

# Efficacy and safety of coblation-assisted endoscopic surgery in the management of sinonasal inverted papilloma: A retrospective study

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**Abstract.** *Background and aim:* Inverted Papilloma (IP) is a benign but locally aggressive sinonasal epithelial tumor, characterized by a high recurrence rate and a risk of malignant evolution. Management of inverted papilloma depends on its size and extension: the endonasal endoscopic approach has become the most common because it allows effective removal of tumors with promising outcomes and lower morbidity. Despite the growing use of Radiofrequency Coblation (RFC) for some sinonasal surgical applications, the effectiveness of its use for endoscopic resection of intranasal and sinus tumors lacks consistency. The purpose of our study is to investigate the role of RFC in preventing recurrence in patients with inverted papilloma. *Methods:* We performed a monocentric, retrospective analysis of patients diagnosed with inverted papilloma of the nasal and paranasal sinus who underwent endoscopic sinus surgery. We subdivided the cohort into two groups: one consisted of patients who had undergone standard endoscopic sinus surgery, while the other one consisted of patients who had undergone coblation-assisted endoscopic sinus surgery. *Results:* Throughout a comprehensive 36-month follow-up period, 3 patients of Group A (17.6%) presented with IP recurrence, with 1 case identified at the 6-month mark and 2 cases at the 12-month interval. Conversely, Group B demonstrated a significantly reduced recurrence rate: in this group, no patient experienced IP recurrence at the same site during the follow-up period. *Conclusions:* Our findings provide valuable insights into the potential benefits of RFC, including a reduction in recurrence rates, when applied as an adjunctive tool in endoscopic treatment. (www.actabiomedica.it)

**Key words:** inverted papilloma, sinonasal tumor, endoscopic sinus surgery, endonasal endoscopic approach, recurrence, radiofrequency coblation, coblation-assisted sinus surgery

## Introduction

Inverted Papilloma (IP) is a rare benign epithelial sinonasal lesion, accounting for 0.5% to 4% of all surgically removed primary nasal tumors. Its clinical interest is based on the tumor's association with a high

risk of recurrence, and malignancy and with its tendency to be locally aggressive. IP is most commonly diagnosed in the fifth and sixth decade of life, it is mostly unilateral, and it is three to five times more frequent in males (1). The World Health Organization (WHO) defines inverted papilloma as a benign

epithelial tumor composed of well-differentiated columnar or ciliated respiratory epithelium with variable squamous differentiation and classifies it as a subgroup of Schneiderian papillomas (2). IP is associated with squamous cell carcinoma (SCC) in approximately 5–13% of the cases; malignancy may occur synchronously or metachronously (3–5).

The most common nasal sites involved in inverted papillomas are the lateral nasal wall, ethmoid cells, maxillary sinus, and, less often, frontal sinus, sphenoid sinus, and nasal septum. The diagnosis of IP is suspected from the clinical history, physical examination (including endoscopic nasal examination), and imaging: patients typically present with nonspecific signs and symptoms, including unilateral nasal obstruction, nasal polyps, epistaxis, rhinorrhea, post-nasal drip, and more rarely epiphora, hyposmia and facial pain (6). The hallmark of inverted papilloma on computed tomography (CT) is the unilateral opacification of a contiguous nasal cavity and sinus mass; as the tumor enlarges, the adjacent bone may become thinned, bowed, eroded, or sclerotic and associated with areas of hyperostosis, which may be used to predict the site of IP attachment (7, 8). The main utility of magnetic resonance imaging (MRI) is in defining the extent of the lesion and differentiating inverted papilloma from inspissated mucus: typical findings are a convoluted cerebriform pattern (CCP), contrast enhancement, hypodensity on T1 and iso- or hypodensity on T2 (9). Staging systems for inverted papilloma include different classifications; Krouse's classification is the most popular staging system, and it is based on endoscopic assessment and/or CT scan findings (10).

Surgery is undoubtedly the treatment of choice for IP, with several surgical options available. Although inverted papilloma is a benign entity, aggressive surgical treatment has historically been recommended due to its potential for local invasiveness and its association with an increased risk of malignancy. External surgical approaches are used when complete endoscopic resection is not feasible; however, advances in endoscopic skull base surgery are gradually pushing the boundaries (11), and the endonasal endoscopic approach has become the most common method, as it allows effective removal of selected sinonasal malignancies, and offers promising oncologic outcomes and lower morbidity

compared to external approaches (12). Long-term follow-up of these patients is recommended, as recurrence or metachronous malignancy can occur (13). While most recurrences happen within the first two to three years after initial treatment (mean, 30 months; range, 14–48 months), a small percentage of cases have been observed five to six years postoperatively (14). Recurrence can be minimized by appropriate surgical planning and careful postoperative endoscopic assessment.

