Cureus
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Open Access Case Report

A Three-Dimensional Radiological Evaluation of Rhinolith by Cone-Beam Computed Tomography: A Report of a Rare Case

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Review began 12/19/2023
Review ended 12/28/2023
Published 11/25/2026

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DOI: 10.7759/cureus.120211

Abstract

A rhinolith is a calcareous mineralized foreign body in the nasal cavity. Rhinoliths can appear at any age but are often missed on clinical examination. It is frequently caused by accidental ingestion of foreign particles retained in the nasal cavity or fungal infections such as aspergillosis. It is a rare condition that manifests asymptomatically and appears as an incidental finding on conventional radiographs such as intraoral periapical (IOPA), occlusal and extraoral radiographs such as orthopantomography (OPG), lateral cephalometric, paranasal sinus (PNS), anteroposterior (AP) skull views. Specialized radiographic imaging techniques such as computed tomography (CT), magnetic resonance imaging (MRI), and cone-beam computed tomography (CBCT) help localize rhinoliths in three-dimensional orthogonal planes. It appears on radiographs as a radiopaque mass in the nasal cavity. It can be mistaken for pathologic entities requiring more invasive surgical operations. We report a case of a rhinolith caused by accidental inhalation of a foreign substance into the nasal cavity, clinical features, differential diagnosis, treatment modalities, and complications. The radiologic aspects of such a rhinolith were evaluated in three-dimensional orthogonal planes by CBCT.

Categories: Oral Medicine, Dentistry
Keywords: cone-beam computed tomography (cbct), diagnostic nasal endoscopy, digital opg, lateral cephalometry, rhinolith

Introduction

Rhinolith is a calcareous mineralized mass in the nasal cavity [1]. The process of formation of rhinolith is called rhinolithiasis [1]. Rhinolithiasis is an uncommon, rare clinical entity characterized by a calcareous mineralized mass in the nasal cavity [1]. These stones are typically formed by the gradual accumulation and calcification of mucus, foreign bodies, dried blood clots, bony sequestrum, and other debris in the nasal passages [1]. The nidus for rhinolith occurs endogenously from retained root or bone fragments after dental extraction, accidental ingestion of surgical sponge during nasal packing for management of nasal bone fractures, endodontic material extruded during endodontic treatment, ectopic teeth, inspissated mucus, drug smugglers who carry marijuana using contraband in their nose in adults and endogenously from accidental ingestion of beads, grains, pearls, coins, fruit seeds in the nose in pediatric patients [1]. Rhinoliths can vary in size, composition, and shape depending on the nidus [1].

Case Presentation

A 49-year-old female reported a chief complaint of halitosis for the past five years. She underwent oral prophylaxis by scaling in a private dental clinic, but her problem of halitosis persisted. Further probing of her history revealed she accidentally inhaled a small insect while jogging six months back. Her medical and surgical history were non-contributory. Her past dental history revealed she underwent tooth restoration one year ago. Her vitals were stable. She again visited another private dental clinic for the same problem, where she was subjected to radiographic imaging modalities, orthopantomography (OPG), and lateral cephalometric radiographs by a dentist for further investigation, which revealed a foreign object within her left nasal cavity (Figure *1*).

How to cite this article
Rajaram Mohan K, Gowda Venkatesha R, Fenn S (November 25, 2026) A Three-Dimensional Radiological Evaluation of Rhinolith by Cone-Beam Computed Tomography: A Report of a Rare Case. Cureus 18(11): e120211. DOI 10.7759/cureus.120211

