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Nasal Septum Defects Detected on Postmortem Computed Tomography

Vasiliki Chatzaraki, MD, Wolf Schweitzer, MD, Michael J. Thali, MD, eMBA, and Garyfalia Ampanozi, MD, MSc

Abstract: Nasal septum defects may have forensic relevance because they are associated with various mechanisms, including trauma and cocaine abuse. Like all human body tissues, the nasal septum may be affected by maggots' infestation during postmortem decomposition. Postmortem computed tomography (PMCT) can reveal small findings and related details. Three cases of early postmortem period and 2 cases of advanced decomposition, where external examination of the nasal cavities and PMCT revealed nasal septum defect, are presented. In the early postmortem period cases, the lesions' edges appeared smoother on PMCT, whereas in the advanced decomposed cases, the edges were irregular and maggots were infested. Postmortem computed tomography can detect nasal septum defects and may help differentiate the preexisting from the postmortem ones based on their edges' radiological appearance. Such findings may indicate possible chronic cocaine abuse (cocaine nose), trauma, or other nasal pathology. It is important to note that such defects may be altered or caused by advanced decomposition.

Key Words: nasal septum lesion, nasal septum perforation, cocaine nose, postmortem computed tomography, virtopsy

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The nasal septum consists of hyaline cartilage and 2 bony parts, the ethmoid and the vomer bone. The septal cartilage, which has a quadrilateral shape, extents from the anterior face including the columella (the visible soft part of the septum separating the nostrils) to posterior at the margins of the ethmoid bone and vomer. The perpendicular plate of the ethmoid bone (superoposterior) and the vomer (inferoposterior) meet and articulate diagonally. Occasionally, the cartilage extents more posteriorly that ethmoid and vomer never meet causing the septum to be consisted only of cartilaginous part.[1] The nasal septum is the dividing wall between the 2 nasal cavities and participates in the sense of smell because its upper part contains olfactory cells.[2]

Deviation, tumors, and perforation of nasal septum have been described in the bibliography. Nasal septum deviation is a common benign incidental finding.[3] It may be congenital or acquired by trauma and sport-related injuries and may also be related to concha bullosa.[4] Congenital birth defects of the nasal septum are rare and may compound with encephalocele, nasal brain heterotopia, teratoma, choanal atresia, or stenosis.[3] The nasal septum may be involved in various sinonasal malignancies, for instance, squamous carcinoma, esthesioneuroblastoma, and odontogenic tumors.[3] Acquired septal lesions may contain intentional nose piercings, possibly for aesthetic or cultural reasons.

The majority of the acquired defects are traumatic (after surgery, repeated cautery, or after rhinotillexomania [chronic nose picking]). Malignant (non-Hodgin T-cell lymphoma, granuloma), inflammatory (Wegener granulomatosis, lupus erythematosus, syphilis, tuberculosis, sarcoidosis, leprosy), drug-induced ("cocaine-nose," topical corticosteroids' and decongestants' usage), or idiopathic causes are also reported. Nasal septum perforation may affect either the cartilaginous and/or the bony septum. Most commonly, the anterior cartilaginous area is involved. The bony septum is affected characteristically by syphilis.[3,5,6]

The evaluation of the nasal cavities and their content as well as of the nasal septum comprises an integral part of a corpse's medicolegal investigation.[7] Nasal septum findings may be commonly of minor relevance in the field of forensic pathology. However, nasal septum lesions are associated with generalized facial trauma and the so known Le Fort nasomaxillary fractures,[8,9] which may be interpreted as result of violence against the face. In addition, laterally applied impact against nose can possibly cause nasal septum inferior detachment.[7] Repeated injuries of the septum can lead to structure disruption and replacement with fibrous tissue.[7]

As long as forensic pathology is performed with toxicological analyses in only selected cases and as long as drug users try to hide bodily consequences of their addiction,[10] identifying suspicious lesions such as septum defects that may be indicative of cocaine abuse is relevant.