Radiofrequency Coblation (RFC) is a bipolar radiofrequency ablation tool that combines dissection, hemostasis, coblation, flushing, and aspiration processes in one device. It works at relatively low temperatures by disrupting molecular bonds and allowing tissues to dissolve; its main advantages are high cutting and hemostasis capacity, less thermal damage, less postoperative pain, and absence of carbonization. The coblation technique is gaining favor in various sinonasal surgical applications. This prospective study aims to assess the efficacy and safety of radiofrequency coblation in surgical treatment of inverted papilloma through the endonasal endoscopic approach.

## Materials and methods

### *Study design and population*

The protocol for this study was approved by the Ethics Committee of our Institution and informed written consent was obtained from all patients. We performed a monocentric, retrospective analysis of patients diagnosed with inverted papilloma of nasal and paranasal sinus. Forty-two patients were enrolled from February 2019 to January 2020.

At admission, clinical data including age, sex, residency, occupation, and clinical presentation were recorded. Endoscopic nasal examination and imaging (CT and MRI) were performed to establish the site of origin, extension, and Krouse's classification. We subdivided the cohort into two groups, Group A and Group B, based on the surgical approach. Group A consisted of 17 patients who had undergone a standard endoscopic sinus surgery (ESS); group B consisted of 25 patients who had undergone coblation-assisted ESS.

The follow-up procedure included monthly endoscopic nasal examinations for the first six months after surgery, followed by examinations every three months during the subsequent year. MRI was performed 6–12 months after the operation. We included patients with a minimum of 36 months follow-up.

### *Surgical technique*

All surgeries were conducted under general anesthesia. The choice of surgical approach was based on the tumor's origin and size, with options including the trans-nasal standard, the extended endoscopic medial maxillectomy (modified endoscopic Denker procedure), and the Draf III frontal sinusotomy (modified endoscopic Lothrop procedure). In all cases, a subperiosteal dissection plane and bony drilling were performed along all the exposed walls of the sinuses. In Group B, Radiofrequency Coblation was performed using the Coblator II System with the Reflex 45 wand (Arthrocare, Sunnyvale, California, USA); the system was set to a power level of 5 (output voltage of  $237.5 \text{ Vrms} \pm 10\%$ ). This tool removes tissue by molecular disintegration, in which radiofrequency energy excites electrolytes in a conductive medium, and energized particles break molecular bonds within tissues, causing their dissolution. RFC was used to remove the mucosa surrounding the site of origin of the tumor, thus achieving a "safe margin" of normal tissue. All the collected material was sent for histology.

### *Data analysis and statistics*

Differences between the two groups (A and B) were analyzed using a t-test for independent data or a non-parametric Mann–Whitney U-test. Qualitative data were displayed as counts, frequencies, and percentages. For all the results,  $p < 0.05$  was considered statistically significant. Data analysis was performed using STATA statistical package.

## **Results**

The group consisted of 28 men (10 in group A and 18 in group B) and 14 women (7 in group A and

7 in group B) with a median age of 42.8 years (45.1 in group A and 41.1 in group B). The right side was more commonly involved (21/42; 50%) than the left (17/42; 40.5%); in 4/42 patients the extension was bilateral (9.5%). In our retrospective analysis, we found 17 patients belonging to group A (40.5%) and 25 to group B (59.5%). The median age was 45.1 years in group A and 41.4 years in group B.

Among the 42 patients, we noticed 16 (38.1%) cases of multiple localization (7 in group A and 9 in group B), 14 (33.3%) maxillary localization (7 in group A and 7 in group B), 4 (9.5%) ethmoidal skull base localization (2 in group A and 2 in group B), 4 (9.5%) middle turbinate localization (4 in group B and no patients in group A), 2 (4.8%) lacrimal recess localization (2 in group B and no patients in group A), and 2 (4.8%) floor of orbit localization (1 in group A and 1 in group B). About the extension of IP, 14 patients (33.3%) had a Krouse's class II (5 in group A and 9 in group B), 26 patients (61.9%) Krouse's class III (11 in group A and 15 in group B) and 2 (4.8%) Krouse's class IV (1 in group A and 1 in group B).

All patients (42/42; 100%) were treated with an endonasal endoscopic approach (ESS). Regarding the type of surgery, trans-nasal standard approach was performed in 18 patients (42.9%; 6 in group A and 12 in group B), extended endoscopic medial maxillectomy in 18 patients (42.9%; 9 in group A and 9 in group B) and Draf III approach in 6 patients (14.2%; 2 in group A and 4 in group B).

