

# A case of Concha Bullosa and potentially related evidences. Concha bullosa discovered in the bones of a medieval skeleton from Brentonico, northeast Italy: a case report

Enrica Tonina<sup>1</sup>, Marta Licata<sup>2</sup>, Caterina Pangrazzi<sup>1</sup>, Ugo Maspero<sup>3</sup>, Luca Romano<sup>3</sup>, Omar Larentis<sup>2</sup>

<sup>1</sup>University of Trento, Department of Humanities, B. Bagolini Laboratory; <sup>2</sup>University of Insubria, Department of Biotechnology and Life Sciences, Center of Research in Osteoarchaeology and Paleopathology; <sup>3</sup> Fondazione Gaetano e Piera Borghi, Brebbia, Varese

**Abstract.** The pneumatization of the middle turbinate, called Concha Bullosa, is one of the most frequent variations of the ostiomeatal complex. Although in literature there is no clarity regarding the role of Concha Bullosa related to the onset or complication of other paranasal area disorders, it is not rare to find the latter in co-occurrence with Concha. The study we present, which was carried out on an archaeological sample, shows the simultaneous presence of Concha Bullosa and pneumocele and their possible correlations. Finally, this contribution acquired importance from the moment in which it was presented as a direct attestation of the evidence discovered in the ancient world.

**Key words:** Concha Bullosa, middle turbinate, anthropology, paleopathology, pneumocele

## Introduction

Middle turbinate are anatomically identified as offshoots of the ethmoid bone occupying the nasal cavity of both sides of the nasal septum. They consist of an upper laminar and a lower bulbous segment covered by hypervascularized spongy tissue and mucous membranes that are rich in glands and cilia, they have the function of purification, humidification and heating inspired air. The middle turbinate may be subject to a hypertrophy of the bone structure attributed to its pneumatization, a condition commonly known as Concha Bullosa (CB).

Its etiology is not to be connected to a pathological condition, whereas, on the basis of studies on twins, it is possible to involve a genetic-component (1).

It is one of the most frequent anatomical variations of the ostium-meatale complex, with an incidence between 14% and 53% in the contemporary

population (2) and it is variable in populations depending on the different regions of the world and the different climatic conditions influencing the affected subjects (3).

A classification of CB types was proposed based on the location of pneumatization (4). Three variants have been identified: the first involves the upper portion of the middle turbinate (Lamellar CB), the second involves the lower portion (Bulbous CB) and the third a combination of the two parts (Extensive CB).

In the paleopathological field, CB and its implications on ancient populations has not been considered effectively. Exceptions are Mays' contributions to the English cases of Castle Mound cemetery in Huntingdon (3) and Warram Percy (5). On one hand the anatomical variations of the nasal district, including CB, may predispose individuals to sinusitis (6), in fact many studies in literature suggest that CB plays an important role in the aetiology of inflammation of

the paranasal sinuses (7, 8). In the other hand the correlation of CB with sinusitis is very discussed, moreover abnormally expanded, aerated frontal sinus, attested in the subject, may not be linked with sinusitis or other nasal diseases (9).

The case reported here is of particular relevance as it represents further evidence of the presence of this conditions in ancient times, usually attested with difficulty due to the poor conservation of the archaeological record of the bones of the nasal district (10).

### Materials and methods

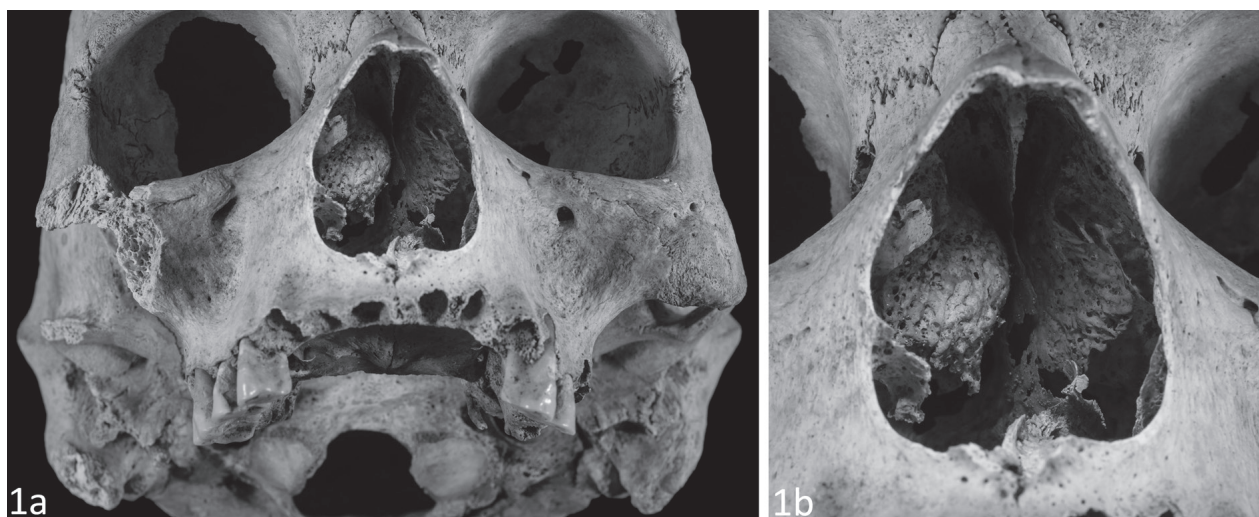
The analyzed osteological material comes from the rural archaeological context of the 16<sup>th</sup> century church of Saints Peter and Paul of Brentonico, Trento (northeast Italy).

