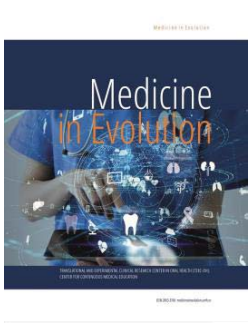
A Cone-Beam Computed Tomography Study of the Greater Palatine Foramen



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Abstract

The greater palatine foramen (GPF) is located in the postero-lateral angle of the hard palate. We aimed at studying these topographical patterns of the GPF. A random retrospective Cone Beam Computed Tomography study was performed on 104 archived case files. There was recorded on each side the topographical type of the GPF. Edentulous sites were noted "E". Bilateral symmetry of the GPF was determined as "right-left" combinations of types. In 41 cases were found bilateral 4E types corresponding to the GPF located medially to the edentulous site of the third upper molar. In 19 cases was recorded the bilateral combination „4+4": the GPF was at the level of the third upper molars. Most existing studies did not document the bilateral combinations of GPF types. We demonstrate that if on one side the GPF has a certain topographical pattern it is not mandatory for the opposite one to have the same tooth-related topography.

Keywords: CBCT; hard palate; maxillary molar; maxilla

INTRODUCTION

The hard palate is built-up by the palatine processes of the maxillae and the horizontal plates of the palatine bones. On each side, the vault of the hard palate is completed by the alveolar processes of the maxillae. A major landmark of the hard palate in dentistry is the greater palatine foramen (GPF) which is located between the horizontal plate of the palatine bone and the body of maxilla.

A certain asymmetry of the GPF was found be Matsuda in 1927 (Matsuda, 1927). Although different studies evaluated by different methods the location of the GPF (Ajmani, 1994, Bahsi et al., 2019, Chrcanovic and Custodio, 2010, Fonseka et al., 2019, Ikuta et al., 2013, Langenegger et al., 1983, Methathrathip et al., 2005, Saralaya and Nayak, 2007, Tomaszewska et al., 2014, Wang et al., 1988, Westmoreland and Blanton, 1982, Von Arx and Lozanoff, 2016), few of these paid attention to the bilateral asymmetry of the foramen. It was therefore decided a Cone-Beam Computed Tomography (CBCT) study of the location and symmetry of the GPF.

Aim and objectives

The aim of this study is to identify the location and symmetry of the greater palatine foramen (GPF) in Cone Beam Computed Tomography.

MATERIALS AND METHODS

The archived cone-beam computed tomography (CBCT) files of 104 patients (43 male, 61 female) were retrospectively and randomly studied. The patients had been scanned for dental medical purposes using an iCat CBCT machine (Imaging Sciences International, Hatfield, PA, USA) (resolution of 0.250, FOV 130o, image matrix size of 640 × 640). The CBCT data were exported as DICOM files further was analysed with the Planmeca Romexis Viewer 3.5.0.R software, as in other studies (Carstocea et al., 2019, Rusu et al., 2020). The patients had provided written informed consent for all their medical data (including CBCT scans) to be used for research and teaching purposes, provided that the anonymity and confidentiality were maintained.

The tooth-related topographical types of the GPF were noted. It was recorded „E" if the respective anatomical site was edentulous. There were defined the following types/variables: (a) type „1", when the GPF was located medially to the interproximal septum between the first two upper molars; (b) type „2", the GPF located medially to the 2nd upper molar; (c) type „3", for the GPF located at the level of the interproximal septum between the 2nd and the 3rd upper molars; (d) type „4" for the GPF at the level of the 3rd upper molar; (e) type „5" for the GPF located distally to the 3rd upper molar. Bilateral evidence was recorded on a „right+left" types pattern.

RESULTS

From the 104 cases (N) that were documented, 63 cases (60.5%) had terminal (distal) edentulous maxillae, thus the position of the GPF was unrelated to a molar tooth or an interproximal septum. These terminal edentations were unilateral in 11.5% of cases and bilateral in 49% of cases. In male subjects (n1=43) there were found 4 (9,3%) unilateral such edentations and 18 (41.8%) bilateral ones. In females (n2=61) the prevalence of such distal edentulous maxillae were, respectively, 13.1% and 54% (fig.1).

