

Management of benign inverted sinonasal papilloma avoiding external approaches

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Abstract

Even though endoscopic removal of inverted papillomas has gained popularity, many studies advocate supplementary external approaches. The impact of including the current surgical staging system into the pre-operative clinical and radiological assessment has not been systematically evaluated. We present our experience with total endoscopic management of inverted papillomas and compare the accuracy of the pre-operative predicted extent of surgery, with the actually performed surgery.

From 1997 to 2005 data from 51 patients with inverted papillomas were prospectively collected and subsequently reviewed. All have been operated on endoscopically without an external approach.

The overall recurrence rate was 3.9 per cent. Pre-operative prediction of extent of surgery was accurate in 26 of 51 (51 per cent). The main reasons for the inaccurate pre-operative prediction were the variable sizes and locations of the inverted papilloma bases, particularly in the maxillary sinus and the frontal recess. Our results encourage us to recommend endoscopic management as the standard treatment of benign inverted papillomas.

Key words: Inverted Papilloma; Paranasal Sinuses; Endoscopic Surgical Procedures

Introduction

Inverted papilloma is a benign mucosal tumour of the nose and paranasal sinus which is characterised by the invagination of epithelium into the underlying stroma.¹ According to the definition of the World Health Organization (WHO), the inverted papillomas together with the exophytic and the columnar cell papillomas are termed as sinonasal papillomas.² Inverted papilloma is a relatively uncommon lesion constituting 0.5–4 per cent of all sinonasal tumours.³ The four characteristics of inverted papilloma are its tendency to recur, its destructive expansion, the associated nasal polyps and its potential for malignant transformation. The combination of imaging and intra-operative findings enables these lesions to be classified into the Krouse⁴ staging system.

The treatment of inverted papillomas with surgical resection using endonasal approaches is gaining increasing popularity. Rapid development of advanced imaging techniques (computed tomography [CT] and magnetic resonance imaging [MRI]) as well as endoscopic instrumentation has allowed endoscopic techniques to provide similar or even lower recurrence rates when compared to the classic open techniques such as the lateral

rhinotomy.^{5–10} Detailed analysis of studies reporting on endoscopic management of inverted papillomas shows that most authors continue to advocate an additional external approach. To our knowledge, Kaza *et al.*¹¹ published the first series on inverted papillomas treated solely with endoscopic techniques. Accurate prediction of required surgical resection is thought to be achieved through pre-operative radiological staging. In reality, both the MRI and CT cannot precisely define the exact site and extent of the inverted papilloma's base in many cases.¹⁰ Thus, any algorithm proposed for surgical treatment is considered to be inappropriate,¹² although accurate prediction of the extent of surgery is desirable for adequate consenting and counselling of the patient especially with regard to potential complications.

The aim of the current study is to present our experience with the total endoscopic management of benign inverted papillomas without the use of any additional external approach. Pre-operatively, tumour extension was assessed by radiological imaging and nasal endoscopy. We evaluated the accuracy of pre-operative surgical planning by comparing the pre-operatively determined surgical plan with the effectively performed extent of surgery.

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Patients and methods

To exclude interobserver variations, only benign inverted papillomas operated by the same surgeon (DH) were included in the study. Additionally a minimum follow up of six months was required for inclusion in the study. Exclusion criteria were inverted papillomas with associated malignancy as these cases require oncological, radical resections with safety margins. Of the 82 patients with sinonasal papilloma seen between 1997 and 2005, 31 were excluded from the study. Data sets of eight patients were incomplete and 12 patients were followed up at another institution. Histopathological work-up by the same pathologist (IH) revealed three exophytic and one columnar cell papilloma and two patients showed associated malignancy for which they underwent radical open surgery. Five patients were excluded as they were operated on using the microscope. The pre-operatively obtained contrast enhanced high resolution CT scans of the remaining 51 study patients were analysed. CT was used to estimate tumour extension and required surgical resection (Table I). Tumour staging according to Krouse was applied to each patient based on clinical and CT findings. The pre-operatively predicted surgical resection extent was then compared with the actually performed surgery, subsequent differences were recorded. At surgery the size and site of tumour attachment at the inverted papilloma's base was documented. The surgical approach used at our institution has been described elsewhere¹³ (for the surgical steps see Table II). As imaging is not reliable enough for accurate prediction of extent of surgery, all patients were consented to undergo endonasal medial maxillectomy if required.

