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## How I Do It

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# The Role of Surgery in the Management of Phantosmia

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David K. Morrissey, MBBS (Hons), FRACS; Upasna Pratap, MBBS (Hons), FRACS;  
Christopher Brown, MBBS (Hons), FRACS; Peter-John Wormald, MD, FRACS

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## INTRODUCTION

Phantosmia is the qualitative disorder of olfaction characterized by the perception of odor, usually unpleasant, when there are no odorants present.<sup>1</sup> It may be described as cacosmic (rotten, decayed, fecal), torquosmic (burned, metallic, chemical-like), or mixed.<sup>2</sup> Phantosmia is a relatively uncommon disorder of olfaction and represents around 10% to 20% of olfactory disorders among those complaining of olfactory dysfunction.<sup>3</sup> When present, it may lead to a significant reduction in quality of life for patients.<sup>4</sup>

Disorders of olfaction can be broadly classified as conductive and sensorineural. Conductive disorders typically involve the presence of a physical barrier, which prevents odorants from reaching olfactory mucosa such as tumors, chronic rhinosinusitis, and nasal polyps. Sensorineural olfactory disorders represent those pathologies for which there is dysfunction of the olfactory sensory receptors, olfactory neurons, or central pathways of olfaction.<sup>1</sup> Hence, phantosmia is considered a sensorineural disorder of olfaction. Phantosmia can be further classified as either peripheral or central in nature. Peripheral phantosmia is thought to be due to the dysfunction of the olfactory receptors or neurons, leading to an inability to form a complete picture of the odor and hence the erroneous interpretation of the odor centrally.<sup>5</sup> It is hypothesized that peripheral phantosmia occurs following an insult to the olfactory mucosa, leading to destruction of the olfactory mucosa innervation

and olfactory receptors. As healing occurs, there is the development of spurious or incomplete reinnervation, typically resulting in the erroneous interpretation of presented odors. The pathophysiologic changes may involve a loss of inhibitory neurons or a development of abnormally active olfactory receptors or neurons.<sup>3</sup> Central phantosmia is a condition thought to be unrelated to the olfactory neurons or receptors, and a consequence of errors made at the integrative and interpretive centers of the olfactory pathways.<sup>3,6</sup> This differentiation between peripheral and central phantosmia is a crucial clinical point because surgery on the olfactory mucosa can only successfully treat peripheral phantosmia and will have no effect on central phantosmia. In this case series, we present the diagnostic features of peripheral and central phantosmia, as well as describe the surgical technique utilized in our institution and the outcomes of the patients after such treatment. Surgical management of phantosmia has been previously described by Leopold,<sup>3</sup> and we elaborate on the author's original description of the surgical technique.

## MATERIALS AND METHODS

After approval by the institutional review board, all patients diagnosed with phantosmia who had been managed over the last 10 years were included. Each had their medical records retrospectively reviewed. The definition of phantosmia was an offensive smell occurring in a patient either spontaneously or following exposure to an innocuous odorant. The smell experienced was usually consistent; particularly offensive to the patient; and significantly affected the patient's quality of life via reduction of appetite, avoidance of social eating, and alteration of lifestyle. The phantosmia was usually experienced every day or most days of the week.

The differentiation between peripheral and central phantosmia is crucial because only peripheral phantosmia will respond to surgery. Table I lists the features that we found useful for differentiating between peripheral and central phantosmia. It is important to understand that not every patient will necessarily show all of the features of either peripheral or central phantosmia; however, the more features that the patient has of peripheral phantosmia, the more likely will be the success of the surgery. This needs to be carefully explained to the patient so that expectations are realistic. In addition, it must be emphasized to the patient that removal of the olfactory epithelium will leave that side of the nose anosmic. Most patients

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Additional supporting information may be found in the online version of this article.

From the School of Medicine, The University of Queensland (D.K.M.), Brisbane, Queensland; The Queen Elizabeth Hospital (D.K.M., P.-J.W.), Woodville, South Australia; The Royal Victorian Eye and Ear Hospital (U.P., C.B.), East Melbourne, Victoria; and the Department of Surgery–Otorhinolaryngology, Head and Neck Surgery, University of Adelaide (P.-J.W.), Adelaide, Australia.