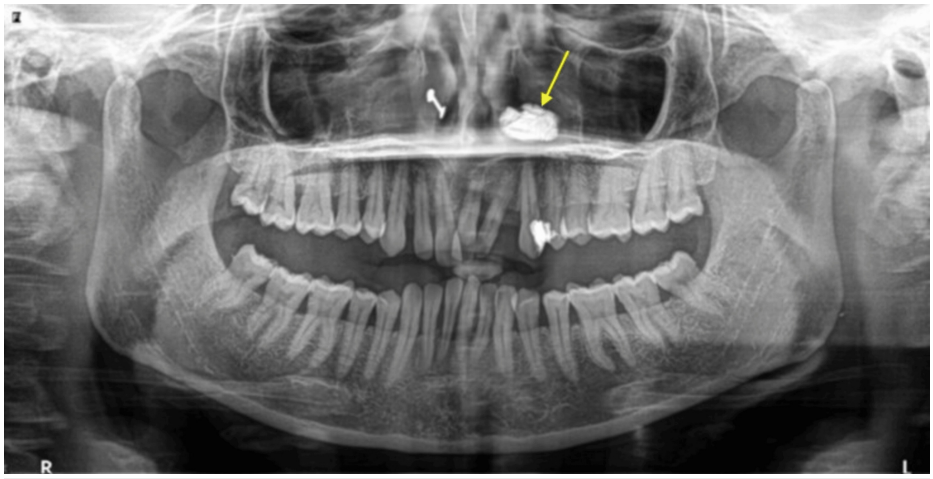


FIGURE 1: Orthopantomography (OPG) image revealed a well-defined radiopaque mass in relation to the floor of the left nasal cavity (yellow arrow).

The lateral cephalometric radiograph revealed a well-defined radiopaque mass within the nasal cavity (Figure *2*).



FIGURE 2: Lateral cephalometric radiograph revealed a well-defined denser radiopaque mass in relation to the floor of the nasal cavity.

So, she was referred to our department for radiological evaluation by cone-beam computed tomography (CBCT) for its exact location. The sagittal section radiographic image obtained by CBCT (Carestream CS 9600 CBCT, Carestream Dental LLC, Atlanta, USA) also confirmed the presence of a hyperdense mass measuring about 8.0 mm x 7.6 mm within the floor of her left nasal cavity (Figure *3*).



FIGURE 3: Cone-beam computed tomography (CBCT) sagittal section revealed a well-defined radiopaque mass measuring about 8.0 mm x 7.6 mm within the floor of the nasal cavity.

The coronal section of CBCT at 1 mm slice thickness revealed a well-defined hyperdense mass measuring about 7.5 mm x 10.3 mm in diameter within the floor of the left nasal cavity (Figure *4*).

