

VARIABLE FORAMEN OF HYRTL OF THE HUMAN SKULL

Ivan Jovanović, Ljiljana Vasović, Slađana Ugrenović, Dejan Zdravković, Slobodan Vlajković,
Marija Daković-Bjelaković and Vesna Stojanović

Variable foramen on the greater wing of sphenoid bone, which is simultaneously complementary opening between the orbit and middle cranial fossa. It can be found, unilaterally or bilaterally, lateral to the superior orbital fissure, below posterior margin of the lesser wings of the sphenoid bone. The aim of this work was, to establish, the incidence of this variable foramen between orbit and middle cranial fossa, and its morphology characteristics in the cases where it exist, on the small series of human skull. Material was 30 human skulls (15 dried and 15 non-dried) from collection of Department of anatomy and Department of forensic medicine of Medical faculty in Nish. The name of the opening was given as suggestion of the autor in this work: the opening on the greater wing of the sphenoid bone was named as foramen of Hyrtl or H-foramen (foramen H); the groove on the greater wing of the sphenoid bone, which extends from this opening, was marked as meningo-lacrimal groove. The presence of this foramen was established in 13 (43,3%) cases, and in 11 (36,7%) cases the opening was unilateral (5 on the left and 6 on the right side). The foramen was bilateral in 2 (6,7%) cases. It was observed that the opening was round or rarely elliptical. The foramen was obvious on the inner surface of the greater wing of the sphenoid bone, as well as on the upper half of the lateral wall of the orbit, with variable distance from the lateral end of the superior orbital fissure. Variable H-foramen was detected in 43,3% of the cases, mostly unilaterally on the greater wing of the sphenoid bone. Simultaneous existence of the H-foramen and meningo-lacrimal groove, indirectly point to the later obliteration of the primitive stapedia artery on the same side. Orbital groove existence do not coincidence with H-foramen existence. Dependence between the size of the H-foramen diameter and the distance from the foramen spinosum and lateral end of the superior orbital fissure was not established. *Arto Medica Medianae 2003; 42(1):1-5.*

Key words: H-foramen, sphenoid bone, orbit, middle cranial fossa

Department of anatomy, Medical faculty in Nish

Correspondence to: Ivan Jovanović

Department of anatomy, Medical faculty,
Brace Taskovic 81, 18000 Nish, Serbia and Montenegro
Telephone: 018/335198, e-mail: ivanjov@junis.ni.ac.yu

Introduction

Variable foramen on the greater wing of the sphenoid bone, is simultaneously the communication opening between the orbit and middle cranial fossa. It can be found, laterally from the superior orbital fissure, below the posterior margin of the lesser wing of the sphenoid bone, unilaterally or bilaterally. It is described as sphenofrontal foramen (1), meningo-orbital foramen (2, 3, 4, 5, 6, 7, 8), crani-orbital foramen (9), stapedia-ophtalmo-lacrimal foramen (10), lacrimal foramen (11, 12), as well as foramen of Hyrtl (13). However, none of these terms didn't find its place in the international nomenclature (14).

There are different data about proportional presence of this foramen; it was found in 6% of the cases during the investigation of the 100 orbits (5), or in the 82,9% of the cases during the investigation of the 170 skulls (8).

We emphasize as historical, Royle and Motson (4) statement, that the Meyer first detected that the branch of

the ophtalmic artery, after it left the orbit through the lateral end of superior orbital fissure, turn back again into the orbit through this foramen. There it was anastomosed with lacrimal artery.

Practical importance is emphasized when the middle meningeal artery has abnormal origin, in the cases of subtemporal epidural hemmatoma, tumors, vascular malformations and in the cases when the foramen spinosum is absent (15), and it is described as alternative transorbital pathway (9).

The aim of this work was to establish the incidence of this variable foramen between the orbit and middle cranial fossa on the small series of the human skulls, and to describe some morphology characteristics in the cases when it is present.

Material and methods

Material was 30 human skulls (15 dried and 15 non-dried) from collection of Department of anatomy and Department of forensic medicine of Medical faculty in Nish. Sex and age of corpses wasn't determined.

The name of the opening was given as suggestion of the author in this work: the opening on the greater wing of the sphenoid bone was named as foramen of

Hyrtl or H-foramen (foramen H); the groove on the greater wing of the sphenoid bone, which extends from this opening, was marked as meningoacrimonial groove. Qualitative characteristics of the foramen were examined with magnifying glass. Quantitative parameters (H-foramen diameter, distance from the lateral end of the superior orbital fissure, distance from the foramen spinosum), were measured with nonius, and were statistically analyzed.

Results

The presence of the H-foramen was detected in the 13 (43,3%) cases (Fig. 1,2, 3). It was situated unilaterally in 11 (36,7%) cases (5 on the left and 6 on the right side), and bilaterally in 2 cases.

Inspection established single, mostly round, rarely elliptic foramen. It was macroscopically visible on the inner surface of the greater wing of the dried skull sphenoid bone, as well as on the upper half of the orbit lateral wall, with variable distance from the lateral end of the superior orbital fissure.

Regarding to quantitative parameters, it was detected that H-foramen diameter ranged from 0,8 to 2,0 mm ($X = 1,2 \pm 0,4$). Average diameter was bigger on the right ($x = 1,32$ mm) than on the left ($x = 1,06$ mm) side. In the cases where was not detected meningoacrimonial groove, average diameter of the H-foramen was 1,9 mm, while the average foramen spinosum diameter was 3,35 mm (Table 1).

