Radial intralesional linear calcifications and focal hyperostosis: key points for diagnosis, extension and point of origin identification of sinonasal inverted papilloma

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Dear Editor:

Sinonasal inverted papilloma (IP) often appears as a unilateral sinonasal soft-tissue mass with varying enhancement, often accompanied by bone remodelling, intralesional calcifications, focal hyperostosis, and cone-shaped bone thickening (observed in 60 to 80% of cases) [1,2]. A non-contrast sinonasal CT scan may reveal a soft tissue polypoid mass that closely resembles inflammatory polyps (Figure 1 A-D). While hyperostosis is recognized as a marker of the tumor's point of origin [1], intralesional calcifications are less frequently described but may offer valuable insights. Early studies, such as those by Lund and Lloyd (1984), highlighted the presence of intralesional calcifications as a distinct feature of inverted papilloma, a finding later supported by studies emphasizing the role of bone morphogenic proteins in calcification development [4-7].

The advent of advanced CT machines, which offer superior image quality and multiplanar reconstructions, now allows for more precise identification of the IP point of origin, facilitating more accurate detection of focal hyperostosis. Additionally, these advanced CT scans facilitate the identification of radial intralesional linear calcifications, when present, centred at the point of origin and exhibiting a centrifugal pattern [7,8]. This pattern is similar to the fan-like distribution observed in the cerebroid pattern on MRI. Such findings not only aid in the diagnosis of inverted papilloma—considered highly suggestive when seen on a non-contrast sinus CT scan—but also assist in determining the site of origin, direction of extension, and surgical planning [9]. Practical considerations include identifying radial and linear calcifications, distinguishing them from inflammatory polyps and malignancies, and correlating them with MRI findings such as the cerebriform pattern. This multidimensional approach enables surgeons to plan a more effective complete resection and minimize the risk of residual tumor, particularly in the frontal or ethmoidal cells—areas where there is a higher risk of leaving tumor remnants—leading to future tumor recurrence.

In radiological studies, focal intralesional calcifications—sometimes subtle and thin, which can cause them to go unnoticed—are often not described and have not been well characterised in the scientific literature. Only a few reports have described bone formation within the tumour [4-6]. Furthermore, in histological reports, the degree and content of intralesional calcifications are not usually specified, as the lesion is removed endoscopically in different fragments during the surgical procedure. Some of these calcifications are attributed to small bony fragments from other structures, such as the turbinates.

In a retrospective analysis of our center's database, we detected calcifications in 60% of patients, 1/3 of these being radial and linear calcifications (Table S1 and Figure S1-S5; Supplementary material). In two patients, we emphasised during surgery the need to correlate CT imaging with histology. In these patients, both fine and coarse calcifications were identified (Figure 1F-GE). Collaborative efforts among radiologists, pathologists, and surgeons could facilitate this endeavor, enhancing our collective understanding of sinonasal pathology. In endonasal surgery, the surgeon typically seeks the lesion's origin based on radiological images. This is particularly important in the maxillary sinus, as it influences the surgical approach depending on the affected wall (9). Similarly, it is crucial to identify a potential origin within the frontal sinus, as assuming the sinus involvement is merely due to mucosal retention could inevitably lead to later recurrence.

Conclusion

Ultimately, a combined approach allows surgeons to anticipate areas of difficult access and plan more precise resections, mini-