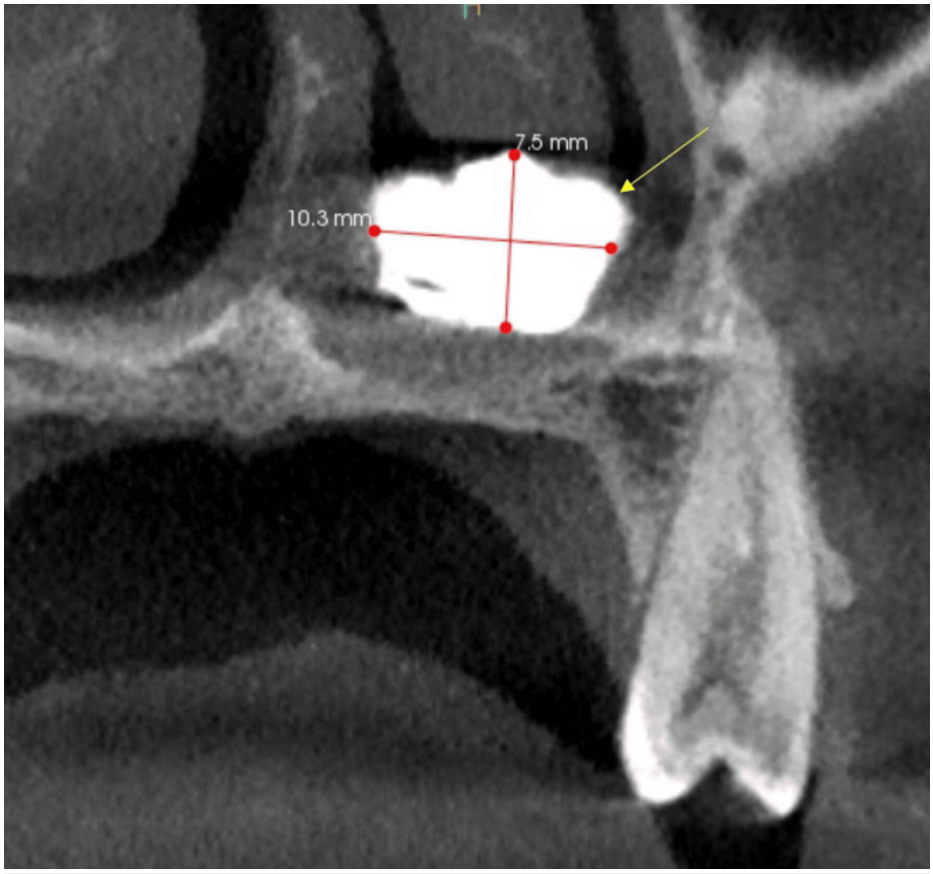


FIGURE 4: Cone-beam computed tomography (CBCT) coronal section revealed a well-defined hyperdense mass measuring about 7.5 mm x 10.3 mm in diameter within the floor of the left nasal cavity and intact floor of the nasal cavity.

CBCT axial section revealed a well-defined hyperdense mass of 9.1 mm x 8.1 mm with lamellation resembling the shape of a handbag (Figure *5*).

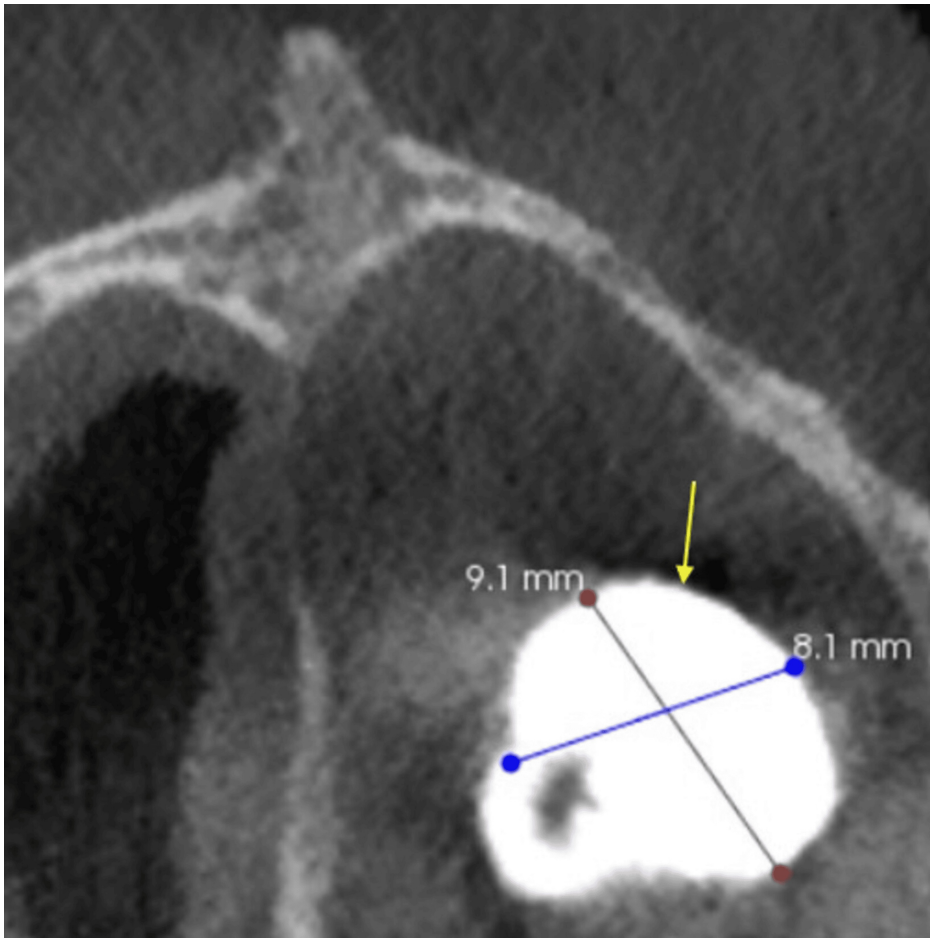


FIGURE 5: Cone-beam computed tomography (CBCT) axial section revealed a well-defined hyperdense area measuring about 9.1 mm x 8.1 mm with lamellation resembling the shape of a handbag.