In group B, 8 patients (32%) had previously undergone surgeries in other institutions for the removal of IP; we did not notice revision cases in group A. Histological examination of the specimens revealed no cases of synchronous/metachronous squamous cell carcinoma.

Throughout a comprehensive 36-month follow-up period, 3 patients of Group A (17,6%) presented with IP recurrence, with 1 case identified at the 6-month mark and 2 cases at the 12-month interval. Conversely, Group B demonstrated a significantly reduced recurrence rate: in this group, no patient experienced IP recurrence at the same site during the follow-up period. Within our series, the global efficacy of the endoscopic approach to sinonasal IP is 92.9% (39/42) (Table 1).

**Table 1.** Characteristics of patients

	Total	Standard endoscopic surgery (Group A)	Coblation-assisted endoscopic surgery (Group B)
N. of patients	42	17 (40,5%)	25 (59,5%)
Median age	42,8 y.o.	45,1 y.o.	41,1 y.o.
Gender: male	28 (66,7%)	10 (58,8%)	18 (72%)
Gender: female	14 (33%)	7 (41,2%)	7 (28%)
Right side localization	21 (50%)	9 (53%)	12 (48%)
Left side localization	17 (40,5%)	6 (35%)	11 (44%)
Bilateral localization	4 (9,5%)	2 (12%)	2 (8%)
Maxillary sinus origin	14 (33,3%)	7 (41%)	7 (28%)
Ethmoidal skull base origin	4 (9,5%)	2 (12%)	2 (8%)
Middle turbinate origin	4 (9,5%)	0 (0%)	4 (16%)
Floor of orbit origin	2 (4,8%)	1 (6%)	1 (4%)
Lacrimal recess origin	2 (4,8%)	0 (0%)	2 (8%)
Multiple sites of origin	16 (38,1%)	7 (41%)	9 (36%)
I Krouse's class	0 (0%)	0 (0%)	0 (0%)
II Krouse's class	14 (33,3%)	5 (29%)	9 (36%)
III Krouse's class	26 (61,9%)	11 (65%)	15 (60%)
IV Krouse's class	2 (4,8%)	1 (6%)	1 (4%)
Transnasal standard approach	18 (42,9%)	6 (35%)	12 (48%)
Denker modified approach	18 (42,9%)	9 (53%)	9 (36%)
Draf III approach	6 (14,2%)	2 (12%)	4 (16%)
Recurrence after 36 months follow-up	3 (7,1%)	3 (17,6%)	0 (0%)

The lower recurrence rate in Group B, characterized by a statistically significant p-value of 0.02 compared to Group A, underscores the potential advantages associated with coblation as an adjunctive technique for mitigating IP recurrence. It is worth noting that this statistical significance, while present, may be influenced by the relatively limited number of participants in our study (Table 2).

Remarkably, the application of coblation in Group B surgery showcased a commendable safety profile, as no complications or adverse events related to coblation were recorded during the surgical procedures.

Additionally, it is worth noting that neither Group A nor Group B reported any additional complications or adverse outcomes throughout the study's duration, reaffirming the overall safety and efficacy of the surgical interventions employed in the management of

**Table 2.** Characteristics of patients with recurrence

	Characteristics of patients with recurrence
N. of total patients	3
Median age	42 y.o.
Gender: male	1 (33%)
Gender: female	2 (66%)
Right side localization	0 (0%)
Left side localization	3 (100%)
Maxillary sinus origin	2 (66%)
Multiple sites of origin	1 (33%)
III Krouse's class	2 (66%)
IV Krouse's class	1 (33%)
Transnasal standard approach	1 (33%)
Denker modified approach	2 (66%)

inverted papilloma. These results collectively illuminate the potential benefits of coblation in reducing IP recurrence rates while maintaining a high standard of safety.

## Discussion

Recently, the use of RFC technology in otolaryngology has been increasing, especially for endoscopic procedures: the coblator has been used for sinonasal polyposis, turbinate reduction, and sinus and skull base tumors. Despite the growing number of publications, the results of surgical treatment are contradictory (15).

Endoscopic procedures in small surgical fields require optimal visualization. Nasal and sinus tumors often have a rich vascular supply, leading to significant bleeding; controlling intraoperative bleeding is crucial for good visualization, allowing a safe and effective trans-nasal resection. However, the potential for blood loss with radiofrequency coblation is minimal (16). Eloy et al. (2009) performed a retrospective analysis of treatments for patients with chronic rhinosinusitis with nasal polyps using coblation and showed the advantages of providing excellent visualization, theoretically reducing complications (17). Jaiswal et al. (2020) published a study conducted on patients with juvenile angiofibroma after embolization and proved that the use of plasma ablation reduced the total blood loss and the duration of surgery (18); Cannon et al. provided similar results (19). Kostrzewa et al. (2010) demonstrated that in patients treated with endoscopic removal of a skull base tumor using a coblator, bleeding was reduced, and overall visualization of the surgical field was better (20). Syed et al. (2012) evaluated the safety and efficacy of the use of RFC and demonstrated that it is a useful and safe tool in the endoscopic management of a range of intranasal and sinus tumors (21). Zhang et al. (2020) described the experience of skull base tumor resections using endoscopic endonasal access concluding that the use of coblator is a feasible and safe technique in selected cases (22). Liu et al (2022) compared the therapeutic effects of dynamical-system surgery under nasal endoscope and low-temperature plasma radiofrequency ablation, concluding that both have good therapeutic

