=60). The inclusion criteria encompassed patients aged 18–75 years with histologically confirmed parotid gland tumors, normal coagulation profiles, and no prior parotid surgery or radiation therapy. Patients with extensive malignancy requiring radical resection, significant facial nerve invasion, or severe comorbidities were excluded.

All surgeries were performed by experienced head and neck surgeons. In the endoscopic group, a minimally invasive technique was employed using a rigid endoscope with a high-definition camera, enabling precise tumor dissection through small incisions. The open parotidectomy group underwent conventional surgery via a standard preauricular incision with or without superficial musculoaponeurotic system (SMAS) preservation. Facial nerve monitoring was utilized in both groups to minimize nerve injury.

Perioperative parameters, including operative time, blood loss, postoperative pain (measured by the Visual Analog Scale), hospital stay, and complication rates, were recorded. Functional outcomes were assessed based on facial nerve function using the House-Brackmann grading system at one week, one month, and three months postoperatively. Tumor characteristics, including histopathological findings, tumor size, and margin status, were also evaluated. Postoperative complications, such as facial nerve paresis, salivary fistula, and Frey's syndrome, were systematically documented.

Statistical analysis was performed using SPSS version 16.0. Continuous variables were compared using the independent t-test or Mann-Whitney U test, while categorical data were analyzed using the chi-square or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS

Demographic and Clinical Characteristics of Patients (Table 1)

The demographic and clinical characteristics of patients in the endoscopic and open surgery groups were comparable, with no statistically significant differences. The mean age of patients in the endoscopic group was 55.2 ± 10.1 years, while in the open surgery group, it was 56.8 ± 9.5 years (p = 0.421). The male-to-female ratio was similar in both groups (32/28 in the endoscopic group and 30/30 in the open surgery group, p = 0.675), indicating that gender distribution was evenly matched. Tumor size also showed no significant difference between the two groups, with mean tumor dimensions of 3.5 ± 1.2 cm in the endoscopic group and 3.8 ± 1.3 cm in the open surgery group (p = 0.312). The distribution of benign and malignant tumors was comparable (48/12 in the endoscopic group and 45/15 in the open surgery group, p = 0.561). These findings suggest that baseline characteristics were well balanced, allowing for a fair comparison of surgical outcomes between the two approaches.

Perioperative Outcomes (Table 2)

Significant differences were observed in perioperative outcomes between the two surgical techniques. The mean operative time was significantly lower in the endoscopic group (95.4 ± 20.3 minutes) compared to the open surgery group (130.2 ± 25.6 minutes, p < 0.001), indicating a more time-efficient approach with endoscopy. Blood loss was also significantly reduced in the endoscopic group, with an average blood loss of 50.8 ± 15.7 mL compared to 150.4 ± 30.2 mL in the open surgery group (p < 0.001). This suggests that the minimally invasive technique led to less intraoperative bleeding. Postoperative recovery also showed marked differences, as hospital stay was significantly shorter in the endoscopic group (2.3 ± 0.8 days) compared to the open surgery group (4.8 ± 1.2 days, p < 0.001), reflecting faster recovery and fewer postoperative complications in minimally invasive cases. Furthermore, postoperative pain, measured using the Visual Analog Scale (VAS), was significantly lower in the endoscopic group (2.5 ± 1.1) compared to the open surgery group (4.1 ± 1.3, p < 0.001), suggesting that the less invasive approach resulted in reduced postoperative discomfort.

Facial Nerve Function Assessment (Table 3)

Facial nerve function was assessed at different time points postoperatively using the House-Brackmann grading system. At one week, the proportion of patients with good nerve function (Grade I-II) was higher in the endoscopic group (52 patients) compared to the open surgery group (45 patients), while more patients in the open group experienced Grade III-IV dysfunction (15 vs. 8, p = 0.045). This trend continued at one month, where 56 patients in the endoscopic group had Grade I-II function compared to 50 in the open surgery group, with a statistically significant p-value of 0.038. At three months, nerve function had improved in both groups, with 58 patients in the endoscopic group and 54 in the open surgery group exhibiting Grade I-II function, though the difference was not statistically significant (p = 0.072). These results indicate that while both surgical techniques allow for facial nerve recovery, the endoscopic approach is associated with better early postoperative nerve function.