Three-dimensional (3D) reconstructed CBCT images revealed a mass within the left nasal cavity and generalised alveolar bone loss (Figures *6A*-*6B*).

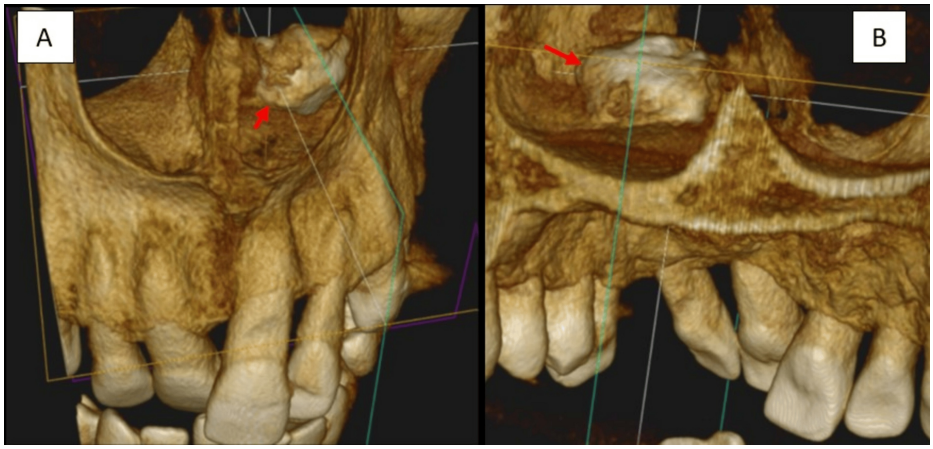


FIGURE 6: (A, B) Three-dimensional (3D) reconstructed cone-beam computed tomography (CBCT) revealed a mass within the left nasal cavity (red arrow) and generalised alveolar bone loss.

The differential diagnosis for rhinoliths includes odontomas, osteomas, sinonasal tumours such as adenoid

cystic carcinomas, small round cell carcinomas, foreign bodies, and fungal infections such as aspergillosis. The patient was referred to an Ear, Nose and Throat (ENT) physician for retrieval of rhinolith. The retrieved rhinolith is shown (Figure 7).

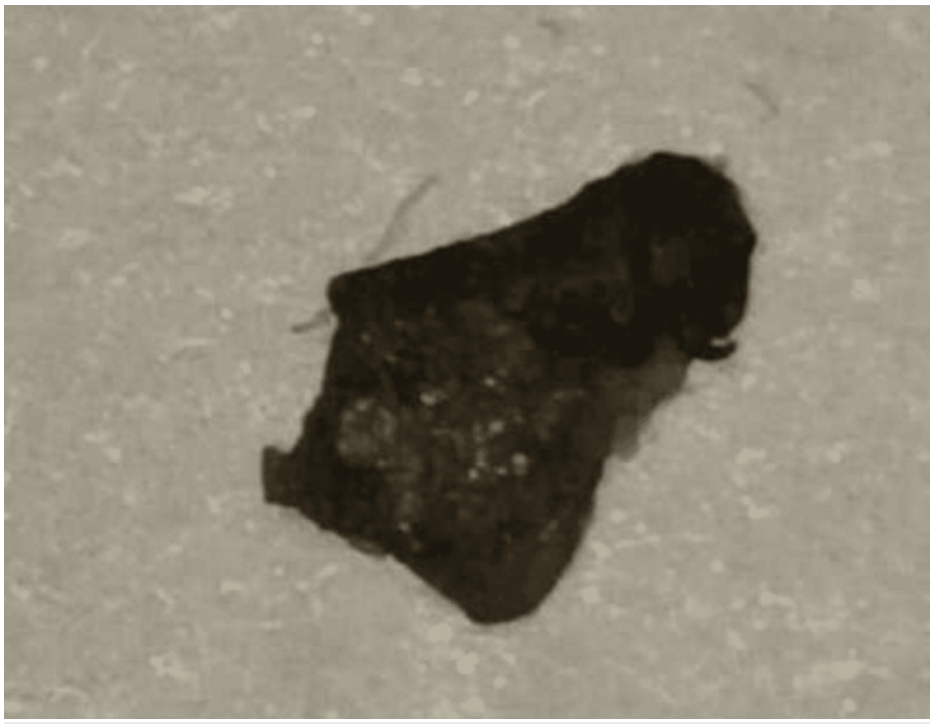


FIGURE 7: Retrieved rhinolith specimen

Discussion

Definition

Rhinoliths are mineralized calcified masses occurring within the nasal cavity [1].