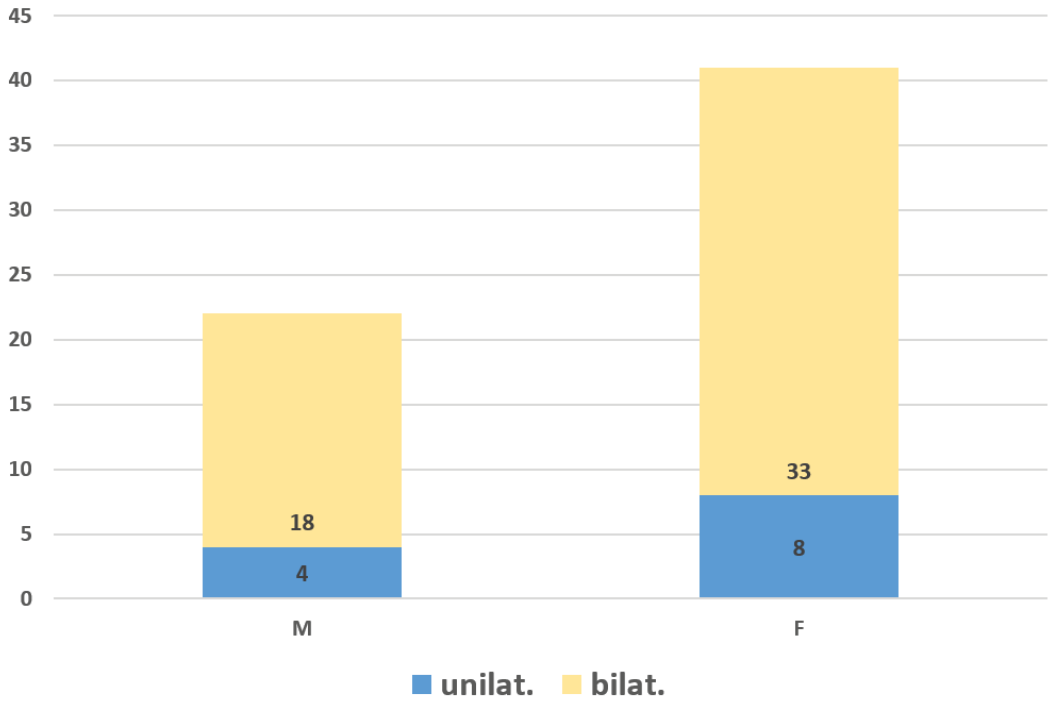

Figure 1. Unilateral and bilateral records of distal edentulous maxillae in males (M, n1=43) and females (F, n2=61)

In the general lot as well as for each gender was determined the topography of the GPF related to the upper teeth. The results of the bilateral evidence are presented in table 1 and fig. 2. There was no evidence on the presence of the GPF at the level of the interproximal septum between the first two upper molars.