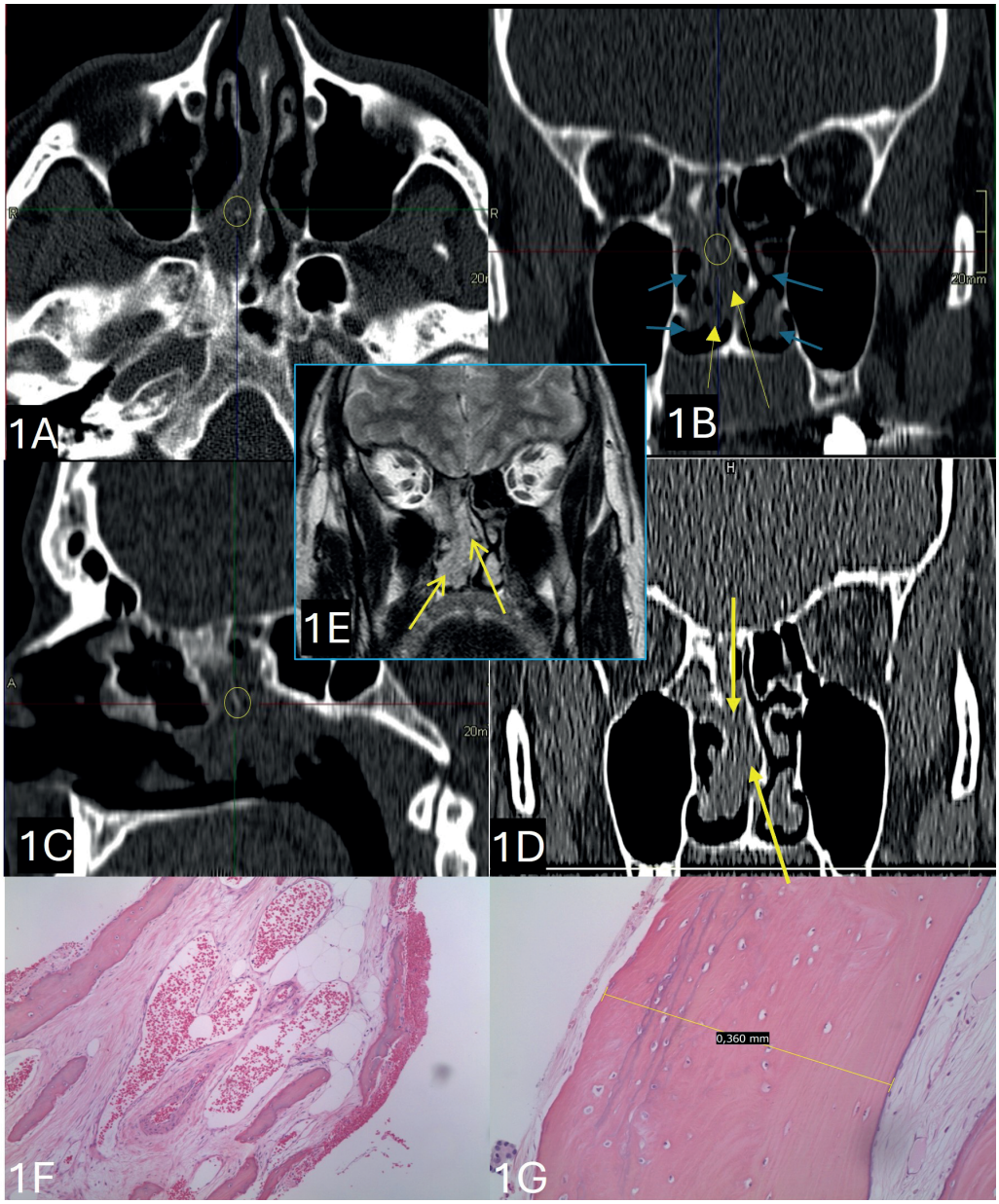

Figure 1. A 63-year-old male patient underwent surgery for an inverted papilloma located in the right nasal cavity. The multiplanar CT slices in bone window focus on an intralesional linear calcification (yellow circle) in different axial (A), coronal (B), and sagittal (C) planes. These images show the lesion originating from the superolateral wall of a right ethmoidal cell, where an area of sclerosis and bony exostosis is noted, continuing caudally with linear calcifications extending into the nasal cavity (yellow arrows), differentiating from the calcifications typical of the turbinates (blue arrows). The calcifications become more evident in the coronal image D when the window is adjusted to soft tissues (parallel cut, almost identical to B). Image 1E shows a coronal T2 MR image with linear hypointensities (yellow arrows) corresponding to the calcifications. The tumor's origin informs the surgical strategy, indicating resection beyond the nasal fossa. Histological analysis reveals both thin (F) and coarse (E) calcifications within the tumor.

mizing the risk of residual tumor and recurrence. Therefore, both focal hyperostosis and radial calcifications should be actively sought and thoroughly reported in radiological assessments.

Authorship contribution

EG has contributed to the design, writing, and submission of this article. The other authors have similarly contributed to the design, review of the work and the literature.

Conflict of interest

No conflict of interest to declare.

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SUPPLEMENTARY MATERIAL

Table S1. Radiological and clinical characteristics of inverted papilloma.

