# Pearls and Pitfalls in Imaging Sinonasal Papilloma: A Pictorial Essay

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**Objective:**

- To provide a comprehensive imaging review of sinonasal inverted papilloma (IP) from diagnosis and treatment to post-therapy surveillance — highlighting advanced imaging techniques for diagnosis, endoscopic surgical planning, and early recurrence detection.

**Materials and methods:**

- A retrospective review of patients with pathologically proven IP identified from databases of three regional hospitals between 2023 to 2025. Imaging features of computed tomography (CT) and magnetic resonance imaging (MRI) for initial diagnosis and follow-up scan were analysed.

## Inverted Papilloma

- IP are benign sinonasal tumours arising from the Schneiderian membrane commonly from the lateral nasal wall and maxillary sinuses.
- Locally aggressive with **high risk of recurrence (15%-78%)** and potential for **malignant transformation (9%).**
- Endoscopic sinus surgery is currently the gold standard for treatment, aiming for **complete excision** of tumour along with the bony attachment site.

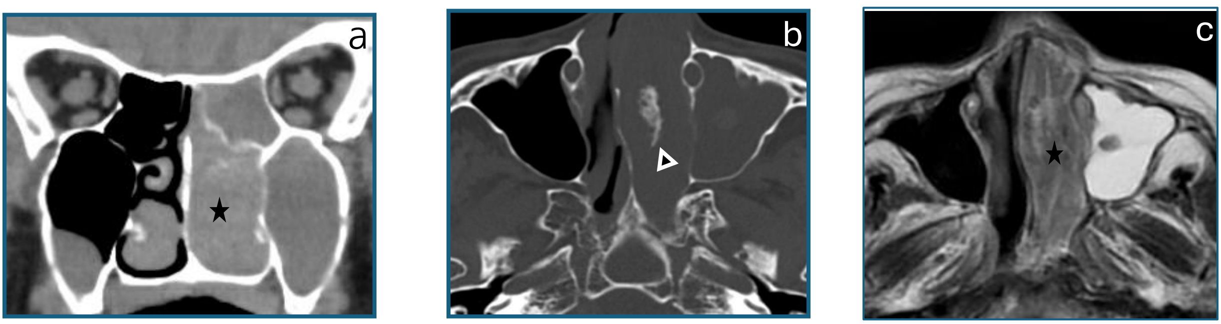


Figure 1. 78-year-old lady with right nasal mass and biopsy proven IP. (a) Coronal non-contrast CT shows soft tissue mass at the left nasal cavity (star), (b) with **focal plaque-like hyperostosis** arising from left middle turbinate (arrowhead). (c) Axial T2W MRI shows **cerebriform pattern** (star). Features are consistent with IP.

## Imaging features

**CT**

- Expansile soft tissue mass
- **Focal bony hyperostosis** (corresponds to tumor origin)
- May have bony resorption/destruction.

**MRI**

- **Convoluted cerebriform pattern** on T2W and T1W contrast enhanced images.

## Malignant transformation

- IP carries risk of malignant transformation (9%), most commonly derived tumour being squamous cell carcinoma.
- Usually develops in the primary mass, however in some cases may occur after surgical therapy of IP (metachronous focus).
- MRI and CT both play complementary roles in early detection of **malignant transformation**. Imaging features include:
    - Rapid growth, invasion of adjacent structures
    - Bone destruction - including resorption of hyperostosis
    - Loss of cerebriform pattern
    - Restricted diffusion