Minimum follow up was five years. The follow up consisted of serial endoscopic office examinations. In the first post-operative year, the patients were reviewed one, two, three, four, six, nine and twelve

months post-operatively. Thereafter, they were seen every six months. Whenever suspicious tissue was observed, a biopsy was performed in the office under local anaesthesia. Follow up CT was utilised in cases where follow-up endoscopy did not allow adequate visualisation.

Results

The most common symptoms leading to investigation and diagnosis of inverted papillomas were nasal obstruction (40/78 per cent), nasal discharge (12/24 per cent), recurrent epistaxis (6/12 per cent), facial tenderness (6/12 per cent) and hyposmia (4/8 per cent). Table III shows the tumour extension on CT, the stage according to Krouse,¹¹ and the predicted extent of surgery as well as the actual extent of performed surgery. Forty-four patients in the study did not have any previous sinus surgery while the other seven (14 per cent) out of 51 had a recurrence after previous removal via an external approach. Two of 51 (3.9 per cent) patients had histologically verified recurrence after endoscopic removal of inverted papillomas while the other 49 remained disease free after a mean follow up of 35 months (range 6–143 months). The sites of recurrence were the anterior portion of the alveolar recess and the frontal recess area, respectively.

In 26 of 51 (51 per cent) the extent of surgery was correctly predicted whereas an overestimation or underestimation was found in eight (16 per cent) and 17 (33 per cent), respectively. Inaccurate pre-operative prediction was always due to an imprecise assessment of size, site and extent of the tumour base. In the eight cases with pre-operative overestimation, the tumour was found to be not attached in the area of the anterior or inferior wall of the maxillary sinus (four patients), frontal recess area (two patients) or middle turbinate (two patients).

TABLE I

ESTIMATED TUMOUR EXTENSION IN CT AND CONSECUTIVELY PLANNED SURGICAL PROCEDURE ($n = 51$)

	Predicted tumour extension in CT	Planned surgical resection
Ethmoid sinus	Anterior ethmoid and no skull base involvement	Partial anterior ethmoidectomy
	Posterior ethmoid and no skull base involvement	Sphenoethmoidectomy
	Contact to skull base posteriorly	Sphenoethmoidectomy
	Contact to skull base anteriorly	Frontoethmoidectomy
Maxillary sinus	Contact skull base anteriorly and posteriorly	Frontosphenoethmoidectomy
	Medial wall	Infundibulotomy and maxillary sinus antrostomy
	Posterior and/or superior wall	Partial anterior ethmoidectomy
Frontal sinus	Anterior, inferior and/or lat wall	Removal of nasolacrimal duct (EMM or mod EMM)
	Frontal recess but not in frontal sinus	Frontoethmoidectomy or frontosphenoethmoidectomy
Sphenoid sinus	Frontal recess and frontal sinus	Frontoethmoidectomy + frontal sinus drainage procedure Type II or III
	Attached to middle turbinate	Sphenoethmoidectomy
Nasal cavity		Resection of middle turbinate along the skull base

EMM = endonasal medial maxillectomy

TABLE II
CLASSIFICATIONS AND DEFINITIONS OF ENDOSCOPIC SINUS PROCEDURES

	Surgical steps
Infundibulotomy	Complete removal of the uncinate process, with or without partial or total removal of the bulla ethmoidalis and enlargement of the natural ostium of the maxillary sinus
Sphenoidotomy	Drainage of the sphenoid sinus by enlargement of its natural ostium in the sphenoidal recess by the transnasal route
Partial anterior ethmoidectomy	IT + either opening of the suprabullar or retrobullar recess or breaking through the ground lamella of the middle turbinate
Sphenoethmoidectomy	PAE + opening the sphenoid sinus through enlargement of its natural ostium in the sphenoidal recess and connecting the PAE route with the thus enlarged opening of the sphenoid sinus
Frontosphenoethmoidectomy	SE + exploring the frontal recess area with 45°-telescope (Draf type I) and special frontal sinus instruments as well as identifying and exposing the frontal sinus clearly
Frontoethmoidectomy	IT or PAE + exploring the frontal recess area with 45°-telescope (Draf type I) and special frontal sinus instruments as well as identifying and exposing the frontal sinus clearly
Endonasal medial maxillectomy	FSE + complete removal of the middle and inferior turbinate, exposing the nasolacrimal sac and removal of the lower two thirds of it, complete removal of the medial wall of the maxillary sinus
Modified EMM	Removal of the lower two thirds of the nasolacrimal sac + complete removal of the medial wall of the maxillary sinus + minimum 1 of the following steps: - PAE, SE or FSE - Resection of the middle or inferior turbinate
Frontal sinus drainage procedures	According to Draf W. (Type II – III)