Radiological finding	Descriptive characteristics	Clinical relevance
Intralesional calcifications	60% of cases; radial in 20%; fine or coarse.	Indicative of tumor origin and growth pattern. Helps differentiate from inflammatory polyps.
Focal hyperostosis	Localized bone thickening at tumor origin; seen in 60-80% of cases.	Key marker for identifying tumor origin; assists in surgical planning.
Origin	38% maxillo-ethmoid angle, 33% maxillary sinus, 19% ethmoid cells, 5% frontal sinus	80% Agreement between the radiologically suggested origin and the site identified during surgery.
Cerebriform pattern (MRI)	66% In T2 or post-contrast T1-weighted MRI; overlaps with CT findings.	Diagnostic confirmation; guides tumor extent assessment. Differentiates tumour vs. mucous retention.
Bone remodeling	39% Thinning or displacement without destruction.	Differentiates from malignancies; aids diagnosis.

Table S1. Radiological and clinical characteristics of inverted papilloma. We reviewed patients with sinonasal polyposis who underwent endoscopic intervention at Parc Taulí Hospital in Sabadell and Hospital de la Santa Creu i Sant Pau in Barcelona, from 2010 to 2024. A total of 66 cases of sinonasal polyposis with available imaging studies and histological confirmation of the diagnosis were included. Among these, 40 patients underwent both CT and MRI scans, 22 were evaluated using only CT, and 4 were assessed exclusively with MRI.