Etymology

The word "Rhinolith" is derived from the Greek words "rhino", meaning nose, and lith, meaning stone [2].

Composition

Powder diffractometry revealed the main constituent of rhinolith that was whitlockite, in addition to calcium phosphate, magnesium carbonate, and phosphate, some of which contain ferrihydrite and siderite, as determined by analysis by X-ray diffraction [3].

Etiology

The nidus for rhinolith occurs endogenously from retained root fragments, cotton whisks after dental extraction, bone sequestrum, dried blood clots, retained suture or gauze, surgical sponge during nasal packing in nasal bone fractures, endodontic material extruded during endodontic treatment, ectopic teeth, inspissated mucus and exogenously by drug smugglers who carry contraband in their nose in adults and exogenously from accidental ingestion of plastic beads, buttons, toy openers, metal wires, implants, pop can openers, grains, pearls, coins, fruit seeds, coins in the nose in pediatric patients [4-7].

Clinical features

Rhinoliths are often located below the inferior concha, close to the nasal septum [8]. Rhinolith occurs unilaterally, rarely bilaterally, within the right or left nasal cavities [8] - patients with rhinolithiasis clinically present without any pain. However, a longer, expanding mass of rhinolith impinges on the nasal mucosa and causes pain and discomfort in the nasal region. Such patients have a history of unilateral nose obstruction, blood-stained rhinorrhea, purulent discharge, sinusitis, headache, anosmia, epistaxis, anosmia, halitosis, and fever [9]. The presence of a rhinolith can lead to nasal discharge associated with halitosis, odontogenic pain, nasal obstruction, congestion, and difficulty breathing through the affected nostril [9-12].

Diagnosis

Radiological imaging techniques such as OPG, lateral cephalometric radiographs, anteroposterior (AP) skull view X-rays, and specialized imaging techniques such as CT or CBCT are typically used to diagnose rhinoliths [13]. Endoscopic or microscopic rhinoscopy is used to diagnose a small-sized rhinolith [13]. Rhinoliths appear homogeneous or heterogeneous depending on the nidus nature. Laminations are present in some rhinoliths. In some cases, rhinolith density exceeds the density of the surrounding bones [13].

Differential diagnosis

The differential diagnosis for rhinolith includes odontoma, osteoma, aspergilloma, and sinonasal tumours such as adenoid cystic carcinoma, squamous cell carcinoma, and small round cell carcinoma. The distinguishing radiographic features of rhinoliths from other lesions (Table *1*).

Distinguishing radiographic features of rhinolith from other lesions	
Rhinolith usually appears as a solitary radiopaque mass.	Odontomas - Odontomas occur as complex and compound. Odontomas are usually multiple radiopaque masses resembling teeth (compound odontomas) or non-tooth-like structures (complex odontomas). When solitary, odontomas appear as dough-nut-shaped radiopacity surrounded by a radiolucent halo.
Rhinoliths usually occur within the nasal cavity or nasal fossa.	Osteoma - Osteoma is usually seen attached to the cortical plate of the bone.
Rhinolith appears irregular in shape and confined only to the nasal cavity. Presence of lamellations within the rhinolith.	Aspergilloma appears as a canon-like fungal ball. Can cause mucosal thickening and obliteration of other paranasal sinuses such as ethmoid, frontal sinus. Absence of lamellations in fungal balls caused by aspergillosis.
Computed Tomography (CT)/Cone-Beam Computed Tomography (CBCT)/Magnetic Resonance Imaging (MRI) - Rhinoliths do not cause bone destruction. Mucosal thickening or deviation of the nasal septum is appreciated.	Computed Tomography (CT)/Cone-Beam Computed Tomography (CBCT)/Magnetic Resonance Imaging (MRI) - High-grade sinonasal malignancies such as adenocarcinomas show extensive bony destruction, whereas low-grade sinonasal malignancies small round cell tumors show permeative invasion and lack of bony destruction.
Magnetic Resonance Imaging (MRI) - Hyperintense on T1 due to the presence of mucus. Low apparent diffusion coefficient (ADC) and diffusion-weighted image (DWI) in case of hemorrhage.	High apparent diffusion coefficient (ADC) indicates the presence of calcified cartilage.