Below the area inside the church and the bell tower, following the archaeological investigations carried out between 2003 and 2004, several architectural phases were highlighted, the first of the 8<sup>th</sup>-11<sup>th</sup> centuries. The bones are chronologically placed on a stratigraphic basis between the 8<sup>th</sup> and 13<sup>th</sup> centuries; the tomb was identified as a secondary deposition, containing the fragmented remains of a minimum of 4 sub-adults and 18 adults. The skull under our examination is in an excellent state of preservation.

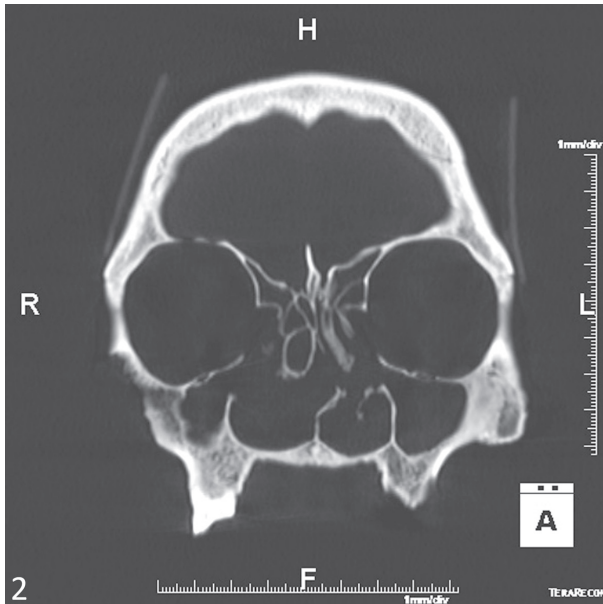
Skeletal sex was determined by morphological analysis and evaluation of the degree of nuchal ridge dimorphism, mastoid process, supraorbital margin, glabella and frontal inclination (11). Age was estimated by analysis of the degree of synostosis of the cranial sutures (12). Due to the significant loss of dental elements, it was not possible to evaluate the degree of dental wear. The investigation of the nasal cavity, carried out also through macroscopic and endoscopic evaluation, allowed us to detect variation and to make a first diagnosis on a morphological basis thanks to the existence of stringent comparisons with other cases of CB present in literature (3,14) (Fig. 1a; Fig. 1b). To obtain the hypotheses originating from the macroscopic analysis and the possible involvement of a paranasal sinus disease like sinusitis, we used TAC investigations (Hitachi Eclon 16, 90-120 Kv, 100-400 mA. TeraRecon, software for image processing) and comparisons with specialistic literature.

### Results

The skull belongs to a male subject of about 35 years. The nasal cavity presents hypertrophy of the middle right turbinate of the second type, which has a maximum anterior-posterior measurement of about 16 mm, distal-sagittal about 22 mm and medium-