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Send correspondence to Professor Peter-John Wormald, Department of Surgery–Otorhinolaryngology, Head and Neck Surgery, The Queen Elizabeth Hospital, 28 Woodville Rd., Woodville, SA 5011, Australia. E-mail: peterj.wormald@adelaide.edu.au

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TABLE I.  
Comparison of Peripheral Versus Central Phantosmia.

	Peripheral Phantosmia	Central Phantosmia
Offensive smell	Often wakes without smell, but any odorant stimulus will cause smell to occur.	Smell is present throughout the day and even if the patient wakes up at night.
Ability to ameliorate smell	Patient can perform a maneuver (nasal douche or crying) that ameliorates smell. Surgeon can alter smell by placing neuropatties (with local anaesthetic) in the olfactory region.	Nothing ameliorates smell No change in smell with local neuropattie placement
Localization	Patient can state that one side is worse than the other; often needs prompting. Get patient to tape one nostril closed on wakening and test to determine which side is worse.	Unable to distinguish that one side is worse than the other
Taping of nostril closed	May improve phantosmia	Has no effect on phantosmia
Application of topical cocaine to the olfactory cleft	Resolution of phantosmia and development of anosmia with topical cocaine application supports a conclusion of peripheral phantosmia.	Although failure of topical cocaine application is suggestive of a central phantosmia, it may be a consequence of inaccurate application to the olfactory cleft and thus must be interpreted with caution.

with peripheral phantosmia are very willing to accept no sense of smell rather than the disabling daily phantosmia; however, this needs to be fully discussed with the patient.

The management paradigm described was used for each patient and the results documented. Each patient in the series had a complete otorhinologic history and examination performed to ensure that there was no alternative cause for the phantosmia. Both computed tomography of the paranasal sinuses and magnetic resonance imaging (MRI) of the brain and olfactory region were performed to ensure that no other pathology was present. Once the diagnosis of phantosmia was reached, the patient was offered a trial of haloperidol for a period of 3 months. The patient was also asked to alternatively tape each nostril to determine which side was predominantly responsible for the phantosmia. If the trial of haloperidol was unsuccessful, only the patient deemed to have peripheral phantosmia was offered surgical intervention, which was on the side the patient had identified as the worse side.

Surgical intervention was undertaken under a general anaesthetic. The nose was prepared with injection of local anaes-

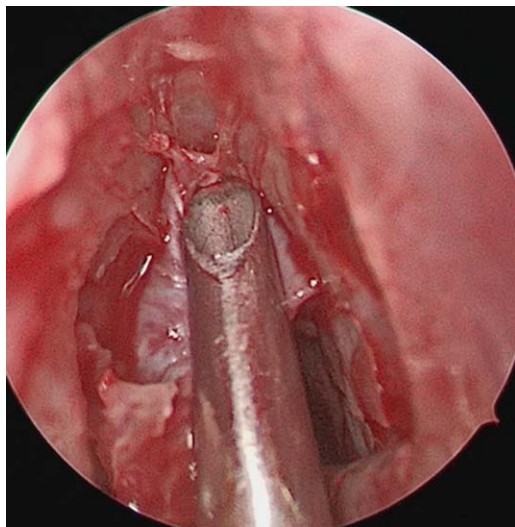


Fig. 1. Elevation of the mucosa of the olfactory cleft following inverted U-shaped incision.