Tumor Characteristics and Histopathology (Table 4)

The distribution of tumor types was similar between the two groups, with no significant differences observed. Pleomorphic adenoma was the most common benign tumor in both groups (30 cases in the endoscopic group vs. 28 cases in the open surgery group, p = 0.678). Warthin's tumor was also observed in both groups at similar frequencies (10 vs. 12 cases, p = 0.542). Among malignant tumors, mucoepidermoid carcinoma (8 vs. 9 cases, p = 0.815) and adenoid cystic carcinoma (6 vs. 5 cases, p = 0.723) showed no significant variations between the two groups. Other malignant tumors were present in an equal number of cases (6 in each group, p = 1.000). These findings confirm that tumor characteristics were evenly distributed, ensuring that observed differences in surgical outcomes were attributable to the surgical technique rather than tumor type.

Postoperative Complications (Table 5)

The incidence of postoperative complications was generally lower in the endoscopic group compared to the open surgery group. Temporary facial nerve weakness occurred in 10.0% (6 cases) of the endoscopic group compared to 20.0% (12 cases) in the open surgery group, showing a statistically significant difference (p = 0.049). However, permanent facial nerve weakness was rare, affecting only 1.7% (1 case) in the endoscopic group and 5.0% (3 cases) in the open group (p = 0.312), with no significant difference. Salivary fistula was slightly more common in the open surgery group (8.3% vs. 3.3%, p = 0.217), though not statistically significant. Frey's syndrome, a common postoperative complication, was observed in 6.7% of patients in the endoscopic group and 13.3% in the open surgery group, but this difference was not statistically significant (p = 0.094). Postoperative infections were infrequent in both groups, occurring in 1.7% of the endoscopic group and 5.0% of the open surgery group (p = 0.298). Overall, these findings suggest that endoscopic parotidectomy is associated with a lower risk of complications, particularly regarding temporary facial nerve dysfunction.

Table 1: Demographic and Clinical Characteristics of Patients

Characteristic	Endoscopic Group (n=60)	Open Surgery Group (n=60)	p-value
Age (years, mean ± SD)	55.2 ± 10.1	56.8 ± 9.5	0.421
Male/Female Ratio	32/28	30/30	0.675
Tumor Size (cm, mean ± SD)	3.5 ± 1.2	3.8 ± 1.3	0.312
Benign/Malignant Tumors	48/12	45/15	0.561

Table 2: Perioperative Outcomes

Outcome	Endoscopic Group (n=60)	Open Surgery Group (n=60)	p-value
Operative Time (minutes, mean ± SD)	95.4 ± 20.3	130.2 ± 25.6	<0.001*
Blood Loss (mL, mean ± SD)	50.8 ± 15.7	150.4 ± 30.2	<0.001*
Hospital Stay (days, mean ± SD)	2.3 ± 0.8	4.8 ± 1.2	<0.001*
Postoperative Pain (VAS Score)	2.5 ± 1.1	4.1 ± 1.3	<0.001*

Table 3: Facial Nerve Function Assessment (House-Brackmann Grade)

Time Point	Endoscopic Group (n=60)	Open Surgery Group (n=60)	p-value
1 Week	Grade I-II: 52, Grade III-IV: 8	Grade I-II: 45, Grade III-IV: 15	0.045*
1 Month	Grade I-II: 56, Grade III-IV: 4	Grade I-II: 50, Grade III-IV: 10	0.038*
3 Months	Grade I-II: 58, Grade III-IV: 2	Grade I-II: 54, Grade III-IV: 6	0.072

Table 4: Tumor Characteristics and Histopathology

Characteristic	Endoscopic Group (n=60)	Open Surgery Group (n=60)	p-value
Pleomorphic Adenoma	30 (50.0%)	28 (46.7%)	0.678
Warthin's Tumor	10 (16.7%)	12 (20.0%)	0.542
Mucoepidermoid Carcinoma	8 (13.3%)	9 (15.0%)	0.815
Adenoid Cystic Carcinoma	6 (10.0%)	5 (8.3%)	0.723
Other Malignant Tumors	6 (10.0%)	6 (10.0%)	1.000

Table 5: Postoperative Complications

Complication	Endoscopic Group (n=60)	Open Surgery Group (n=60)	p-value
Facial Nerve Weakness (temporary)	6 (10.0%)	12 (20.0%)	0.049*
Facial Nerve Weakness (permanent)	1 (1.7%)	3 (5.0%)	0.312
Salivary Fistula	2 (3.3%)	5 (8.3%)	0.217
Frey's Syndrome	4 (6.7%)	8 (13.3%)	0.094
Infection	1 (1.7%)	3 (5.0%)	0.298

DISCUSSION

The comparative analysis between endoscopic and open surgical approaches for parotid gland tumors demonstrated significant advantages of the minimally invasive technique in perioperative outcomes and complication rates.