TABLE 1: Differential diagnosis of rhinolith from other lesions

Self-created by the author.

The various literature reviews on case reports on rhinolith (Table *2*).

Author	Year	Age-Gender	Clinical features
Mitchell D et al. [14]	2023	34-year-old male	Asymptomatic rhinoliths can be found incidentally on anterior rhinoscopy, nasal endoscopy, or imaging studies.
Ersözlü T, Gültekin E [15]	2020	59-year-old male	Rhinolith was reported in an unusual location concha bullosa. Rhinolith can be discovered as an incidental finding. Extraction is performed under local or general anaesthesia depending on the location, size, and age of the patient.
Akasal C [16]	2019	N= 23; Female = 17; Male = 6	A rhinolith is most commonly found between the inferior concha and the nasal septum. Nasal septal deviation and mucosal thickening of the maxillary sinus were the most common sinonasal symptoms. The removal of rhinoliths has traditionally been accomplished through septoplasty.
Ali M [17]	2018	15-year-old girl	Rhinolith is a very rare clinical finding. It is estimated that it has an incidence of about 1 in 10,000 Ear, Nose and Throat (ENT) patients. In situations of persistent foul-smelling rhinorrhoea, rhinolith should be investigated.
Noh KB et al. [18]	2017	66-year-old female	Rhinolithiasis is a rare condition that can go untreated for years before presenting with difficulties. Clinical history and physical examination are used to make the diagnosis, which should be evaluated in cases with unilateral nasal blockage with foul-smelling nasal discharge.

TABLE 2: The various literature reviews of case reports on rhinoliths

Treatment

Treatment usually involves surgical retrieval of the rhinolith accomplished through various methods such as endonasal or sinus endoscopic surgical retrieval by an ENT physician by lateral rhinotomy incision or Caldwell-Luc approach with general anesthesia [19].

Complications

Recurrent sinusitis, oro-antral fistula, dacryocystitis, perforation of the hard palate or floor of the nasal cavity, unilateral nasal obstruction or discharge, epistaxis, and epidural abscess are the complications that can arise if rhinolith is left untreated.

Conclusions

Rhinolith is often a clinically missed entity. Rhinolith can remain silent for many years and are incidentally discovered during routine radiographic investigations. Rhinolith can mimic odontogenic pain or allergic rhinitis. Secondarily, infected rhinolith can lead to sinusitis, epidural abscess, and hard palate perforation. A thorough history and physical examination with added radiological imaging, such as CBCT, are essential for diagnosing rhinolith. CBCT aids in the precise location of rhinolith in 3D orthogonal planes. Undoubtedly, CBCT is an important diagnostic radiological tool and a gold-standard non-invasive technique for diagnosing and precisely locating rhinolith in 3D orthogonal planes in coronal, axial, and sagittal sections. Prevention involves good nasal hygiene, including regular cleaning of the nasal passages to prevent the accumulation of debris that could contribute to the formation of rhinoliths.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Karthik Rajaram Mohan, Saramma Mathew Fenn, Ramachandra Reddy Gowda Venkatesha

Acquisition, analysis, or interpretation of data: Karthik Rajaram Mohan, Ramachandra Reddy Gowda Venkatesha

Drafting of the manuscript: Karthik Rajaram Mohan, Saramma Mathew Fenn, Ramachandra Reddy Gowda Venkatesha

Supervision: Karthik Rajaram Mohan, Saramma Mathew Fenn, Ramachandra Reddy Gowda Venkatesha

Critical review of the manuscript for important intellectual content: Saramma Mathew Fenn, Ramachandra Reddy Gowda Venkatesha

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Acknowledgements

Dr. P.T. Ravikumar for his referral to an ENT specialist.

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