Nasal septum defects can be related with recreational drug usage and specifically with the so-called *cocaine nose*. Long-term (3 months are reported to be enough) of cocaine snorting may result in ulceration and perforation of the nasal septum as result of chemical irritation, topical vasoconstriction, and ischemic necrosis. Self-induced injury by the instruments used for cocaine snorting is also a possible mechanism.[3,9] Septal lesions may be asymptomatic or cause nasal discharge, congestion, epistaxis, whistling (especially by small anterior lesions), nasal crust, facial swelling, and pain.[3,6]

For the diagnosis of erosive lesions of the nasal septum, clinical examination of the region is usually adequate. Further etiological investigation is based mainly on the clinical history and histopathology. For further examination of the sinonasal region for exclusion of related masses, extension and characterization of a septal damage computed tomography and magnetic resonance imaging are used.[3] Postmortem computed tomography (PMCT) is an invaluable supplement to conventional forensic autopsy and is increasingly used in the forensic pathologist's routine.[11,12]

After death, insects are attracted to the dead body, which concern necrophagous species that feed on the body, predators and parasites that feed on the necrophagous insects, and omnivorous species that feed on both the body and the other species.[9] Thus, during myiasis, larvae feed on all the human body tissues during, and contributing to, postmortem decomposition.

Five cases (3 in early postmortem period and 2 of advanced decomposition) with nasal septal lesion detected on PMCT are presented.

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From the Department of Forensic Medicine and Imaging, Institute of Forensic Medicine, University of Zurich, Zurich, Switzerland.
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Reprints: Vasiliki Chatzaraki, MD, Department of Forensic Medicine and Imaging, Institute of Forensic Medicine, University of Zurich, Zurich, Switzerland. E-mail: vasiliki.chatzaraki@irm.uzh.ch; or chatzaraki@outlook.com.gr.

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Case Histories

Case 1

A 46 year old man died in his domicile shortly after a neighbor heard screams and called the paramedics. Their resuscitation measures remained unsuccessful. During the scene investigation, large amounts of quetiapine (atypical antipsychotic for schizophrenia and bipolar depression), mefenamic acid (nonsteroidal anti-inflammatory drug) blisters, and empty vodka bottles were found. Time of death was estimated to be compatible with the time of interruption of the attempted resuscitation. His medical history contained chronic alcohol abuse, treatment under methylphenidate hydrochloride (central nervous system stimulant), and quetiapine

