Journal of the Anatomical Society of India xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Journal of the Anatomical Society of India

journal homepage: www.elsevier.com/locate/jasi

Original Article

Anatomical study of the Foramen Venosum and its clinical implications

Nilton Alves[a,b,*], Naira Figueiredo Deana[c]

[a] Faculty of Dentistry, La Frontera University, Temuco, Chile
[b] Applied Morphology Research Centre (CIMA), Universidad de La Frontera, Temuco, Chile
[c] Máster Program in Dentistry, Faculty of Dentistry, Universidad de La Frontera, Temuco, Chile

ARTICLE INFO

Article history:
Received 5 June 2016
Accepted 28 March 2017
Available online xxx

Keywords:
Foramen venosum
Sphenoid emissary foramen
Foramen of Vesalius
Anatomical variation
Morfometry

ABSTRACT

Introducción: The foramen venosum (FV) is located in the sphenoid bone anterior and medial of the foramen ovale and is crossed by a vein connecting the pterygoid plexus with the cavernous sinus. Anatomical knowledge of the FV is important because its variants may lead to surgical complications in procedures in the region of the middle cranial fossa. To assess the incidence of the FV, its unilateral or bilateral frequency and the distances from the FV to the foramen ovale (FO) (FV-FO) and from the FV to the foramen spinosum (FS) (FV-FS), including analysis by sex and race.
Method: We examined 178 macerated skulls belonging to individuals of both sexes, black and white. Bilateral or unilateral presence of FV was analysed. The FV-FO and FV-FS distances were measured with a digital caliper. Statistical analysis was done using chi-squared and Student's t tests.
Results: FV was found in 32.02% of the sample. In 23.6% the FV presented bilaterally and in 8.42% unilaterally. FV was more prevalent in white males than in white females. The FV-FO distance was greater in white males than in white females and significantly greater in black females than in white females. There were racial and sexual differences in the FV-FS distance, which was significantly greater in white males than in white females.
Discussion: FV is a very frequent anatomical variation, located antero-medially of the FO; it may present either bilaterally or unilaterally, and there is no preference for either side. Specific differences exist in FV distribution by sex and race.

1. Introduction

The foramen venosum (FV) or venous foramen, also known as the sphenoid emissary foramen or foramen of Vesalius, is an inconstant foramen generally present in 40% of individuals.[1,2] It may present unilaterally or bilaterally, and in addition may be double in 1.75% of individuals.[3]

When present, the FV is located in the sphenoid bone anterior and medial of the foramen ovale[4–6] and is crossed by a vein connecting the pterygoid plexus with the cavernous sinus.[2,7] Lang[2] says that a small nerve, the nervulus sphenoidalis lateralis, may also pass through the FV; furthermore, in 20% of cases the FV contains an accessory meningeal artery.[8]

Anatomical knowledge of the FV is important because its variants may lead to surgical complications in procedures in the region of the middle cranial fossa, as well as in radiofrequency rhizotomy, the technique used to treat neuralgia of the trigeminal nerve.[3] Furthermore, because the FV is a communication pathway between the cavernous sinus and the outside of the skull, it may facilite the dissemination of extracranial infections resuting from acute sinusitis, otitis or a dental abcess into the intracranial region.[9,10]

The object of the present study was to assess the incidence of FV, the number of FV in each half of the skull, its unilateral or bilateral frequency and the distances from the FV to the FO and from the FV to the FS, including analysis by sex and race.

2. Materials and Methods

We examined 178 macerated skulls of Brazilian individuals, both sexes, black and white, aged between 20 and 100 years (mean 40.38 years), belonging to the Museum of skulls – Department of Morphology and Genetics, UNIFESP, Brazil. Skulls in poor condition

* Correspondence to: Nilton Alves, Faculty of Dentistry, Universidad de La Frontera, 1145 Francisco Salazar Avenue. PO BOX 54-D, Temuco, Chile.
E-mail addresses: nilton.alves@ufrontera.cl, niltonnalves@yahoo.com.br (N. Alves).

http://dx.doi.org/10.1016/j.jasi.2017.03.002
0003-2778/

Fig. 1. Inferior view of the skull showing the foramen venosum (FV), foramen ovale (FO) and foramen spinosum (FS).

or for which the sex and/or skin colour were not identified were excluded from the study. The presence of FV (bilateral or unilateral) was observed (Fig. 1), with the side and the number of FV in each half of the skull. The distances from the FV to the foramen ovale (FO) (FV-FO distance) and from the FV to the foramen spinosum (FS) (FV-FS distance) were measured using a digital caliper. Statistical analysis was done using Pearson's Correlation, chi-squared and the Student's *t* tests as appropriate. Results were considered statistically significant at $p \leq 0.05$.