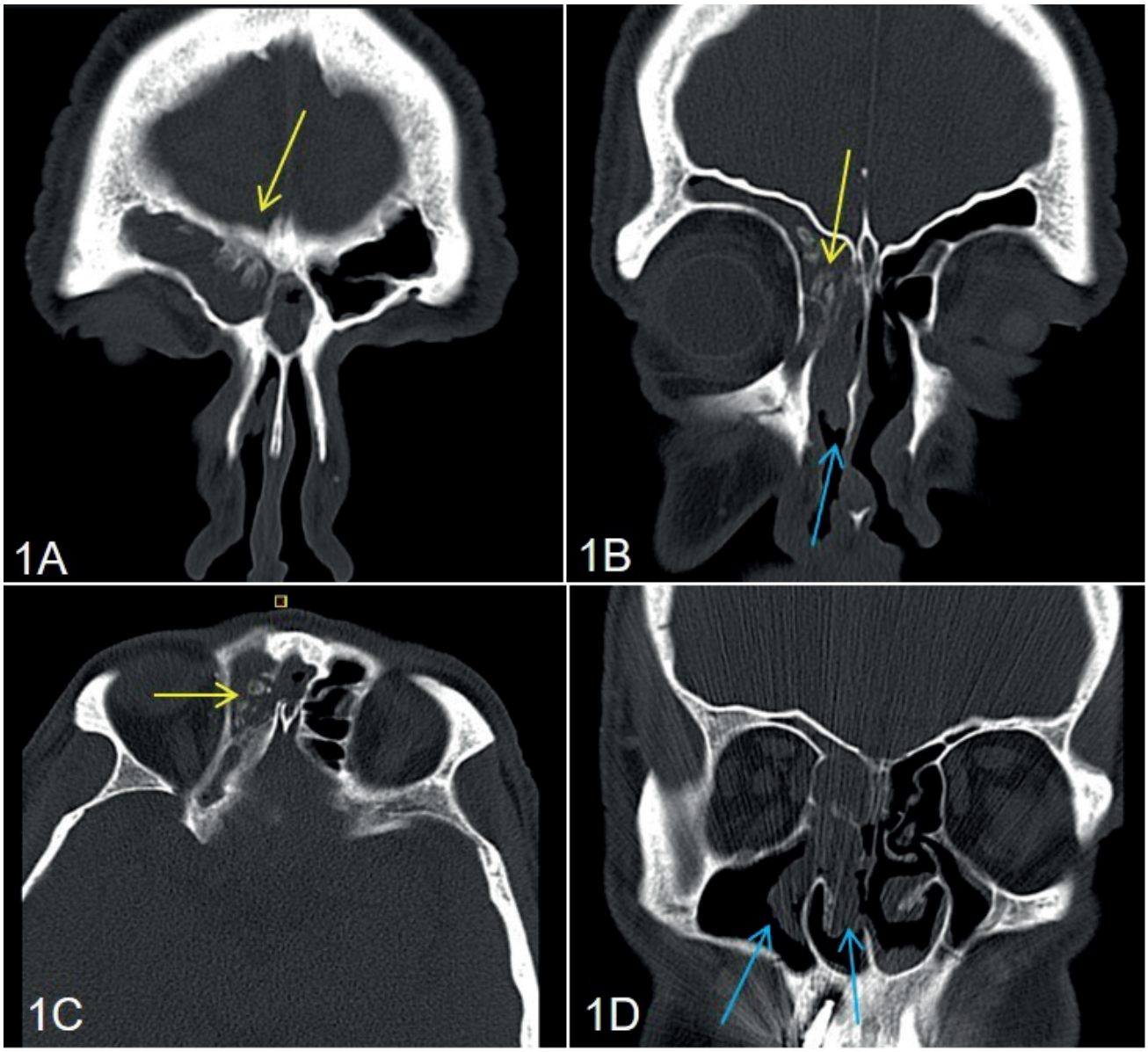

Figure S1. CT coronal (A, B, D) and axial (C) bone window, showing right frontal IP, containing grose linear calcificacions (yellow arrows), centered on the focal hiperostosis on the superior wall of the supraorbital extension of the right frontal sinus. Caudally, the lesions extend into the right nasal fossa and maxillary sinus (blue arrows in B and D).

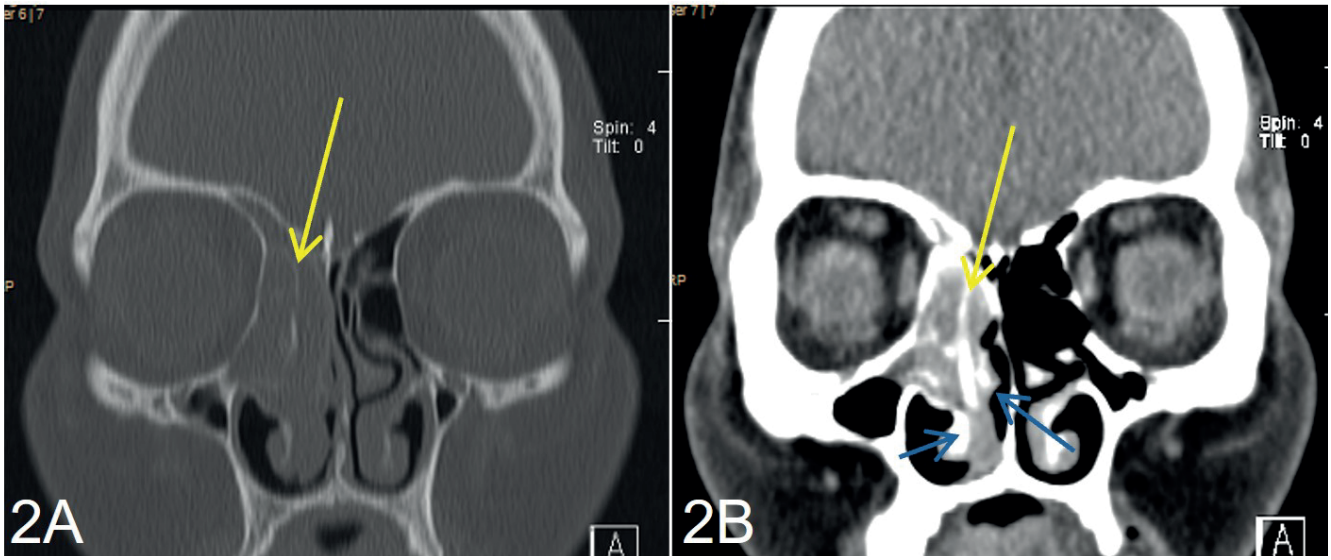

Figure S2. (A) Coronal CT scan in bone window of a 57-year-old female patient with a PI in the right nasal cavity originating from the superolateral area of the wall of a right ethmoidal cell, showing a main linear calcification descending and occupying the right middle meatus. The papilloma contacts the floor of the right nasal cavity. The soft tissue window image (B) better demonstrates the difference between the intralesional linear calcification (yellow arrow) and the calcification of the right middle and inferior turbinates (blue arrows).