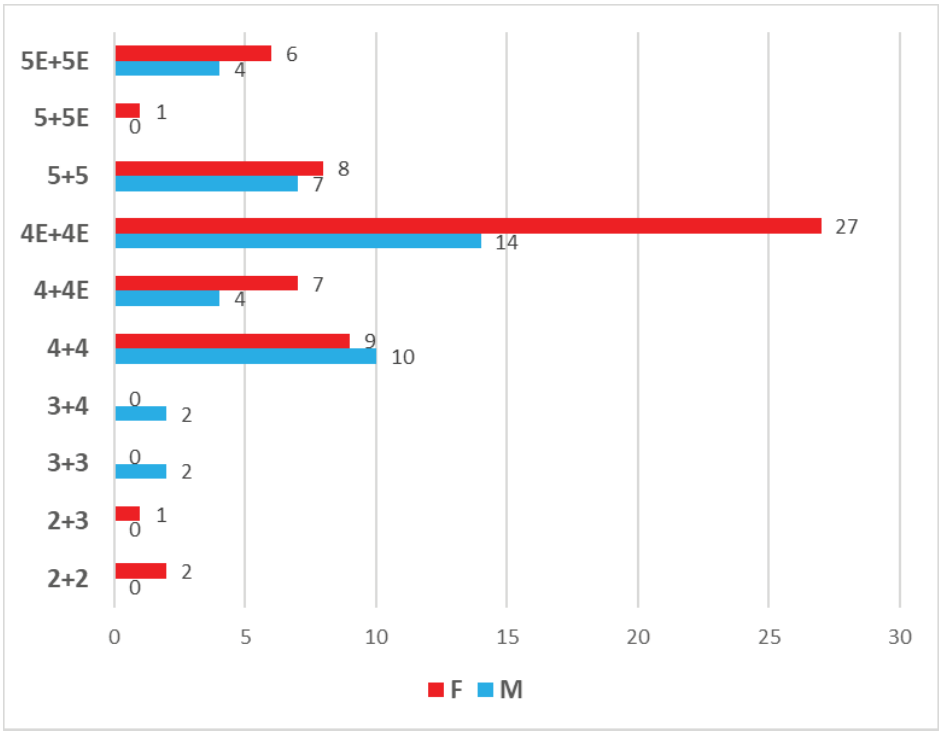

Figure 2. Compared bilateral topographical patterns (types) of the greater palatine foramen, in males (M) and females (F). E: edentulous

Table 1. Bilateral tooth-related topography in the general lot and gender-related. There was recorded the "right+left" pattern

	2+2	2+3	3+3	3+4	4+4	4+4E	4E+4E	5+5	5+5E	5E+5E
M (43)	0	0	2	2	10	4	14	7	0	4
F (61)	2	1	0	0	9	7	27	8	1	6
TOTAL (104)	***2***	***1***	***2***	***2***	***19***	***11***	***41***	***15***	***1***	***10***

In the general lot (N=104), 41 cases (39.42%) were recorded with bilateral 4E types (fig.3). This corresponds to the GPF located medially to the edentulous site of the 3rd upper molar. In 19 cases (18.27%) was recorded the bilateral combination „4+4": the GPF was located bilaterally at the level of the 3rd upper molar. In 15 cases (14.42%) was recorded the combination „5+5", GPF located distally to the 3rd upper molar. In 11 cases (10.58%) was found the „4+4E" combination, GPF medially to the 3rd upper molar on one side and to the edentulous 3rd upper molar site on the opposite side. In 10 cases (9.62%) was found the combination „5E+5E", thus GPF located distally to the edentulous site of the 3rd upper molar. The combinations „2+2" (fig.4), „3+3", and „3+4" were found in 2 cases (1.92%) each. The combinations „5+5E" and „2+3" were found in one case (0.96%) each.

In males (n1=43) prevailed the bilateral 4E pattern (32.56%). There were not found the combined types „2+2", „2+3" and „5+5E" (fig.5). In females (n2=61) also prevailed the bilateral 4E pattern (44%). The combinations "3+3" and "3+4" were not found in females (fig.6).

In the general lot (n=104) there were just 41 bilateral dentate subjects, 21 males and 20 females. The tooth-related topography in those subjects is presented in table 2. In most male cases (47.62%) the GPF was bilaterally located medial to the third maxillary molar (type 4) (fig.7). In most female cases (85%) the GPF was either medially to the third maxillary molar, or distal to it.