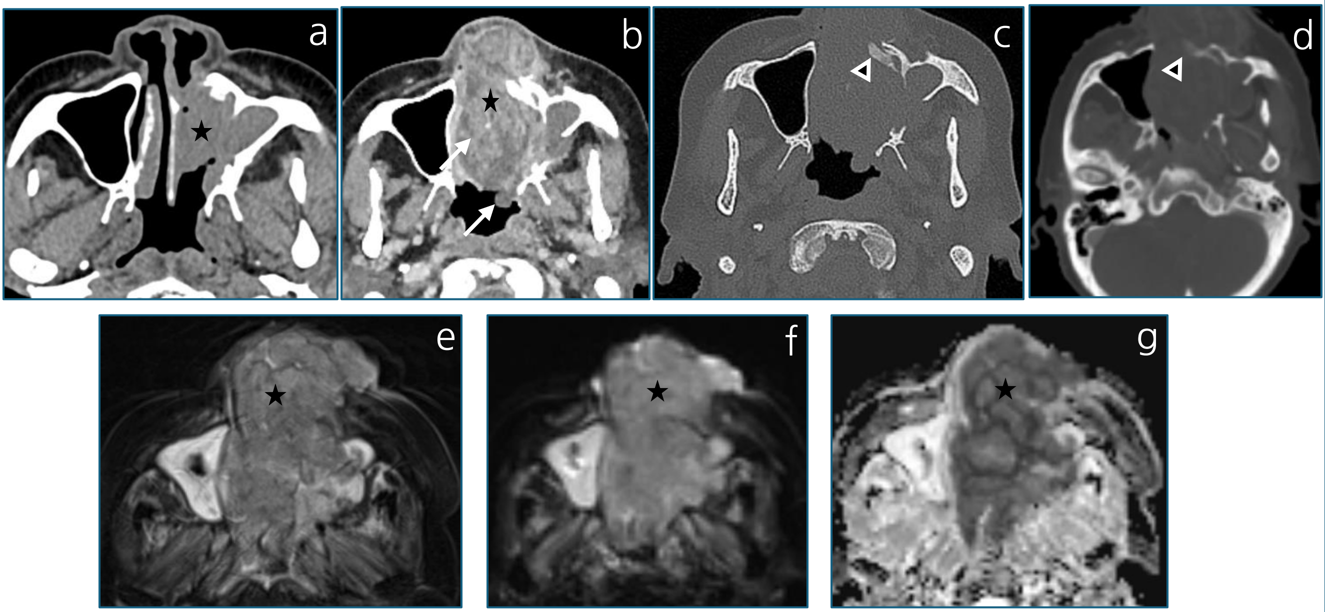


Figure 2. 67-year-old female with history of recurrent IP. (a) Axial non-contrast CT shows recurrence of IP at the left nasal cavity and maxillary sinus (star). (b) Interval axial contrast enhanced CT shows enlargement of the mass, extending to right nasal cavity and nasopharynx (white arrows) with destruction of bony septum (star). Serial 6 months CT images (c) and (d) demonstrate destruction of bony hyperostosis at the lateral wall of left maxillary sinus (arrowheads). (e) Axial T2W MRI shows loss of cerebriform pattern, DWI/ADC images (f) and (g) demonstrating restricted diffusion, consistent with malignant transformation (star). Repeated biopsy confirms diagnosis of squamous cell carcinoma.

## Pre-operative planning and Post-treatment monitoring

- **Biopsy** remains the gold standard for diagnosis. **CT** and **MRI** play ***complementary*** roles in determining tumour origin, extent, and in surgical planning for endoscopic sinus surgery.
- CT and MRI help delineate tumour which guides the choice of surgical approach (endoscopic versus combined).
- CT identifies **focal hyperostosis** corresponding to the tumour's origin—an essential finding for achieving complete endoscopic resection and preventing recurrence.
- MRI defines **tumour extent**, differentiates tumour from entrapped secretions, and guides biopsy, thereby reducing sampling error.
- **High-resolution MRI (512 × 512 matrix)**, with a small field of view and non-fat-suppressed coronal T2-weighted sequences, facilitates detection of recurrence and highlights key anatomical variations critical for surgical navigation, including:
    - Anterior cranial fossa variants (Keros and Gera classifications)
    - Lamina papyracea integrity
- Minimizing risk of complications such as cerebrospinal fluid (CSF) rhinorrhoea and orbital injury.

| Keros Classification: Measures depth of olfactory fossa determined by the height of the lateral lamella of the cribriform plate: | Gera Classification: Angle between lateral lamella and horizontal plane of cribriform plate. |
|---|---|
| Type I: 1-3mm (low risk) | Class 1: >80° (low risk) |
| Type II: 4-7mm (moderate risk) | Class 2: 45-80° (moderate risk) |
| Type III: 8-16mm (high risk) | Class 3: <45° (high risk) |

| Krouse staging for Inverted Papilloma |
|---|
| T1: Tumour isolated to one area of the nasal cavity without extension to the paranasal sinuses |
| T2: Tumour involves medial wall of the maxillary sinus, ethmoid sinuses or osteomeatal complex. |
| T3: Tumour involves the superior, inferior, posterior, anterior or lateral wall of the maxillary sinus, frontal sinus or sphenoid sinus |
| T4: Tumour with extra-sinonasal extent or malignancy |