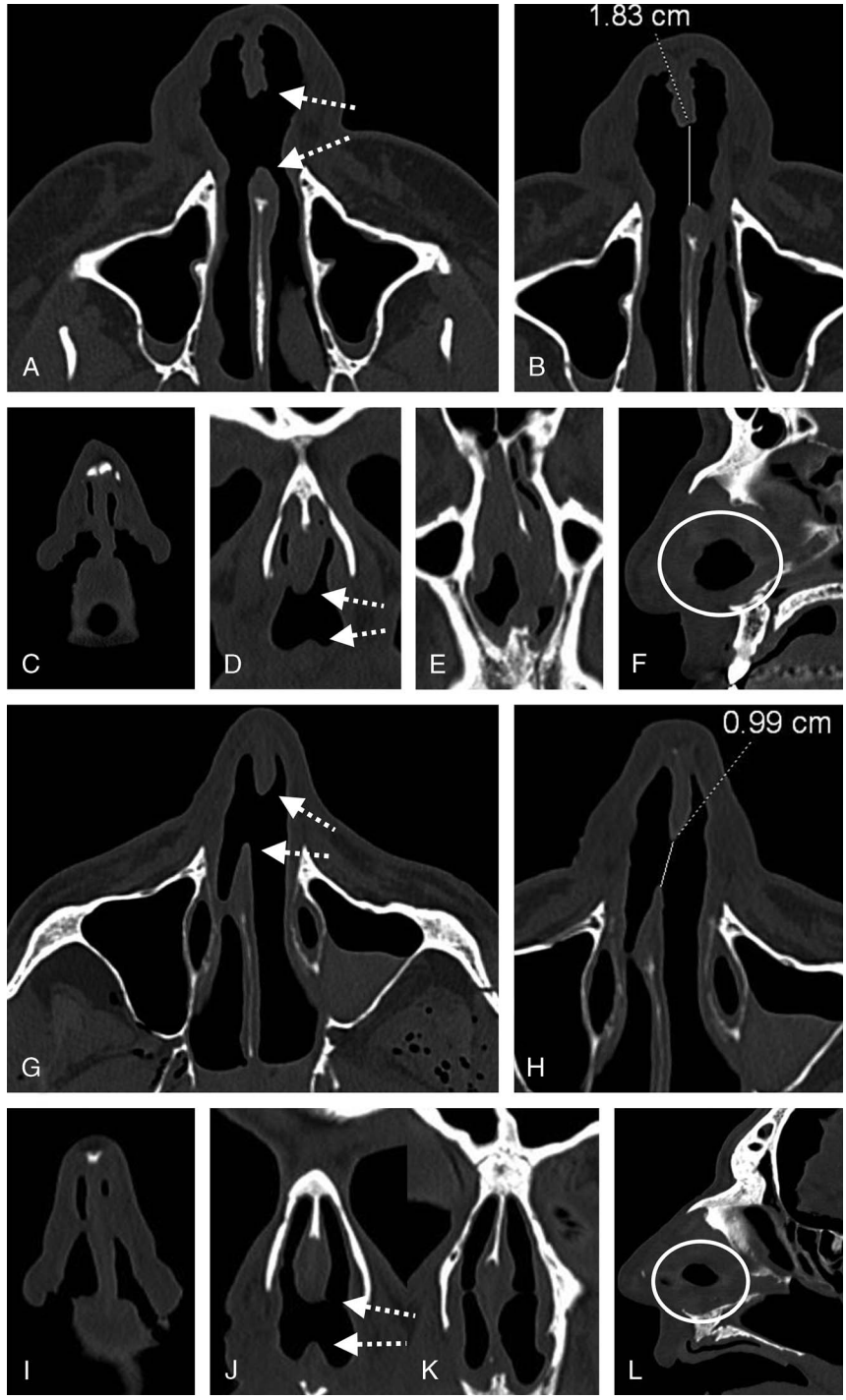

FIGURE 1. Case 1 (A–F) and case 2 (G–L)—axial (A, B, G, H), coronal (C–E, I–K), and sagittal (F, L) PMCT slices through nose and nasal septum. In both cases, PMCT revealed nasal septum defect of maximal diameter approximately 1.8 cm for case 1 and 1 cm for case 2. Note the smoothly defined edges of the mucosa covering the cartilaginous septum defect (white dashed arrows). Coronal slices are ordered according to anteroposterior (backward) direction for each case.

(atypical antipsychotic). One failed suicide attempt with pills 4 months before his demise was also recorded.

Case 2

A 55-year-old man was found dead lying in a pool of blood in the charcoal storage room at the bottom of his garage. A small-caliber pistol was located beneath the corpse. During external inspection, a defect compatible with entrance gunshot wound was revealed on the left temporal region of the head. Time of death was estimated to about 1 to 1.5 days before the external examination of the body. No specific information about his history was known.

Case 3

A 48-year-old man was found dead lying on his bathroom's floor. During the external inspection of the body, no signs of violence were detected. A large number of cigarette packs were found at the scene. A small tube with white powder compatible with cocaine was found in his trouser pocket. Time of death was estimated to range approximately between 6 to 12 hours before discovery. No diseases were noted in his history according to his family doctor.

Case 4

A 38-year-old man was found in a decomposed state, incompletely hanged in his bathroom, after neighbors complained for odor emissions in the building. Empty bottles of alcohol beverages were found at the scene. Time of death was estimated as roughly between 1 to 2 weeks before discovery. In his history, depression and suicidal expressions were known.

Case 5

The body of a 53-year-old woman was found in a decomposed state on an open field. A bottle (20 mL, 60 mg/mL) of diphenhydramine (antihistamine) with ¼ missing content, a packet of 50 lorazepam (benzodiazepine) pills (2.5 mg) with 5 of them missing, and 3 empty tramadol (opioid pain killer) bottles (one bottle: 10 mL, 100 mg/mL) were found in her backpack. Time of death was estimated to be roughly between 1 to 2 weeks before discovery. She was known psychiatric patient with numerous failed suicidal attempts in the past. The cadaver was delivered to our institute for further investigation including identification. Besides conducting postmortem imaging before forensic autopsy, antemortem imaging data and records taken 8 months before patient's demise were available for comparison.

MATERIALS AND METHODS

After transport of the bodies to our institute for further examination, all bodies underwent PMCT. Time interval between discovery of the body and imaging was 1, 10.5, 16, 1.5, and 1.5 hours for the cases, respectively.