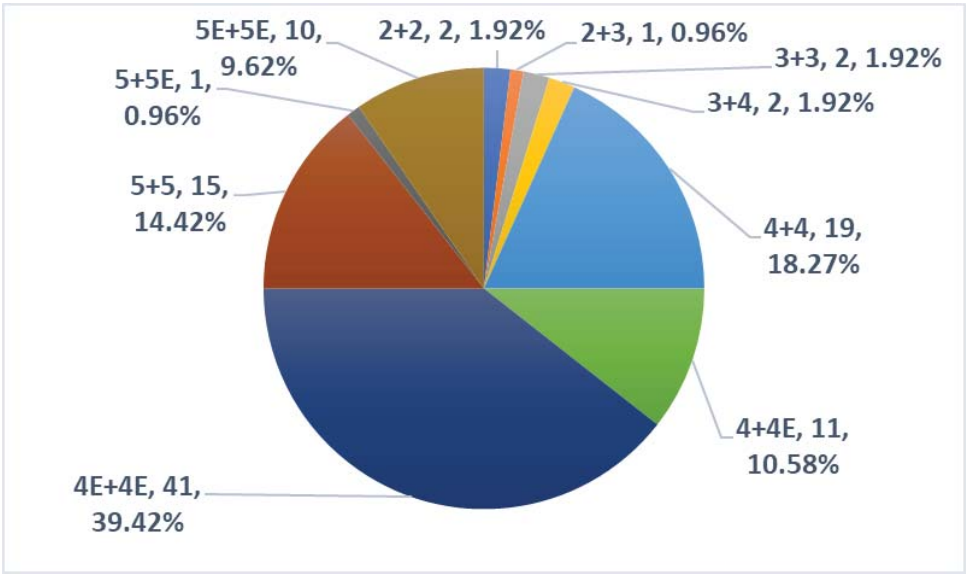

Figure 3. Combined bilateral topographical types of greater palatine foramina in the general lot (N=104). There are indicated the combined "right+left" type, the recorded values and prevalences

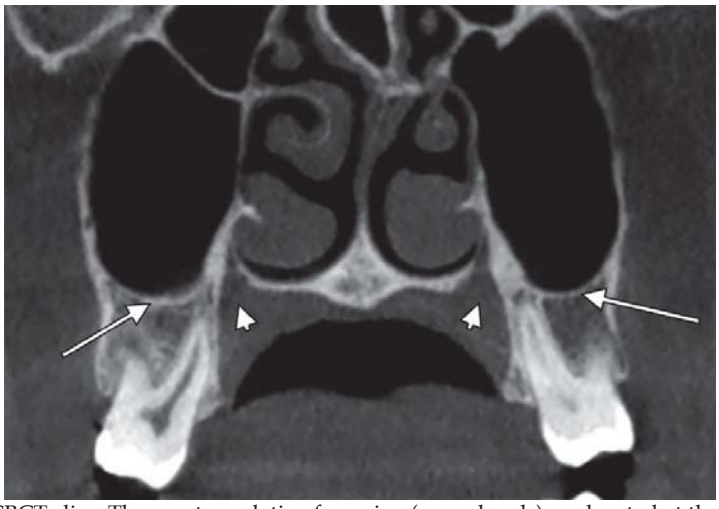

Figure 4. Coronal CBCT slice. The greater palatine foramina (arrowheads) are located at the level of the second maxillary molars (arrows)