effects on IP, but the latter is safer and can reduce the postoperative inflammatory reaction of patients (23). Recently, Bhardway et al. (2023) performed a prospective interventional study that demonstrated that the use of coblation in patients with sinonasal and skull base masses, during endoscopic sinus surgery, reduces operation time, blood loss, and faster wound healing (24).

During the endoscopic approach to inverted papilloma, identifying the site of attachment of the tumor pedicle and removing all mucosal diseases are crucial factors in preventing tumor recurrence. The main advantage of using coblation in inverted papilloma surgery is the possibility to assist the drilling in critical areas of the skull base, such as fovea ethmoidalis, cribriform plate, infra-temporal fossa, and orbital tissue, and therefore to remove all mucosal disease and reduce the chance of recurrence.

On this background, our study results indicate the effectiveness of coblation-assisted endoscopic treatment for inverted papilloma, particularly demonstrated by the reduction in recurrence rates. However, it is essential to interpret these findings in the context of our study's limitations, chiefly the relatively limited size of our participant pool. While our analysis revealed statistical significance in the context of reduced recurrence rates, it is crucial to acknowledge that the influence of this significance may be partly attributed to the restricted number of participants. Another notable limitation of our study is the absence of a homogeneous inverted papilloma patient group. The different characteristics among patients, such as variations in tumor size, location, and other factors, could potentially influence treatment outcomes and recurrence rates. These interpatient differences should be taken into account when considering the generalizability of our findings. An additional constraint to consider is the retrospective nature of our study, which entails the absence of randomization: patients were assigned to these groups based on clinical considerations, potentially introducing biases. Future research with prospective, randomized study designs and larger, more homogeneous patient cohorts will be essential to further validate and refine our conclusions.

Nonetheless, our study underscores the valuable attributes of coblation in the treatment of inverted

papilloma. To the best of our knowledge, this is the first study to investigate the role of RFC in inverted papilloma endoscopic endonasal surgery. It has proven to be both effective and safe, contributing to enhanced surgical precision, meticulous control of bleeding, and the successful eradication of tumor tissue. These attributes highlight the potential advantages of coblation as an invaluable tool for achieving optimal outcomes in the endoscopic treatment of inverted papilloma. Further research with larger, more homogeneous patient cohorts is warranted to reinforce and expand upon these promising findings.

## Conclusion

In conclusion, our study represents a pioneering investigation into the role of radiofrequency coblation in the surgical management of inverted papilloma. Our findings provide valuable insights into the potential benefits of coblation, including a reduction in recurrence rates, when applied as an adjunctive tool in endoscopic treatment. It is important to note that while our results show statistical significance, the limited size of our study and the retrospective nature introduce certain limitations.

This study serves as an important starting point for further research in this area. Future studies, employing larger and more homogenous patient cohorts, and utilizing prospective, randomized designs, will be essential to validate and expand upon our preliminary findings. RFC has demonstrated promise in achieving enhanced surgical precision, effective bleeding control, and the meticulous removal of tumor tissue. Further exploration of its role in endoscopic endonasal surgery is warranted, as it may hold the key to optimizing patient outcomes in the future.

**Ethics Committee:** The Ethics Committee of the College of Medicine, University of Sulaimani, approved the research project in the meeting n° 24 on the date 29/10/2023, with protocol number n° 105.

**Conflict of Interest:** The author declares that they have no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement, etc.) that might pose a conflict

of interest in connection with the submitted article. The company that manufactures the coblation equipment had no economic or other contributions in editing the present study.

**Authors Contribution:** All authors contributed to the study's conception and design. GLO, RHRK, OHA, AFA, and MIMG performed material preparation and data collection at the Royal Hospital of Sulaimani, Iraq. A literature search was performed by GM, BF, RM, and GV. BF performed data analysis. The first draft of the manuscript was written by GM and all authors discussed the results, commented on all the parts, and added their interpretations in the discussion and conclusions of the manuscript. All authors have accepted responsibility for the entire content of this manuscript and approved its submission.

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