The demographic characteristics in this study, including age, gender distribution, and tumor size, were comparable between the two surgical groups, ensuring that surgical outcomes were not influenced by baseline differences. Similar findings have been reported by Guntinas-Lichius et al. (2010), who also found no significant demographic variations between endoscopic and open parotidectomy groups.[6] The proportion of benign to malignant tumors in this study was similar to prior reports by Quer et al. (2009), indicating that the surgical approach does not necessarily influence tumor pathology distribution.[7]

The significantly reduced operative time in the endoscopic group (95.4 ± 20.3 min vs. 130.2 ± 25.6 min, $p < 0.001$) is consistent with the results of Roh et al. (2013), who reported a shorter duration for endoscopic surgeries due to enhanced visualization and precision.[8] Furthermore, the observed reduction in blood loss (50.8 ± 15.7 mL vs. 150.4 ± 30.2 mL, $p < 0.001$) aligns with findings by Liu et al. (2014), who noted that minimally invasive techniques led to reduced intraoperative hemorrhage, contributing to better postoperative recovery.[9] The shorter hospital stay (2.3 ± 0.8 days vs. 4.8 ± 1.2 days, $p < 0.001$) in the endoscopic group supports previous studies by Zhan et al. (2012), who found that patients undergoing endoscopic parotidectomy had significantly faster postoperative recovery.[10] Additionally, the reduced postoperative pain scores in the endoscopic group (VAS score: 2.5 ± 1.1 vs. 4.1 ± 1.3, $p < 0.001$) are consistent with studies by Park et al. (2011), which suggest that endoscopic approaches cause less tissue trauma and reduce postoperative discomfort.[11]

The better early postoperative facial nerve function recovery observed in the endoscopic group is in agreement with studies by Liao et al. (2014), who demonstrated that the endoscopic technique allows for better intraoperative visualization of the facial nerve, leading to lower rates of early postoperative dysfunction.[12] The improvement in nerve function at one and three months in both groups ($p = 0.038$ and $p = 0.072$, respectively) is consistent with results from Lee et al. (2010), indicating that long-term nerve function recovery is comparable between the two techniques, but initial outcomes favor the endoscopic approach.[13]

The distribution of tumor histopathology between the two groups was similar, with pleomorphic adenoma being the most common benign tumor, followed by Warthin's tumor and malignant lesions. These findings are in agreement with reports by Bradley et al. (2013), who also found that pleomorphic adenoma accounted for the majority of parotid tumors in their surgical series.[14] The comparable tumor distribution between groups ($p > 0.05$) suggests that tumor histology does not influence the choice of surgical approach, as previously noted by Witt et al. (2009).[15]

The significantly lower incidence of temporary facial nerve weakness in the endoscopic group (10.0% vs. 20.0%, $p = 0.049$) corresponds with findings from Witt et al. (2009), who reported a lower risk of transient facial nerve dysfunction in minimally invasive procedures.[16]The rates of permanent facial nerve weakness were low in both groups (1.7% vs. 5.0%, $p = 0.312$), aligning with previous reports by Sood et al. (2011), which indicated that nerve preservation is feasible with both techniques when performed by experienced surgeons.[16] The incidence of Frey's syndrome was lower in the endoscopic group (6.7% vs. 13.3%, $p = 0.094$), similar to findings by Koch et al. (2013), who noted that smaller incisions in endoscopic surgery reduce the likelihood of postganglionic parasympathetic nerve regeneration leading to gustatory sweating.[17]

CONCLUSION

This study demonstrates that endoscopic-assisted parotidectomy offers significant advantages over conventional open surgery, including reduced operative time, lower blood loss, shorter hospital stays, and improved cosmetic outcomes. Early postoperative facial nerve function recovery was better in the endoscopic group, with lower rates of temporary facial nerve weakness and complications like Frey's syndrome. However, open parotidectomy remains the gold standard for larger or deep-lobe tumors requiring extensive dissection.

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