The PMCT was performed on a 128-slice scanner (SOMATOM Definition Flash, Siemens Healthineers, Erlangen, Germany), with the bodies in supine position, using automatic dose modulation (CARE Dose 4D, Siemens Healthineers, Erlangen, Germany). Imaging parameters were as follows[13]: tube voltage, 120 kVp; slice collimation, 128 × 0.6 mm. The PMCT image reconstructions of head and neck as well as thorax and abdomen were performed,[13] with slice thickness of 1.0 mm and increments of 0.6 mm, using the soft-tissue and lung window with soft and hard kernels, respectively. Images were evaluated by usage of Syngo.via imaging software for multimodality reading (Syngo.via; Siemens Healthineers Headquarters, Erlangen, Germany).

PMCT FINDINGS

Case 1

A defect of the cartilaginous part of the nasal septum with maximal diameter of approximately 1.8 cm was detected

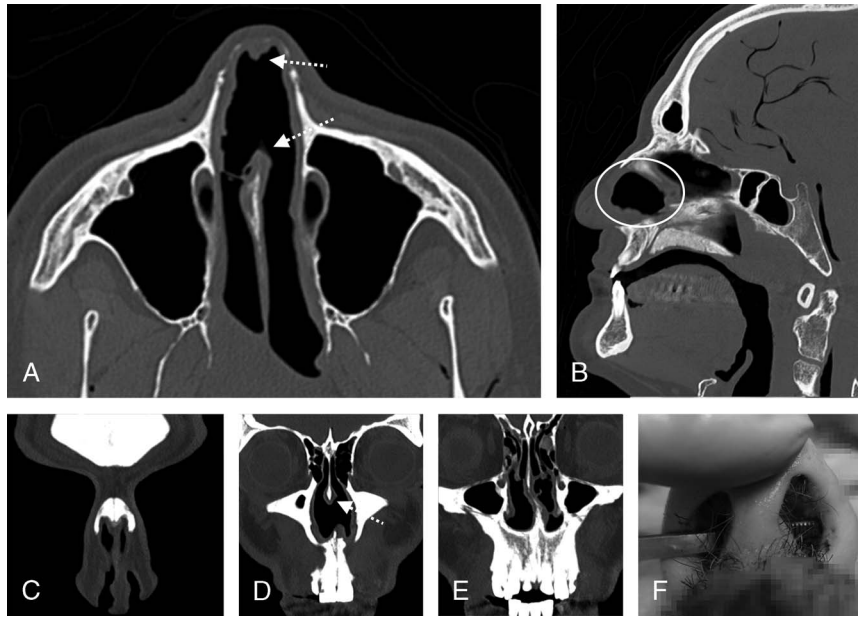

FIGURE 2. Case 3—axial (A), sagittal (B), and coronal (C–E) PMCT slices through nose and nasal septum and caption during external examination of the body before autopsy (F). Coronal slices (C–E) are ordered according to anteroposterior (backward) direction. A large nasal septum defect of maximal diameter approximately 2.9 cm with smoothly defined edges covered by mucosa (white dashed arrows) is revealed. A small tube with white powder compatible with cocaine was found in the deceased's trouser pocket during death scene investigation.

