

Patent nasopalatine ducts: Evidence to support persistence of the vomeronasal system?

Maire-Caitlin Casey, David J.A. Orr

Department of Plastic & Reconstructive Surgery, St. James Hospital, Dublin 8, Ireland

SUMMARY

The vomeronasal system is comprised of the nasopalatine duct and the vomeronasal organ. While this system functions in chemodetection in mammals, its presence and function in adult humans remains to be clearly elucidated. Here, a case of asymptomatic, bilateral, patent nasopalatine ducts is presented. We postulate that the presence of these patent structures represents persistence of the embryological nasopalatine duct component of the vomeronasal organ into adult life.

Key words: Persistent nasopalatine duct – Incisive foramen – Vomeronasal organ – Vomeronasal system

Abbreviations:

Nasopalatine duct, NPD
Vomeronasal organ, VNO
Vomeronasal system, VNS

INTRODUCTION

A variety of congenital oronasal fistulae and associated cysts in the region of the incisive foramen have been described in adult humans (Rodrigues et al., 2009; Werder et al., 2016). The origin of these fistulae is controversial: some may be secondary to breakdown of primary dentigerous cysts associated with the roots of the central incisors, but it has been proposed that some may be persistent nasopalatine ducts associated with a vestigial vomeronasal or Jacobson's organ (Chapple and

Ord, 1990; Jacob et al., 2000; Von Arx et al., 2017).

Here we describe a case of bilateral, symmetrical oronasal fistulae in the region of the incisive canal that were not associated with any cyst or other dental pathology and that we consider likely to be due to persisting nasopalatine ducts associated with a vestigial vomeronasal complex.

CASE REPORT

A 17-year-old girl with no significant past medical history, presented to clinic complaining of being able to 'suck air' through her anterior palate in the region of the incisive foramen. Her symptoms had appeared only in the previous six months while she was undergoing routine orthodontic treatment with braces. There was no associated pain, dental sensitivity, nasal regurgitation of food or interference with speech. There was no previous history of any swelling, cyst or discharge in the area. The symptom caused no distress, but the patient was anxious for an explanation of this unusual phenomenon. Clinical examination showed no obvious abnormality other than a slightly prominent papilla in the region of the incisive foramen. Gentle, atraumatic probing allowed the passage of fine gutta-percha probes from the oral cavity into the nose via patent bilateral paramedian nasopalatine or incisive canals (Fig. 1). Dental radiographs showed no evidence of any bony cyst or other dento-alveolar abnormality and a diagnosis of bilateral persistent nasopalatine duct was made (Fig. 2). At a follow up appointment, nine months later, there was no change in symptoms and no change in the radiographic findings. No specific treatment was recommended but the patient was advised to return if she experienced any new discomfort or change in symptoms.

Corresponding author: Mr David Orr. St James Hospital,

Dublin 8, Ireland.

E-mail: dorr@tcd.ie

Submitted: 18 February, 2018. Accepted: 28 May, 2018.

DISCUSSION

The vomeronasal organ (VNO) was discovered in mammals by Ludvig Jacobson in the early 1800s and has since been shown to be present in most tetrapods, although it is vestigial or has been secondarily lost in many groups (Jacobson et al., 1998). The organ is comprised of paired tubular structures on the anteroinferior aspect of the nasal septum near the vomer bone. The medial aspect of each tubular structure is lined by sensory epithelium with detector neurons, while the lateral side is comprised of richly vascularized tissue that actively pumps substrate into the vomeronasal lumen (Trotier, 2011). It constitutes an accessory olfactory system with chemoreceptors that are distinct from those associated with the main olfactory system and whose sensory neurons project to the accessory olfactory bulbs, which lie posterior to the main olfactory bulbs (Mohedano-Moriano et al., 2008). In mammals, this accessory olfactory system appears to be mainly associated with the detection of pheromones rather than environmental odorants (Trotier, 2011). It is not clear why some species retain the VNO while others lose it during evolution, but it has been hypothesized that it may be due to a “sensory trade-off” of neuronal resources (Trotier, 2011).

The status of the vomeronasal organ in humans has been controversial (Trotier et al., 2000; Radlanski et al., 2004; Falci et al., 2013; Kim et al., 2017). Embryological studies clearly demonstrate the presence of a vomeronasal complex in human fetuses (Radlanski et al., 2004; Falci et al., 2013). Most authors agree that if any part of the vomeronasal complex persists in adult humans it represents a vestigial structure with no physiological function (Smith et al., 1997; Garrosa et al., 1998; Martinez-Marcos, 2001; Halpern and Martinez-Marcos, 2003). However, the intriguing studies of Stern and McClintock (1998) indicate the possibility that there is a functional vomeronasal olfactory system in humans that functions to detect pheromones.