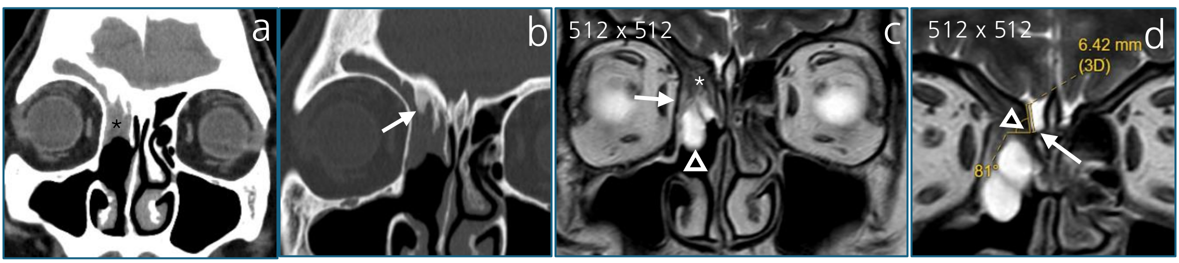


Figure 3. 69-year-old female with Krouse stage 3 recurrent IP involving frontal sinus. Pre operative (a) coronal non-enhanced CT shows soft tissue opacity at the right ethmoid and frontal sinus (asterisk). (b) Bone window demonstrates bony stalk at the fovea ethmoidalis (white arrow). (c) Coronal high-resolution non-fat suppressed coronal T2-weighted MRI shows recurrence at the frontal and ethmoid sinuses (asterisk). Differentiation is made from the associated retention changes at the inferior ethmoid sinus (arrowhead). Laterally the intact lamina papyracea is clearly demonstrated with remodelling changes (white arrow). Same MRI image (d) demonstrates Keros type II olfactory fossa (arrowhead) which carries intermediate risk for iatrogenic lateral lamella injury and Gera class I angle (white arrow), which is favourable for endoscopic resection. Draf 2B frontal sinusotomy was subsequently performed to ensure resection.

## Differential diagnosis

### Antrochoanal Polyp

- No associated bony destruction.
- Mass effect often with widening of maxillary ostium.
- No focal bony hyperostosis.

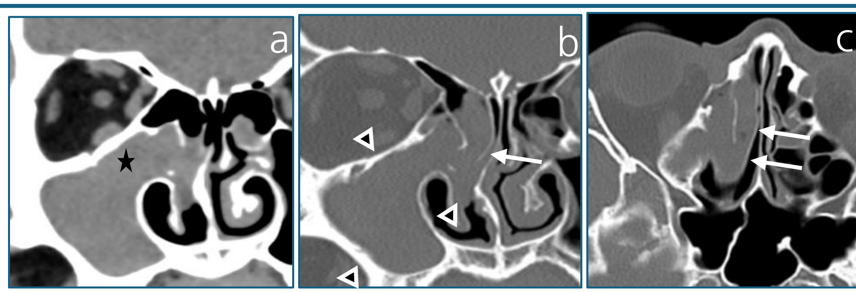


Figure 4. 25-year-old male with nasal obstruction and right nasal polyp. (a) Coronal non-enhanced CT shows soft tissue mass at the right maxillary sinus with widening of maxillary ostium (star). Coronal (b) and axial (c) bone window show preserved sinus walls (arrowheads) and displaced right middle turbinate without erosion (white arrows) consistent with antrochoanal polyp.

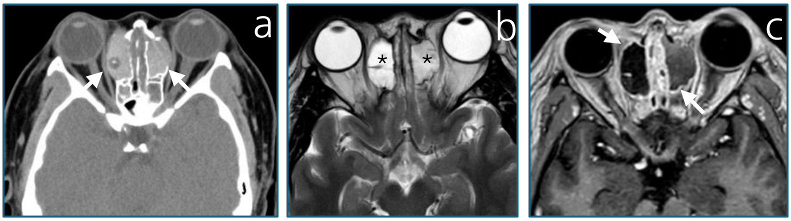


Figure 5. 38-year-old lady with history of bilateral sinonasal polyposis and FESS performed. Follow-up (a) axial non-enhanced CT shows complete opacification of both ethmoid sinuses with thinning of lamina papyracea (white arrows) (b) Axial T2W MRI shows hyperintense signals within the affected sinus (asterisk) with (c) peripheral enhancement on axial T1W contrast-enhanced MRI consistent with mucoceles (white arrows).

## Mucocele

- Air-tight, expanded sinus
- No associated bony destruction.

## Mycetoma

- Single sinus with predilection for maxillary sinuses
- May have central serpiginous calcifications
- Bony remodelling. No erosive changes.

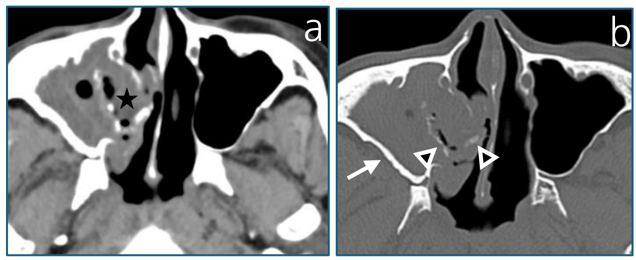


Figure 6. 65-year-old male with history of chronic sinusitis. (a) Axial non-enhanced CT shows soft tissue occupying the right maxillary ostium. (b) Bone window shows central calcifications (arrowheads) and surrounding bony sclerosis of right maxillary walls (white arrows), compatible with a mycetoma.

## Conclusion

CT and MRI play complementary roles in the diagnosis, pre-operative planning and post-operative surveillance of IP. This pictorial essay underscores critical imaging pearls and pitfalls to improve radiologist accuracy and patient outcomes.

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