3. Results

FV was found in 114 half skulls (32.02%) generally antero-medial of the FO. In 23.60% the FV presented bilaterally and in 8.42% unilaterally, of which there were 4.21% on each side (half-skull). Presence of the FV only on the left side was more common in white males (53.1%) and black females (52.4%), presence of the FV only on the right side was more common in white females (52.3%); for black males 50% of the unilateral FV presented on the right side and 50% on the left. There was no statistically significant difference between sides.

In our study FV was more prevalent in white males than white females ($p = 0.02$); black males and black females each presented FV in 30.2% of cases (Table 1). The presence of double FV was not observed in the sample studied.

Black females, white males and black males presented approximate mean values for the FV-FO distance; white females presented lower mean values (Table 2). A statistically significant difference was observed between white males and white females ($p = 0.01$) and between white females and black females ($p = 0.03$).

The highest mean values for the FV-FS distance were found in white male, while white females presented the lowest values found (Table 3). A statistically significant difference was observed between black males and white males ($p = 0.05$), between black females and white females ($p = 0.05$) and between white males and white females ($p = 0.001$).

Pearson's test was used to calculate the correlation between the FV-FO x FV-FS distances. A statistically significant positive correlation was found only on the left side in black females (Table 4).

4. Discussion

FV is a fairly common anatomical variant. In the present study in Brazilian individuals we observed that FV was present in 32.02%, a similar percentage to that found by Shinohara et al.[3] (33.75%), Gupta et al.[15] (34%), Martínez et al.[18] (34%) and Ozer and Govsa[19]

Table 1
Results of studies reporting the frequency of the foramen venosum and its unilateral or bilateral presence on left and right sides in males and females.

Authors	Sample size	Specimen examined	Total frequency (%)	Unilateral (%)	Bilateral (%)	Right (%)	Left (%)	Males (%)	Females (%)
Kale et al.[1]	347	skulls	45	19.9	25.1	9.5	10.4	–	–
Lang et al.[2]	–	–	40	–	–	49	36	–	–
Shinohara et al.[3]	400	macerated skulls	33.75	18.25	15.5	7.75	10.5	–	–
Berlis et al.[11]	60	dry skulls	36	21	15	25	35	–	–
Boyd[12]	1500	skulls	36.5	21.8	14.7	10.6	11.2	–	–
Gingsberg et al.[13]	123	temporal bone CT	80	30.8	48.8	–	–	–	–
Gupta et al.[14]	35	dry skulls	32.85	20	22.85	20	12.85	22.7	50
Gupta et al.[15]	200	dry skulls	34	20	14	15	19	–	–
Kim and Kim[16]	305	temporal bone CT	47.5	21.3	26.2	10.2	11.1	–	–
Kodama et al.[17]	400	skulls	adults: 21.75	male: 24.64[b] female: 27.78[b]	male: 75.36[b] female: 72.22[b]	–	–	21.5	22.78
Martínez et al.[18]	53	dry skulls	34	22.7	11.3	7.5	3.8	–	–
Ozer and Govsa[19]	172	dry skulls	34.8	25.5	9.3	10.4	15.1		
Reymond et al.[20]	100	macerated skulls	17	6	5	6	5	–	–
Rossi et al.[21]	80	dry skulls	40	26.25	13.75	15.62	11.25	25	52.25
Sharma and Garud[22]	50	dry skulls	62	18	44	8	10	–	–
Wohua et al.[23]	100[a]	skulls	42.5	14.5	28	45	40	–	–
Presenty study	178	dry skulls	32.02	8.42	23.6	4.21	4.21	40^{WM} 30.2^{BM}	25^{WF} 30.2^{BF}

-Not informed, CT computed tomography.[WM] white males, [WF] white females, [BM] black males, [BF] black females.
[a] Only males.
[b] Different method of calculating percentage.

Please cite this article in press as: N. Alves, N.F. Deana, Anatomical study of the Foramen Venosum and its clinical implications, J Anat Soc India (2017), http://dx.doi.org/10.1016/j.jasi.2017.03.002