Cystic lesions in the region of the incisive canal

are well-described and have been attributed to proliferation of epithelial remnants of the fetal nasopalatine duct, although this is controversial (Hedge and Shetty, 2006; Escoda Francolí et al., 2008). Surgical excision of these cysts is usually advised (Escoda Francolí et al., 2008; Nelson and Linfesty, 2010). The isolated bilateral oronasal fistulae, not associated with any kind of cyst, which were present in our patient, are much less frequently described (Rodrigues et al., 2009; Von Arx et al., 2017). We postulate that these are congenital structures that only became obvious during orthodontic treatment, perhaps due to tooth movement or perhaps due to sensory attention having been focused on this area by the presence of dental appliances. The fact that these structures were bilateral, symmetrical and not associated with any kind of dental cyst or tooth pathology suggests that they represent persistence of the embryological nasopalatine duct component of the vomeronasal organ into adult life. The incidence of persistent nasopalatine duct in the general population is unknown but, given the almost complete lack of symptoms prior to orthodontic treatment, it is possible that many cases go unnoticed.

REFERENCES

- CHAPPLE IL, ORD RA (1990) Patent nasopalatine ducts: four case presentations and review of the literature. *Oral Surg Oral Med Oral Pathol*, 69(5): 554-558.
- ESCODA FRANCOLÍ J1, ALMENDROS MARQUÉS N, BERINI AYTÉS L, GAY ESCODA C (2008) Nasopalatine duct cyst: report of 22 cases and review of the literature. *Med Oral Patol Oral Cir Bucal*, 13(7): E438-443.
- FALCI SG, VERLI FD, CONSOLARO A, SANTOS CR (2013) Morphological characterization of the nasopalatine region in human fetuses and its association to pathologies. *J Appl Oral Sci*, 21(3): 250-255.
- GARROSA M, GAYOSO MJ, ESTEBAN FJ (1998) Prenatal development of the mammalian vomeronasal organ. *Microsc Res Tech*, 41(6): 456-470.
- HALPERN M, MARTINEZ-MARCOS A (2003) Structure and function of the vomeronasal system: an update. *Prog Neurobiol*, 70(3): 245-318.



Fig 1. Gutta-percha probes in each patent NPD, passing from the oral cavity toward the nasal floor.



Fig 2. Radiographic images of a probe in each NPD passing towards the nasal floor.

- HEGDE RJ, SHETTY R (2006) Nasopalatine duct cyst. *J Indian Soc Pedod Prev Dent*, 24: 31-32.
- JACOB S, ZELANO B, GUNGOR A, ABBOTT D, NACLERIO R, MCCLINTOCK MK (2000) Location and gross morphology of the nasopalatine duct in human adults. *Arch Otolaryngol Head Neck Surg*, 126(6): 741-748.
- JACOBSON L, TROTIER D, DOVING KB (1998) Anatomical description of a new organ in the nose of domesticated animals by Ludvig Jacobson (1813). *Chem Senses*, 23(6): 743-754.
- KIM JH, OKA K, JIN ZW, MURAKAMI G, RODRÍGUEZ-VÁZQUEZ JF, AHN SW, HWANG HP (2017) Fetal development of the incisive canal, especially of the delayed closure due to the nasopalatine duct: a study using serial sections of human fetuses. *Anat Rec (Hoboken)*, 300(6): 1093-1103.
- MARTÍNEZ-MARCOS A (2001) Controversies on the human vomeronasal system. *Eur J Anat*, 5(1): 47-53.
- MOHEDANO-MORIANO A, PRO-SISTIAGA P, UBEDA-BAÑÓN I, DE LA ROSA-PRIETO C, SAIZ-SANCHEZ D, MARTINEZ-MARCOS A (2008) V1R and V2R segregated vomeronasal pathways to the hypothalamus. *Neuroreport*, 19: 1623-1626.
- NELSON BL, LINFESTY RL (2010) Nasopalatine duct cyst. *Head Neck Pathol*, 4(2): 121-122.
- RADLANSKI RJ, EMMERICH S, RENZ H (2004) Prenatal morphogenesis of the human incisive canal. *Anat Embryol (Berl)*, 208(4): 265-271.
- RODRIGUES MT, MUNHOZ EA, CARDOSO CL, JUNIOR OF, DAMANTE JH (2009) Unilateral patent nasopalatine duct: a case report and review of the literature. *Am J Otolaryngol*, 30(2): 137-140.
- SMITH TD, SIEGEL MI, MOONEY MP, BURDI AR, BURROWS AM, TODHUNTER JS (1997) Prenatal growth of the human vomeronasal organ. *Anat Rec*, 248(3): 447-455.
- STERN K, MCCLINTOCK MK (1998) Regulation of ovulation by human pheromones. *Nature*, 392(6672): 177-179.
- TROTIER D (2011) Vomeronasal organ and human pheromones. *Eur Ann Otorhinolaryngol Head Neck Dis*, 128(4): 184-190.
- TROTIER D, ELOIT C, WASSEF M, TALMAIN G, BENSIMON JL, DØVING KB, FERRAND J (2000) The vomeronasal cavity in adult humans. *Chem Senses*, 25(4): 369-380.
- VON ARX T, SCHAFFNER M, BORNSTEIN MM (2017) Patent nasopalatine ducts: an update of the literature and a series of new cases. *Surg Radiol Anat*, <https://doi.org/10.1007/s00276-017-1926-8>
- WERDER P, BASSETTI R, KUTTENBERGER J (2016) Surgical treatment option of the patent nasopalatine duct: a case report. *J Surg Case Rep*, 2016(5): pii: rjw090.