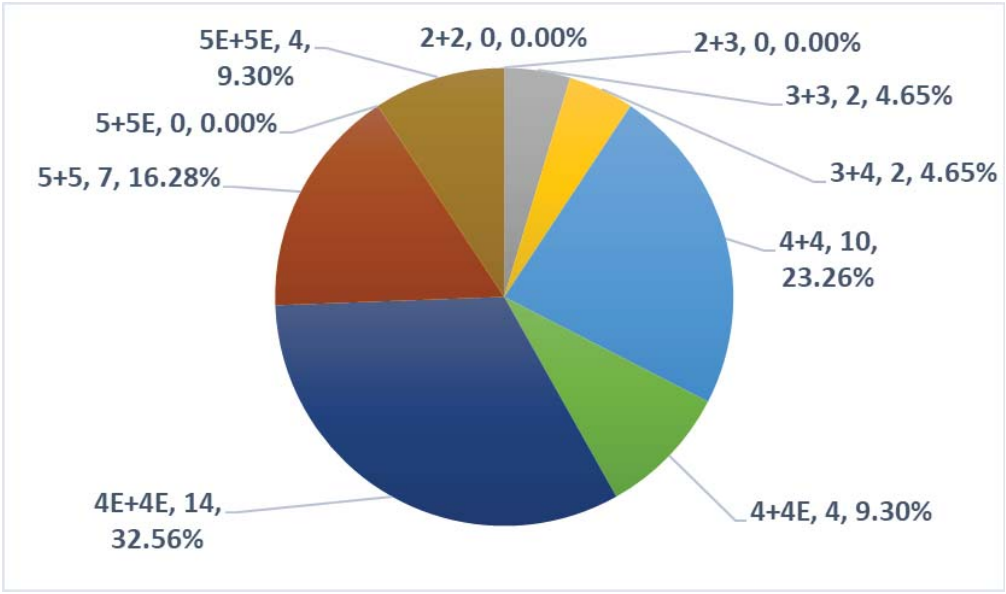

Figure 5. Combined bilateral topographical types of greater palatine foramina in males (n1=43). There are indicated the combined "right+left" type, the recorded values and prevalences

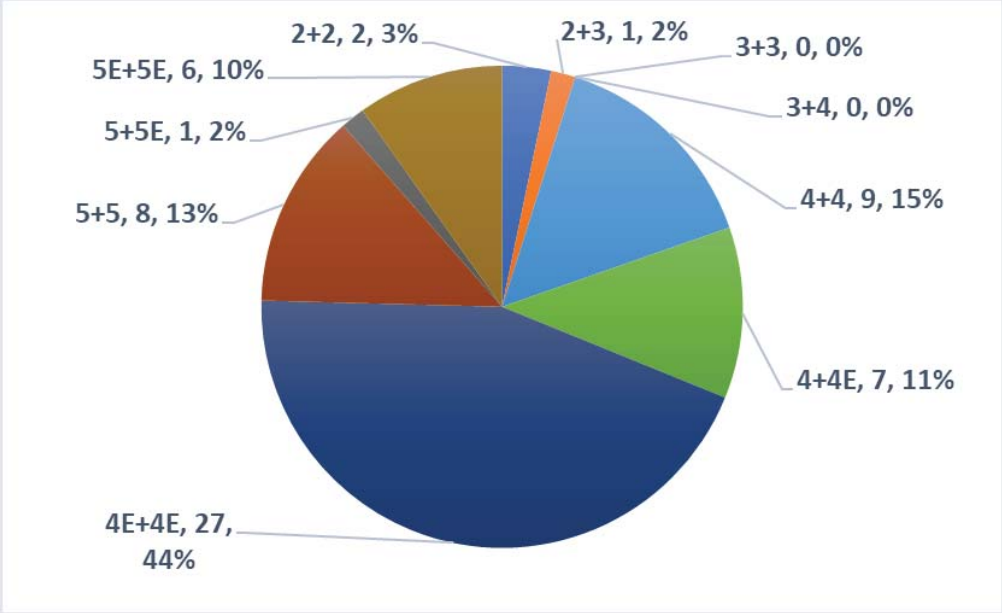

Figure 6. Combined bilateral topographical types of greater palatine foramina in the general lot (n2=61). There are indicated the combined "right+left" type, the recorded values and prevalences