thetic with adrenaline and placement of topical vasoconstrictive agents on neuropatties. An uncinectomy with middle meatal antrostomy and a complete sphenoidectomy were performed, as well as Draf IIA frontal recess clearance. The superior and middle turbinates were cut about 1 centimeter from the skull base. A septoplasty was performed with the hemitransfixion incision on the side opposite the olfactory mucosa excision. After removal of a superior strip of cartilage, a second surgeon was able to place either a suction instrument or a skull base 1-mm Blakesley forceps from the other side into the operative field via a septal window by utilizing nonopposing septal incisions. An inverted U-shaped incision was performed anterior to the olfactory fossa onto bone and continued for about 1 centimeter down the septum. This was joined to a horizontal incision along the septum, about 1 centimeter below the skull base and up to the anterior face of the sphenoid. The submucosal surgical plane was established anteriorly and the mucosa displaced inferiorly (Fig. 1). The second surgeon then reflected the olfactory mucosa, inferiorly displaying each olfactory neuron in turn. The first surgeon then used an angled skull base scissor (3-mm angled scissors) to cut each neuron in turn (Fig. 2). An angled scissor is important because the scissor needs to be placed parallel to the skull base with the cutting of each neuron. This protects the very thin bone of the olfactory fossa from damage via the scissors. Some of the neurons are quite large, and it is typical to see a small cerebrospinal fluid leak after these neurons are cut from within the neuron. This progressive mobilization of the olfactory mucosa is first continued onto the residual 1 cm of the middle turbinate, then the superior turbinate, and down to the horizontal mucosal incision on the septum—allowing the whole olfactory mucosa to be mobilized from anterior to posterior until the anterior face of the sphenoid is reached and the olfactory mucosa is removed. It is usual to see multiple small cerebrospinal fluid leaks at the cut ends of the olfactory neurons. The mucosa from the previously removed middle turbinate is dissected to serve as a free mucosal graft, which is used to cover the entire olfactory fossa. It is secured in position with fibrin glue. Either no support or a light pack can be placed. The patient started nasal saline douches the next day and was on systemic antibiotics for 10 days postsurgery. The patient was then seen in the clinic at 2 and 6 weeks following surgery. A video of the procedural steps accompanies this article (Supp. Video, online only).

To date, we have managed five patients with phantosmia, three of whom have required surgical intervention.

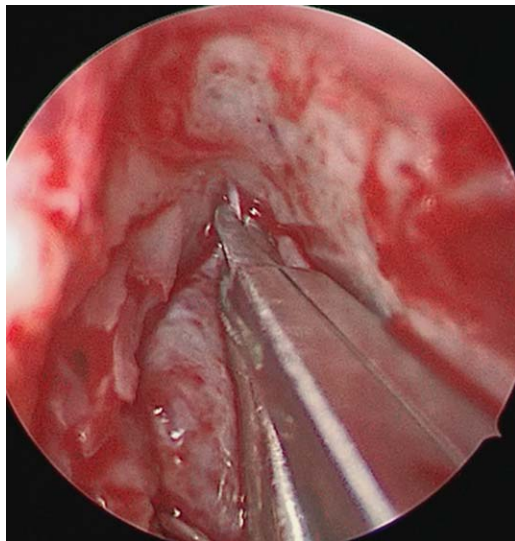


Fig. 2. Identification and division of the first olfactory neuron. Note the use of angled scissors to reduce the risk of injury to the skull base.

## RESULTS

The five patients managed by our institution for phantosmia are represented in Table II. The effect of the phantosmia on the quality of life for all of our patients was typically significant. Some patients felt that their quality of life had deteriorated to such a degree that in two instances within our cohort patients had experienced suicidal thoughts. We managed two patients with

likely central phantosmia with haloperidol. The other three patients were thought to have peripheral phantosmia and elected to undergo the described surgical intervention; each experienced complete resolution of their symptoms. No patient experienced any complication, aside from the expected unilateral anosmia in the surgically managed patients. In particular, there were no cerebrospinal fluid leaks. The patients who were managed surgically have been followed for in excess of 5 years in two cases, and for 18 months in our most recent case.

## DISCUSSION

In this case series, the diagnostic criteria for distinguishing peripheral from central phantosmia are presented, as well as the surgical steps for removing the olfactory epithelium and the outcomes achieved with this management protocol. Phantosmia is an extremely distressing but fortunately a rare condition. The etiology of phantosmia remains unknown. Peripheral phantosmia is thought to be due to an initial insult to the olfactory receptors or neurons—possibly viral because it often occurs after an upper respiratory tract infection. There is subsequently thought to be aberrant regeneration of the synapsis, leading to phantosmia secondary to any odor. Central phantosmia may result from excessive abnormal activity or lack of inhibition at any of the sites of neurotransmission within the olfactory system.<sup>3,7</sup> In patients with peripheral phantosmia, the improvement or resolution of symptoms following removal of the olfactory epithelium and division of the olfactory neurons

TABLE II.  
Clinical Presentation of Phantoms Patients.