EMM = endonasal medial maxillectomy; IT = infundibulotomy; PAE = partial anterior ethmoidectomy; SE = sphenoethmoidectomy; FSE = frontosphenoethmoidectomy

In the 17 patients where extent of surgery was underestimated, five patients had a tumour base originating from the middle turbinate, and four patients had a tumour arising from the area of the nasolacrimal duct, necessitating the removal of the lower two thirds of the lacrimal sac. In two patients, intra-operative finding revealed a tumour base attached to the frontal or alveolar recess while in one the posterior ethmoid had to be explored more extensively than pre-operatively expected. In another four patients the tumour extended to the anterior skull base, requiring wide exposure of the anterior skull base. In one patient, the tumour base was not only adherent to the middle turbinate but also to the anterior wall of the maxillary sinus. MRI was obtained in five (10 per cent) patients but did not provide significantly more information to predict the extent of required surgery.

One patient required early surgical revision for severe bleeding from the sphenopalatine artery post-operatively. No blood transfusion was necessary. Permanent mild hyposensitivity of the infraorbital nerve was observed in one patient. No other complications occurred during the follow up, resulting in a complication rate of 4 per cent (2/51).

Discussion

The recurrence rates of less than 4 per cent in our study with entirely endoscopically managed benign inverted papillomas and the 14 per cent in Kaza's study¹¹ are promising. Although further studies with more patients are required, our experience allows us to recommend endoscopic surgery as standard technique for treatment of benign inverted

papilloma (inverted papillomas), especially with regard to the current literature where higher recurrence rates in external approaches are reported.^{5–10}

It is essential to consider the specific aspects of tumour biology in benign inverted papillomas. The biology and the clinical behaviour of sinonasal papilloma including the columnar cell, exophytic as well as of malignant inverted papillomas are different from benign inverted papillomas. Malignant transformation per se is an independent risk factor for high recurrence rates in inverted papillomas.^{14–17} Our study population solely comprised of inverted papillomas without malignant transformation.

The most cited staging classification by Krouse *et al.* distinguishes four tumour categories. Radical removal of inverted papillomas requires identification and complete resection of its tumour base. Since the exact site, extent and size of the tumour attachment cannot be predicted neither by nasal endoscopy nor by any radiological imaging,^{9,18} it is worth questioning whether it makes sense to differentiate a benign inverted papilloma into a T₂ or T₃ stage. We could not calculate any statistically significant differences in recurrence rates between T₂ and T₃ stages as our series is too small. In addition, when comparing the pre-operatively predicted extent of surgery with the effectively performed procedure an inaccurate estimation was encountered in nearly 50 per cent. Interestingly, further analysis of this ineffectivity of pre-operative planning demonstrated that a tumour attachment to the alveolar or frontal recess as well as to the anterior and lateral wall of the maxillary sinus resulted in pre-operative misinterpretation and subsequently required the surgeon to perform surgery beyond