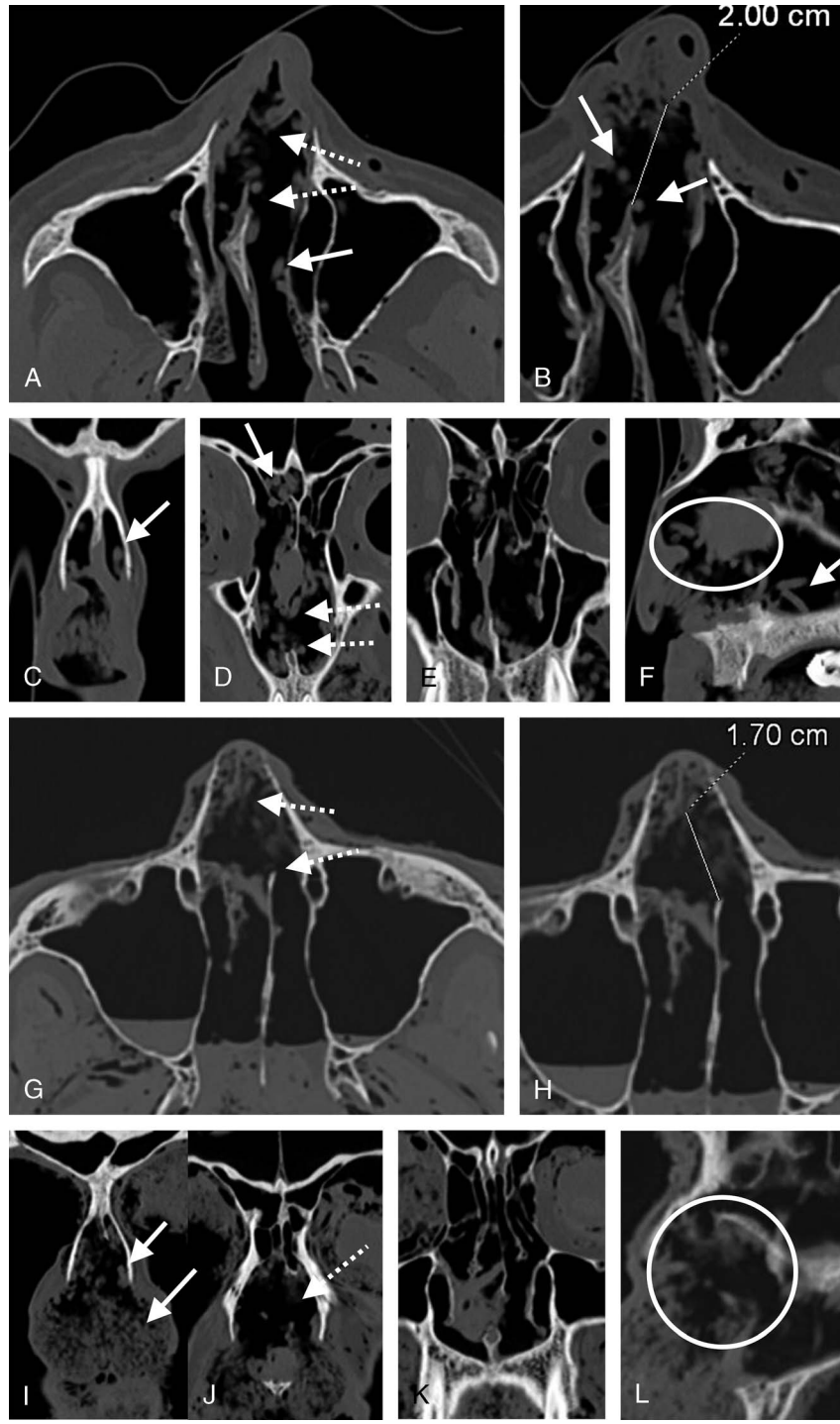

FIGURE 3. Case 4 (A–F) and case 5 (G–L)—axial (A, B, G, H), coronal (C–E, I–K), and sagittal (F, L) PMCT slices through nose and nasal septum. The extended maggots' infestation is noted (white arrows). Postmortem computed tomography revealed nasal septum defect of maximal diameter approximately 2 cm for case 4 and 1.7 cm for case 5. Note the edges of the defect are not that smoothly defined (white dashed arrows) compared with Figures 1 and 2.

on PMCT (Fig. 1, A–F). The cartilaginous edges of the defect were smoothly defined, covered by mucosa (Fig. 1, white arrows). The defect was revealed also during autopsy. Signs of decomposition were detected neither on PMCT nor during postimaging forensic autopsy. Toxicological analysis revealed quetiapine, alcohol, and methylphenidate in peripheral blood. Cause of death was acute cardiac failure caused by excited delirium syndrome.

Case 2

There was a defect of the cartilaginous part of the nasal septum with maximal diameter of approximately 1 cm on PMCT

(Fig. 1, G–L). The cartilaginous edges of the defect were smoothly defined, covered by mucosa (Fig. 1, white arrows), like in case 1. Its inspection was firstly not possible on the death scene owing to fresh blood as consequence of a firearm injury to the head, but its presence was confirmed during the postimaging forensic autopsy. Signs of decomposition were detected neither on imaging nor during autopsy. Presence of cocaine and benzodiazepines in the blood was identified in the peripheral blood. Cause of death was combination of central failure caused by traumatic brain injury due to gunshot wound, exsanguination, and gas embolism.