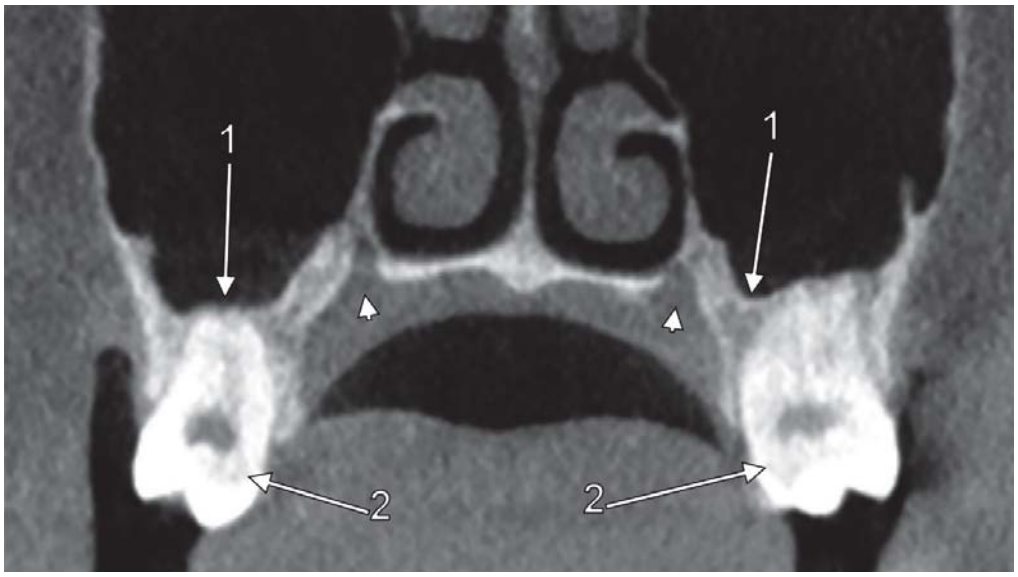

Figure 7. Coronal CBCT slice through the greater palatine foramina (arrowheads). 1.maxillary sinus floor; 2.third maxillary molars

DISCUSSIONS

Changes of the alveolar crest result after physiological resorption with age, use of prostheses, traumatic extractions, or alterations of the bone metabolism (Rapado-Gonzalez et al., 2015). Therefore, the usefulness of the distance between the GPF and the vestibular bone plate is limited (Rapado-Gonzalez et al., 2015). Bilateral asymmetry of the GPF could be determined by the sutural growth between the maxillary and palatine bones, as well as by an increase in the length of the palate during tooth eruption (Rapado-Gonzalez et al., 2015). As resulted from the present study, nor referring the GPF to a certain maxillary tooth seems reliable.

Different previous reports of the topography of the GPF did not indicate explicitly the edentulous/dentate status of the patients that were randomly investigated by CBCT (Bahsi et

al., 2019, Fonseka et al., 2019). Other authors explicitly indicated they used only fully dentate dry skull specimens (Wang et al., 1988, Westmoreland and Blanton, 1982) or CBCT cases (Ikuta et al., 2013). However, as shown by the present study, if patients are randomly selected, a good part of them have terminal maxillary edentations. Noteworthy, when edentulous alveolar sites of maxillary molars are found, the location of the GPF can be estimated with accuracy either in relation to other maxillary molars, or by using different other landmarks (Methathrathip et al., 2005).

When previous studies determined the tooth-related topography of the GPF, the respective authors did not investigate, or report the bilateral symmetry, or asymmetry, of the GPF (Bahsi et al., 2019, Ikuta et al., 2013, Wang et al., 1988, Dave et al., 2013), such as we did here. There are studies that did not relate the findings on the GPF topography to any side, right or left (Nimigean et al., 2013). Fonseka et al (2019) found that on each side prevailed the types 3 and 4 of GPF (Fonseka et al., 2019). The results of Fonseka et al (2019) correspond to those of Westmoreland and Blanton (1982). However, these authors did not document the bilateral combinations of tooth-related topographical patterns.

The GPF serves as anterior landmark for the pyramidal space which, in turn, is defined for surgical dissection to release the palatal flaps (Jung and Lo, 2020). Therefore, an anterior location of the GPF, such as in types 1-3, extends anteriorly this pyramidal space and facilitates the surgical dissection. The type 1, when the GPF is located medially to the interproximal septum between the first two upper molars, was found by Wang et al (1988) in 2% of cases, just on the left side. In the present study we did not find this tooth-related topographical pattern of the GPF.

CONCLUSIONS

We demonstrate that if on one side the GPF has a certain topographical pattern it is not mandatory for the opposite one to have the same tooth-related topography.

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