**Figure 1.** a) Frontal view of the skull; b) In detail, morphology of the CB.



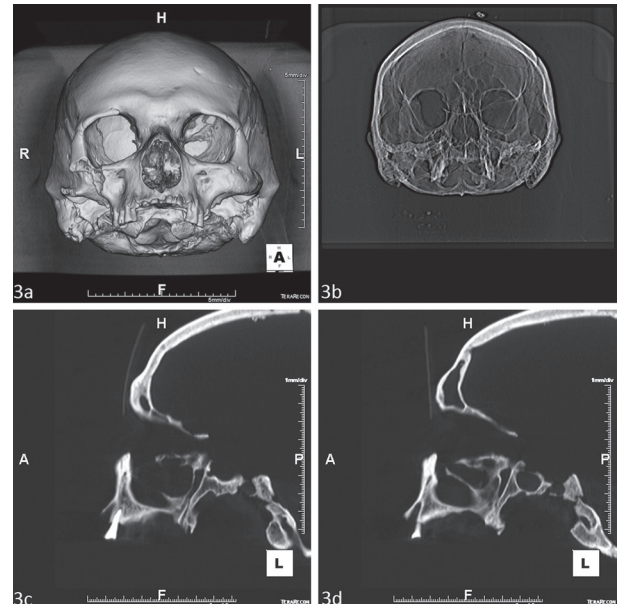
**Figure 2.** On the coronal CT image, the evidences of the CB.

lateral of about 15 mm (Fig. 2). The cortical surface of the right middle turbinate has a spinous form of bone formation associated with a slight cribrosity (Fig. 1b). TAC analysis of the skull (Fig. 3a) allowed us to observe a large, aerated left sinus (Fig. 3b) with an abnormal anterior and posterior sinus tables (Fig. 3c; Fig. 3d). The absence of frontal bossing, intracranial extension, ethmoids or orbital encroachment with a generalized thinning of the bony sinus walls enable us to identify an example of pneumocele (9) that may be associated with sinusitis (15, 16).

The presence of anatomic variations of the middle turbinate can be related to contralateral septal deviation, this can also be connected the contralateral expansion of the frontal sinus.

### Differential diagnosis

Morphological evaluation of CB is insufficient, since it is possible that the area of the nasal septum is affected by less frequent conditions that also cause hypertrophy and that may present a visual similarity. Pathologies such as fibrous dysplasia (17), benign neoplasms, hemangiomas (18) and ossifying fibromas (19)



**Figure 3.** a) Frontal view CT skull reconstruction; b) Frontal projection CT of skull, aerated and large left sinus; c) On the median CT image, the right sinus and its tables; d) On the median CT image, the left sinus and its tables.

can be distinguished from CB due to the presence of internal structures. In our case, TC analysis revealed how the internal space of bone growth is empty, a condition that allows us to discard these pathologies from the diagnosis.

CB is an asymptomatic condition, however the developing complications of this can affect quality of life. As stated by Mays *et al.* this condition may increase the risk of infections of the paranasal sinuses and chronic sinusitis (5). The subjects in which CB caused airway obstruction areas and contact between the mucous membranes that line the turbinates (3, 20) and those presenting the type of CB that involves the bulbous portion of the bone structure (4) are considered to be more susceptible to these problems. The incidences of CB and the appearance of this pathology have been studied several times, but a direct link with anatomic variation has not always been noticed, as in the case of Stallmann *et al.* (2).

There appears to be a strong correlation between the presence of unilateral CB and the contralateral deviation of the nasal septum (2). Furthermore, in addition to those previously listed, CB can be considered a

basis for the development of particular conditions, it is in fact present in the literature and archaeological case of Mucocyste, and without any doubt it is caused by the presence of the turbinate pneumatization (21). This condition is macroscopically framed by lesions affecting the walls of the maxillary sinuses, often connected with the destruction of the orbital roof. In our case, the lack of macroscopic elements of the bone can be correlated with the presence of the mucocyste which makes it possible to discard these complications of the pathological picture of the subject. The expanded frontal sinus is not thoroughly understood in the literature, in fact this evidence is defined in many terms that include: pneumosinus frontalis, sinus hypertrophy, arocele, pneumocyste, hyperpneumatization, blistering and sinus ectasia (9).

The etiology is still not clear, and several causes have been proposed; spontaneous drainage of mucocyste, presence of gas-producing microorganism, post-traumatic involvement, benign and malignant neoplasia, hormonal abnormalities and congenital factors (14). In this instance it is possible to define a case of pneumocyste, according to Urken *et al.* (9), the clinical presentation of this evidence is sinus-dependent and varied and it may include headache, nasal obstruction, decreased visual acuity and sinusitis.

## Conclusions

This contribution is important for both osteoarchaeological and modern clinical literature because the coexistence of CB and pneumocyste is rarely attested. Moreover, this article allows us to highlight the possible presence of CB and pneumocyste in an ancient sample, thus attesting its antiquity (14).

Although these two pieces of evidence are not necessarily linked to each other and their implications at the pathological level are not yet completely clear, it is possible to suppose that their simultaneous presence has exponentially decreased the quality of life of the subject.