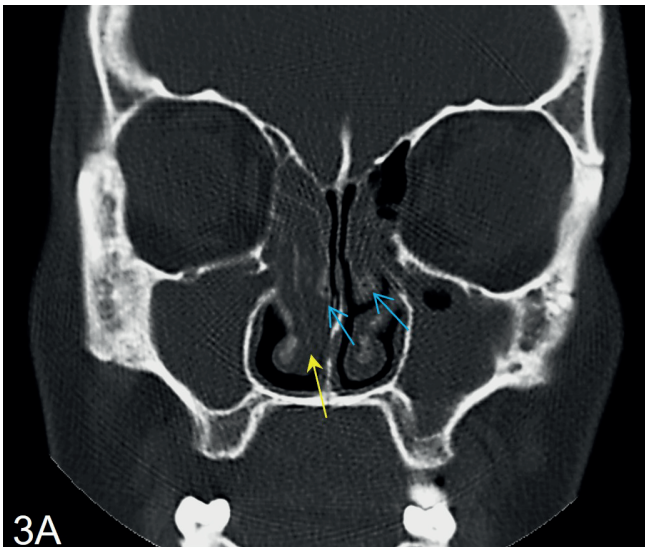

Figure S3. Coronal CT scan in bone window centered on the right nasal cavity, showing a PI with intralesional linear calcification originating from the inferior region of the lateral wall of an ethmoidal cell and the ethmoid-maxillary angle, descending medial to the right inferior turbinate, displacing the middle turbinate (middle turbinates marked with blue arrows).

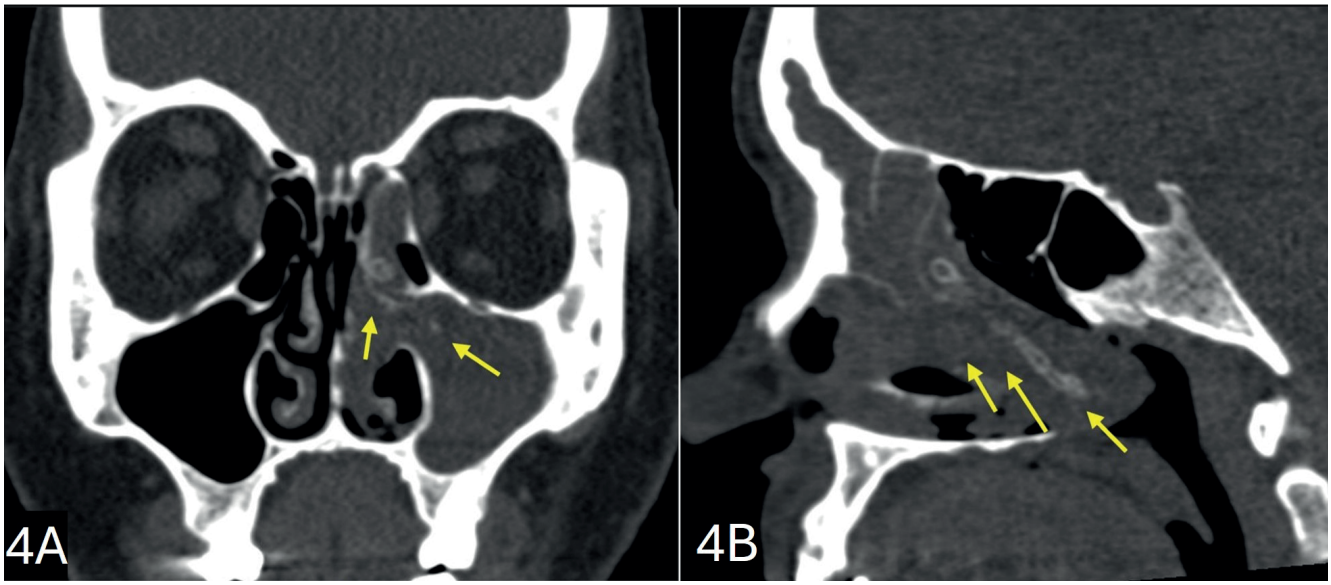

Figure S4. CT scan, bone window. Histologically confirmed IP attached to the anterior wall of an anterior ethmoid cell. (A) Coronal view showing radial linear calcifications extending into the left nasal fossa and maxillary sinus. (B) Sagittal view centred on the radial calcifications extending into the left choana and partially occupying the nasopharyngeal cavity.