TABLE III

PATIENTS WITH BENIGN INVERTED PAPILLOMAS – ACCURACY OF SURGICAL PLANNING *n* = 51

Pat. No	age	Previous surgery?	CT findings											Krouse staging	planned surgery	surg. proc.	accuracy of surgical planing			follow-up (months)
			maxillary sinus				ethmoid sinus				frontal sinus	sphenoid sinus	less than expected				more than expected	accurate		
			med	lat	inf	sup	ant	OMC	ant	post									frontal recess	
1	75	yes	-	+	+	-	+	+	+	-	-	-	-	III	MEMM	EMM		×		6
2	48	no	+	+	+	+	+	+	-	-	-	-	-	III	MEM	MEMM			×	6
3	57	no	+	+	+	-	-	+	+	+	+	-	-	III	EMM	EMM			×	6
4	57	no	+	+	+	+	+	+	+	-	-	-	-	III	EMM	EMM			×	7
5	76	no	+	+	+	+	+	+	+	+	+	-	+	III	EMM	MEMM	×			7
6	39	no	+	-	+	-	+	+	u	-	-	-	-	III	PAE, MEMM	PAE	×			9
7	73	no	+	+	+	+	+	+	-	-	-	-	-	III	MEMM	MEMM			×	10
8	54	no	+	-	-	-	-	+	+	+	-	-	+	II	PAE	EMM		×		10
9	45	no	(+)	-	-	-	-	+	-	-	+	-	-	II	FE	FE			×	11
10	70	no	+	+	+	+	+	+	-	-	-	-	-	III	MEMM	MEMM			×	12
11	78	no	-	-	-	-	-	+	-	-	-	-	-	I	PAE	PAE			×	13
12	56	no	-	-	-	-	-	(+)	-	-	-	-	-	I	transnas. Res.	transnas. Res.			×	13
13	40	no	+	-	-	-	-	+	+	+	-	-	-	II	PAE	MEMM		×		14
14	38	no	-	-	-	-	-	+	-	-	-	-	-	II	PAE	PAE			×	14
15	50	no	-	-	-	-	-	+	+	+	-	-	-	II	PAE	MEMM		×		15
16	53	yes	+	+	+	+	+	+	+	+	+	+	+	III	EMM	EMM			×	15
17	70	no	+	+	+	-	(+)	+	u	u	-	-	-	III	MEMM	MEMM			×	17
18	57	no	-	-	-	-	-	-	-	-	-	-	-	I	FSE	FSE			×	18
19	46	no	+	-	-	-	-	+	+	+	+	+	+	II	FSE	MEMM		×		19
20	64	no	+	+	+	+	+	+	+	+	+	+	+	III	EMM	EMM			×	20
21	75	no	+	+	+	+	+	+	u	-	+	-	-	III	MEMM	SE	×			21
22	43	no	-	-	-	-	-	+	++	++	++	+	+	III	FE	MEMM		×		23
23	46	no	+	+	+	+	+	+	-	-	-	-	-	III	MEMM	EMM		×		23
24	40	no	-	-	-	-	-	+	-	-	-	-	-	I	PAE	PAE			×	28
25	55	no	+	+	+	+	+	+	+	+	+++	+	-	III	EMM	EMM			×	28
26	41	yes	-	-	-	-	-	-	-	-	+	+	+	II?	FSD	FSD			×	29
27	40	no	+	+	+	+	+	+	-	-	-	-	-	III	MEMM	MEMM			×	30
28	55	no	+	+	+	-	+	+	+	+	-	-	-	III	MEMM	MEMM			×	31
29	33	no	+	-	-	+	-	+	-	-	-	-	-	III	PAE	PAE			×	36
30	63	yes	-	-	-	-	-	-	-	-	-	-	-	III?	SE	SE			×	38
31	44	no	+	-	+	+	+	+	+	-	+	+	+	III	MEMM	MEMM			×	40
32	80	no	+	+	+	+	+	+	+	-	+	+	?	III	FE, MEMM	EMM		×		40
33	44	no	-	-	-	-	-	+	+	-	+	+	+	II	FE, FSDP	EMM			×	41
34	46	no	+	+	+	+	+	+	+	u	+	-	-	III	FE, MEMM	EMM		×		41
35	24	no	+	+	-	+	+	+	+	-	-	-	-	III	MEMM	MEMM			×	43
36	78	no	+	+	+	+	+	+	+	+	+	-	-	III	FE, MEMM	EMM		×		44

Continued

TABLE III Continued

Pat. No	age	Previous surgery?	CT findings											Krouse staging	planned surgery	surg. proc.	accuracy of surgical planing			follow-up (months)
			maxillary sinus					ethmoid sinus			frontal sinus	sphenoid sinus	less than expected				more than expected	accurate		
			med	lat	inf	sup	ant	OMC	ant	post									frontal recess	
37	55	no	-	-	+	(+)	-	-	-	++	-	-	-	III ?	SE	EMM		×		45
38	38	yes	+	-	-	+	+	+	+	-	-	-	-	III	MEMM	EMM		×		46
39	47	no	+	-	-	-	-	+	-	-	+	-	-	II	FE	FSE		×		48
40	56	no	+	-	-	+	+	+	+	-	+	+	+	III	FE, MEMM	EMM		×		55
41	57	no	-	-	-	-	-	-	+	+	+	-	-	II	FE	FSE		×		60
42	70	no	-	-	-	+	+	-	-	-	-	-	-	III	MEMM	PAE	×			60
43	65	no	-	-	-	-	-	-	+	+	-	-	+	II	PAE	FSE		×		62
44	33	no	-	-	-	-	-	+	-	-	-	-	-	II	PAE	PAE			×	63
45	77	no	+	+	+	+	+	+	+	+	+	+	+	III	EMM	SE	×			65
46	22	no	+	-	-	-	-	+	+	+	-	-	-	II	PAE	SE			×	68
47	80	no	+	+	+	+	+	+	+	+	-	-	(+)	III	FE, MEMM	FE	×			72
48	54	yes	-	-	-	-	-	-	-	-	-	-	-	III	SE	SE			×	80
49	33	no	+	-	-	+	-	+	+	-	(+)	-	-	II	FE	PAE	×			90
50	54	yes	+	-	+	-	+	+	+	-	+	-	-	II	FE	FE			×	96
51	52	no	-	-	-	-	-	+	+	+	+	+	+	II	FE, FSDP	SE	×			102