Sex and Age	Clinical Presentation	Phantosmia Classification	Outcome
Male 40 years	Unilateral phantosmia Present throughout day Normal CT scan Severe impact on quality of life with suicidal ideation. Improved with taping nostril. Symptoms present > 12 months	Peripheral	Surgical excision olfactory mucosa with complete resolution
Male 58 years	Initial bilateral anosmia with subsequent bilateral phantosmia following upper respiratory tract infection Normal CT and MRI Instigated by other odors. Wakes with phantosmia. Symptoms present < 6 months	Central	Successful trial with haloperidol
Female 22 years	Unilateral phantosmia precipitated by odor noticed soon after waking and present throughout day Improved with saline douches Normal CT and MRI scans Impact on ability to work in food industry and significant weight loss as consequence of phantosmia. Symptoms present > 24 months	Peripheral	Surgical excision olfactory mucosa with complete resolution
Male 23 years	Unilateral phantosmia precipitated by odor noticed soon after waking and present throughout day Improvement with saline douches. Normal CT and MRI Patient became socially reclusive due to phantosmia and social impact. Symptoms present > 24 months	Peripheral	Surgical excision olfactory mucosa with complete resolution
Male 53 years	Bilateral anosmia following upper respiratory tract infection. Bilateral phantosmia thereafter. Symptoms present < 6 months	Central	Resolved with haloperidol

CT = computed tomography; MRI = magnetic resonance imaging.

supports the hypothesis of an abnormality in the local olfactory epithelium. One would not expect an improvement if the mechanism was purely central.

Central phantosmia has been associated with other central nervous system disorders such as migraine and epilepsy, whereas olfactory hallucinations are also associated with psychiatric disorders such as schizophrenia and depression.<sup>2</sup> Some authors report neurological changes on functional MRI in patients reporting phantosmia, which in the future may go some way to identifying the causation of phantosmia. Positron emission tomography has also demonstrated increased activity, particularly in the frontal and temporal regions.<sup>8,9</sup>

Peripheral phantosmia is typically unilateral, and tends to have a spontaneous onset and an episodic nature with its intensity waxing and waning. It is usually more severe on the side, with less olfactory function if bilateral in nature.<sup>8</sup> The phantosmia sensation generally cannot be masked by other odors. In some patients, it may occur in the absence of nasal airflow; other patients report elimination of the phantosmia with occlusion of nasal airflow on the affected side. Patients may report that their phantosmia can be initiated by actions such as a sniff or sneeze. The variability of the patient experience of peripheral phantosmia further adds to the complexity of the conditions diagnosis and management.

Peripheral and central phantosmia can have a significant impact on the wellbeing of those with the disorder. Patients often report a reduction in their quality of life, and many will have objective disorders of olfaction coexisting with the phantosmia. This can lead to disturbance of flavors; weight loss; mood disturbance<sup>4</sup>; and in our experience, suicidal thoughts.

Various treatment modalities, both medical and surgical, have been suggested in the management of phantosmia. Medications including antipsychotics, antidepressants, and anticonvulsants have all been used for the management of central phantosmia, some with positive results.<sup>10</sup> For peripheral phantosmia, cocaine has been shown to cause a temporary loss of olfaction when applied to the olfactory mucosa, as has the application of other forms of

local anaesthetic.<sup>9</sup> Surgical excision of the olfactory epithelium, with significant success in relieving the phantosmia, has previously been described by Leopold.<sup>3</sup> Other surgical procedures, such as removal of the olfactory bulb, have also been described.<sup>11</sup> While acknowledging the outcomes in this paper are limited by the small number of patients as well as the retrospective nature of the study, we present our protocol for distinguishing between peripheral and central phantosmia and the surgical steps for managing a patient diagnosed with peripheral phantosmia.

## CONCLUSION

In summary, we provide a management algorithm with the results of five patients for the assessment and treatment of phantosmia. Although the results are promising, more research into phantosmia is required to optimize treatment.

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