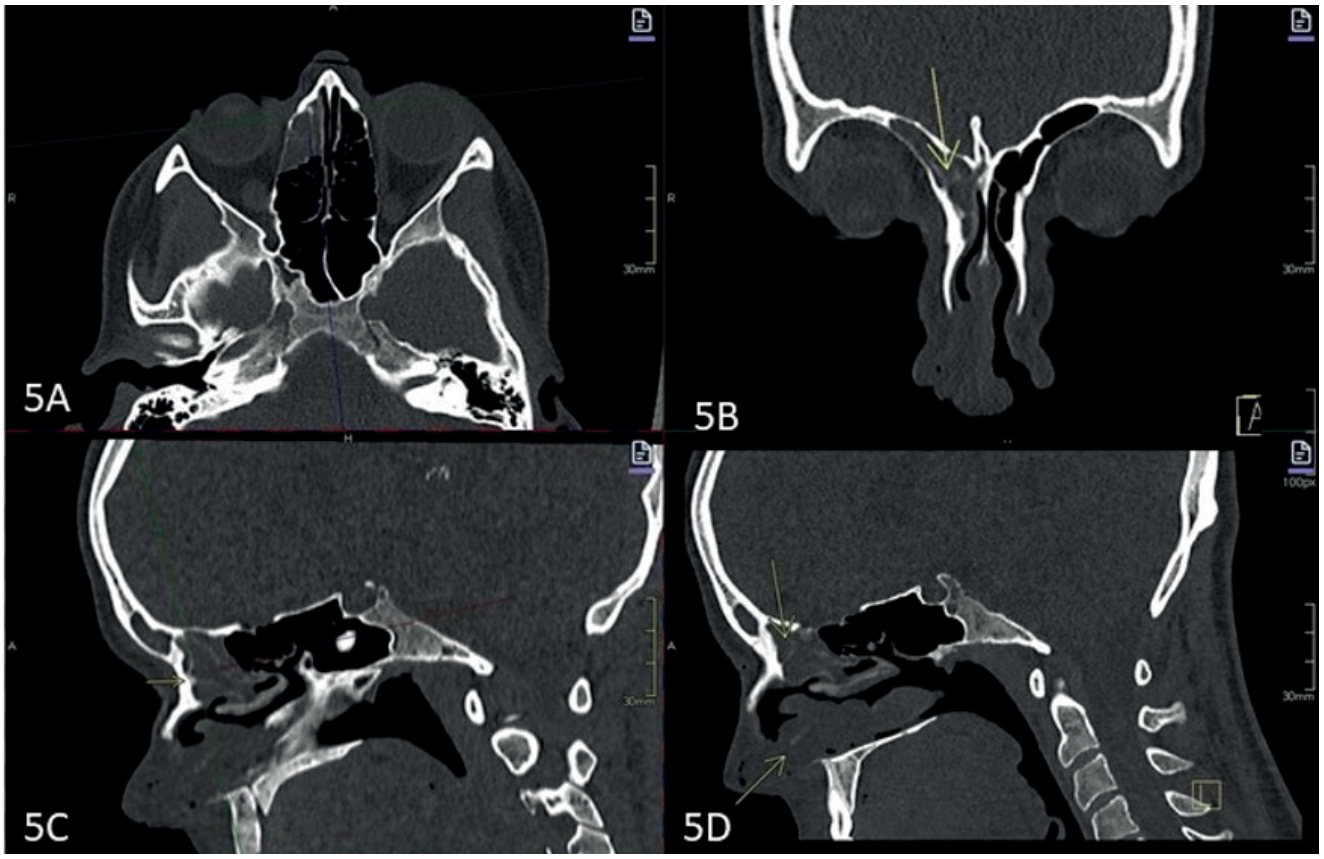

Figure S5. Multiplanar reconstructions in axial (A), coronal (B), and sagittal planes (C and D) using bone window settings, centred on the infundibulum of the right frontal sinus, from which an inverted papilloma arises. This lesion contains multiple linear branching calcifications originating at its base. The calcifications extend into the right nasal cavity and vestibule. Image (D) highlights, with yellow arrows, both the calcifications at the frontal implantation base and those in the right nasal vestibule.