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## References

1. Chaiyasate S, Baron J, Clement P. Analysis of paranasal sinus development and anatomical variations: a CT genetic study in twins. *Clin Otolaryngol* 2007; 32(2): 93-7.
2. Stallman JS, Lobo JN, Som PM. The incidence of concha bullosa and its relationship to nasal septal deviation and paranasal sinus disease. *Am J Neuroradiol* 2004; 25: 1613-8.
3. Mays SA, Mavrogordato M, Lambert J, Sofaer J. The prevalence and health implications of concha bullosa in a population from mediaeval England. *Int J Osteoarchaeol* 2014; 24(5): 614-22.
4. Bolger WE, Butzin CA, Parson DS. Paranasal sinus anatomic variations and mucosal abnormalities: CT analysis for endoscopic sinus surgery. *Laryngoscope* 1991; 101(1): 56-64.
5. Mays S, Vincent S, Snow M, Robson-Brown K. Concha bullosa, a neglected condition in palaeopathology. *Int J Paleopathol* 2011; 1: 184-7.
6. Subramanian S, Rampal GRL, Wong EFM, Mastura S, Razi A. Concha Bullosa in Chronic Sinusitis. *MJM* 2005; 60(5): 535-9.
7. Clark ST, Babin RW, Salazaar J. The incidence of concha bullosa and its relationship to chronic sinonasal disease. *Am J Rhinol* 1989; 3: 1-11.
8. Lloyd GAS. CT of the Paranasal sinuses: Study of a control series in relation to endoscopic sinus surgery. *J Laryngol Otol* 1990; 104: 477-81.
9. Urken ML, Som PM, Edelstein D, Weber AL, Biller HF. Abnormally large frontal sinus. II. Nomenclature, pathology, and symptoms. *Laryngoscope* 1997; 97: 606-11.
10. Licata M, Borgo M, Armocida G, Nicosia L, Ferioli E. New paleoradiological investigations of ancient human remains from North West Lombardy archaeological excavations. *Skeletal Radiol* 2016; 45(3): 323-31.
11. Acsádi G, Nemeskéri J. History of human life span and mortality. Budapest: Akademiai Kiado; 1970.
12. Meindl RS, Lovejoy CO. Ectocranial suture closure: a revised method for the determination of skeletal age at death based on the lateral-anterior suture. *Am J Phys Anthropol* 1985; 68(1): 57-66.
13. Brothwell DR. *Digging up Bones*. New York: Cornell University Press; 1981.
14. Cattaneo C. Analisi antropologica e patologica delle ossa umane di Campione d'Italia. *Rivista Archeologica dell'Antica Provincia e Diocesi di Como* 1995; 177: 269-78.
15. Koifmann ACB, Oliveira Ferraz L, Blanco BT, Bustamante Prota Filho LE. Frontal sinus pneumocyste: case report and literature review. *Radiol Brasil* 2013; 46(4): 259-60.
16. Kiroglu Y, Karabulut N, Sabir NA, Yagci B. Pneumosinus dilatans and multiplex: report of three rare cases and review of the literature. *DMFR* 2007; 36: 298-303.

17. Saetti R, Silvestrini M, Marino F, Narne S. Fibrous dysplasia of middle turbinate associated with Widal syndrome: endoscopic treatment of a rare case. *Acta Otorhinolaryngol Ital* 2004;24: 288-91.
18. Akiner MN, Demirtas M, Atmis EO. Intraosseous cavernous hemangioma of inferior turbinate: a rare case report. *Case Rep Otolaryngol* 2011; 2011: 431365.
19. Galvan O, Gassner EM, Neher A, Gunkel AR. Fibroosseous lesion of the middle turbinate: ossifying fibroma or fibrous dysplasia. *J Laryngol Otol* 2007; 121(12): 1201-3.
20. Calhoun KH, Waggenspack GA, Simpson CB, Hokanson JA, Bailey BJ. CT evaluation of the paranasal sinuses in symptomatic and asymptomatic patients. *Otolaryngology and Head and Neck Surgery* 1991; 104(4): 480-3.
21. Kwiatkowska B, Gawlikowska-Sroka A, Szczurowski J, Czerwiński F. A case of concha bullosa mucopyocele in a medieval human skull. *Int J Osteoarchaeol* 2011; 21: 367-70.

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Correspondence:

Marta Licata

Department of Biotechnology and Life Sciences,

Center of Research in Osteoarchaeology and Paleopathology

O.Rossi, 9 Pad. Antonini, 21100 Varese

E-mail: marta.licata@uninsubria.it