EMM = endonasal medial maxillectomy; MEMM = modified endonasal medial maxillectomy; IT = infundibulotomy; PAE = partial anterior ethmoidectomy; SE = sphenoidectomy; FSE = frontosphenoidectomy; FE = frontoethmoidectomy; FSDP = frontal sinus drainage procedure (according to Draf W)

the pre-operatively predicted extent. Vice versa, when the tumour base was suggested to be attached to these structures pre-operatively, surgery was much easier and less extensive as the inverted papilloma was only bulging into these spaces without any actual attachment to be found. Some of our patients had massive extension of the tumour in the maxillary sinus, expanding into the pterygomaxillary space with consecutive pressure erosion of the maxillary sinus back wall. Bony erosion of the lamina papyracea or cribriform plate due to pressure by the expanding tumour leaving orbital periosteum or dura intact was also encountered in our series. Although histopathologically benign, the Krouse classification does not clearly define whether this kind of tumour extension be regarded as T₃ or T₄. Our study could not prove the value of Krouse's classification with regard to planning of the surgical strategy. As mentioned above, precise site and extent of tumour base attachment can only be defined intra-operatively, but not through radiological imaging. We therefore use radiological imaging for tumour localisation and extension but not to plan the extent of surgery.

Krouse wrote a historical review on the development of surgery for inverted papillomas.¹⁹ In fact, the tendency to operate upon inverted papillomas endoscopically is not new.^{20–22} However, the majority of the studies conclude that an endoscopic approach must be supplemented by an external approach in patients with extensive disease. The surgical principals we used are similar to Kaza *et al.*,¹¹ preserving normal mucosa, a modification of the classical endonasal maxillectomy is sufficient in most of the cases.

Some authors emphasise that additional external approaches (e.g. lateral rhinotomy) with endoscopic techniques are mandatory especially in inverted papillomas extending into the maxillary sinus or frontal recess area.^{14–15,17,23–24} According to our experience this is not necessary. If the tumour expands into the frontal recess area, a frontoethmoidectomy such as a frontal sinus drainage procedure Draf Type I should be attempted. Tumours attached to the frontal recess mucosa may require a frontal sinus drainage procedure Draf Type II or even III. In addition, if tumours are found in the maxillary sinus all sides of tumour contact with the sinus walls must be visualised. This can be achieved through resection of the lower two thirds of the nasolacrimal duct as described by Sadeghi *et al.*²⁵ Tumours with a close relationship to the anterior skull base should be approached by initial identification and exposure of the skull base, which is most easily performed in a posteroanterior fashion by identifying the planum sphenoidale initially as the most constant landmark of the anterior skull base, then subsequently surgery can be continued anteriorly to the frontal recess (sphenoidectomy). The limitations of total endoscopic management are evolving, intracranial involvement or proven malignant transformation mandate a combined endoscopic-external approach for radical removal and reconstruction purposes.^{9,26} No intracranial involvement was observed in our series.

- **Despite endoscopic removal of inverted papillomas gaining in popularity, many studies advocate supplementary external approaches**
- **This study demonstrates experience with total endoscopic management of inverted papillomas in 51 cases and compares the accuracy of the pre-operative predicted extent of surgery, with the actually performed surgery**
- **Although further studies with more patients are required, this experience allows the recommendation of endoscopic surgery as a standard technique for treatment of benign inverted papilloma**
- **The limitations of total endoscopic management are evolving, intracranial involvement or proven malignant transformation mandate a combined endoscopic-external approach for radical removal and reconstruction purposes**

The complication rate in the current study is lower when compared to other reports.²⁶ The low complication rate can probably be attributed to the modified medial maxillectomy techniques we use, contrasting the complication rates in other series after standardised medial maxillectomy with removal of inferior, middle turbinate and lacrimal bone.^{26,25}

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