Case 3

A defect of the cartilaginous area of the septum with maximal diameter of approximately 2.9 cm was detected on PMCT (Fig. 2, A–E). Like in cases 1 and 2, the cartilaginous edges were smoothly defined and covered by intact mucosa (Fig. 2, white arrows). All 3 defects (cases 1, 2, and 3) appeared to be present antemortem. The external inspection of the nasal openings showed a septum defect (Fig. 2F). Signs of beginning decomposition were detected on PMCT with few to moderate gas accumulations in the internal organs.[14] No toxicological tests were conducted after autopsy had revealed a clear natural cause of death by decompensated liver cirrhosis.

Case 4

Signs of advanced decomposition, like gas accumulations, parenchymal organ changes, and maggots' infestation, were detected on PMCT. Maggots' infestation was prominent in the paranasal sinuses and the upper airways. A defect of the cartilaginous nasal septum with a diameter of approximately 2 cm and manifested maggots within and around the septal defect were revealed on PMCT (Fig. 3, A–F). Contrary to the cases 1 to 3, the defect edges were not smoothly defined, they were irregular and maggots were present. No relevant substances were detected from the toxicological blood analysis, and the autopsy findings were consistent with hanging.

Case 5

Signs of advanced decomposition and maggots' infestation were detected on PMCT. Maggots' infestation was prominent in the paranasal sinuses and the upper airways. A defect of the cartilaginous nasal septum with a diameter of approximately 1.7 cm and manifested maggots in the same region were revealed (Fig. 3, G–L). Like in case 4, the defect edges were irregular. Interestingly, on the antemortem computed tomography images (8 months before death), no nasal septum defect was visible. During visual comparison of the paranasal sinuses between antemortem and postmortem images, sinuses' morphology was the same.[15,16] Bromazepam, citalopram, quetiapine, tramadol, and zolpidem were detected in the blood, and cause of death was intoxication due to tramadol.

DISCUSSION

The PMCT as a noninvasive supplement to traditional autopsy can reveal small but relevant findings, which may go undetected during the external examination of the body or during autopsy.[17–22] A nasal septum defect may be such a finding, as clinical examination of the nose and the nasal cavities may be difficult, especially in cases of advanced decomposition with maggots' infestation or cases of severe facial trauma. The PMCT can easily and quickly reveal septal defects and allows further detailed investigation of its characteristics, like its edges' morphology and the presence of insects in the region. As shown in the presented decomposed cases, myiasis may possibly result to defects of relative similar morphology with preexisting defects.

The PMCT, however, despite revealing such lesions, does not provide definitive information about their origin. It is assumed by the authors that preexisting lesions may have smoother ("healed") edges (like in cases 1, 2, and 3) than lesions caused by decomposition. The findings of the 2 reported putrefied cases (4 and 5) may support this assumption. In addition, in cases 2 and 3, the septal defect seemed preexisting and highly suspected to be effect of cocaine abuse because cocaine was detected in the toxicological blood analysis in case 2 and white powder compatible with cocaine was found at the death scene in case 3. However, even though this seems to be the most likely assumption, other causes cannot be excluded. In case 1, no information was given about chronic drug abuse, previous trauma, or other pathology related to nasal region. In such instances, a nasal lesion would play the role of an indicator for toxicological analysis in case of lack of information.

From literature, only a few maggot species appear to consume cartilage.[23] According to authors' opinion, advanced decomposition with maggots' infestation can cause nasal septum lesions with irregular edges. However, a preexisting nasal defect can be simply widened by maggots' infestation in the postmortem period. Even though no lesion was detected in the antemortem images of case 5, the possibility that a perforation occurred in the 8-month interval before death cannot be excluded.

No assessment of nasal septum mucosa specimens for differentiation between cocaine-induced destructive lesions and lesions induced by other causes[24] was conducted. Further research on PMCT with larger samples is needed for more accurate findings' interpretation.

CONCLUSIONS

Nasal septum defects can be revealed quickly and easily by PMCT. In the forensic field, they act as an indicator of probable chronic cocaine abuse or previous trauma. In cases of advanced body decomposition with insects' infestation, a decomposition-induced septal lesion should always be in the differential diagnosis; however, preexisting defects cannot be excluded.

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