Distance from the lateral end of the superior orbital fissure ranged from 1 to 26 mm ($x = 10,9 \pm 5,9$), and from the foramen spinosum ranged from 47 to 53 mm ($X = 48,3 \pm 3,2$). Eventhough, the largest variability was related to the distance from the lateral end of the superior orbital fissure, there wasn't established positive correlation between this parameter and size of the H-foramen diameter.

Simultaneously existence of the H-foramen and meningoacrimonial groove was detected in 10 (76,9%) cases (Table 2).

Groove on the lateral wall of the orbit, which extended from the posterior end of the inferior orbital fis-

sure to H-foramen, was detected in one case, on the left side. The groove was shallow and wide (Fig. 4).

Three cases (2nd, 3rd and 7th) were interesting in reference to average references previously cited in Table 1, for the following reasons:

A. H-foramen diameter values were bigger in all three cases.

B. Larger values of the foramen spinosum diameter and the absence meningoacrimonial groove on the inner surface of the greater wing of the sphenoid bone, was established in the 2nd and 7th case.

C. Distance from the lateral end of the superior orbital fissure, and from the foramen spinosum was smaller in the 7th case.

Foramen spinosum have always been present, except in one case where it was damaged.

Discussion

Georgiou and Cassel (10) described H-foramen on the greater wing of the sphenoid bone as rudiment of embryology canal for supraorbital division of the primitive stapedia artery (PSA) on its way through the orbit. Although, Hyrtl (1836) first described PSA, as well as the fact that in the International Nomenclature (14) are accepted abbreviations for the designation of the anatomy structures, we suggested term H-foramen (foramen H), and used this term during the discussion, without intention to dispute terms suggested by the other authors.

It is necessary to give a brief review on embryology causality connection between vascular and bone-canal factor (16). Arteries which supply the orbit originate from primitive stapedia artery (PSA), both in humans and other placental mammals. During embryology development, PSA enters into the structural of the cranial cavity, where it divides into superior and inferior branch. Inferior branch runs across the base of the future middle cranial fossa, then enters into the infratemporal fossa, where it gives off branches for the upper and lower jaw. Simultaneously, PSA superior branch goes on toward the orbit together with the branches of the ophthalmic nerve. Therefore, it was differentiated two topographic parts of the PSA, intraorbital and in-

Table 1. H-foramen quantitative parameters values

Case number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	X	SD
f.s.* -f.l.** (mm)	53	47	52	45	49	49	40	50	/	48	47	50	48	51	47	48,29	3,22
s.o.f***-f.l. (mm)	8	8	12	13	16	17	1	5	9	26	7	11	14	8	9	10,93	5,90
H-foramen diameter (mm)	1	1,8	2	0,8	0,8	0,8	2	1	1,4	1,4		1	1	0,8	0,8	1,19	0,43
foramen spinosum diameter (mm)	2,6	4,0	2,2	4,0	2,8	1,6	3,6	2,6	/	2,1	2,0	2,2	3,2	2,2	3,4	2,8	

* Foramen spinosum

** Foramen lacrimale

*** Superior orbital fissure

Table 2. Evidence of the simultaneous presence of the H-foramen and meningoacrimonial groove in 15 cases

Case number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Groove presence	+	0	+	+	+	+	0	0	0	+	+	+	0	+	+

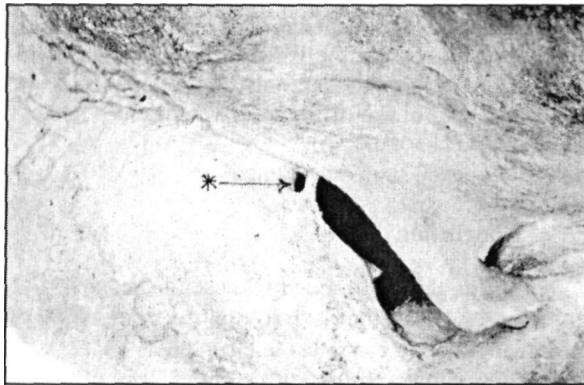


Figure 1. Communication openings between the orbit and middle cranial fossa on the left side of the dried skull; H-foramen (*)

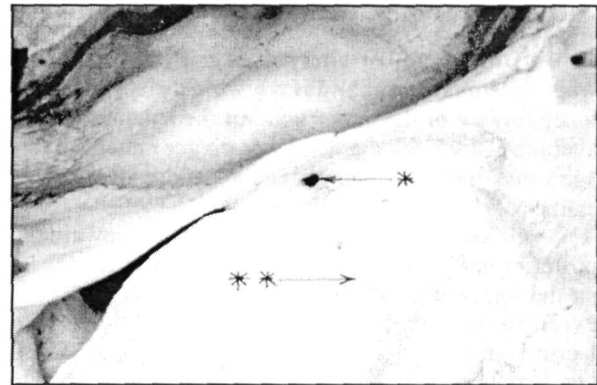


Figure 2. Communication openings between the orbit and middle cranial fossa on the left side of the dried skull; H-foramen (*); groove for the middle meningeal artery orbital branch (**)

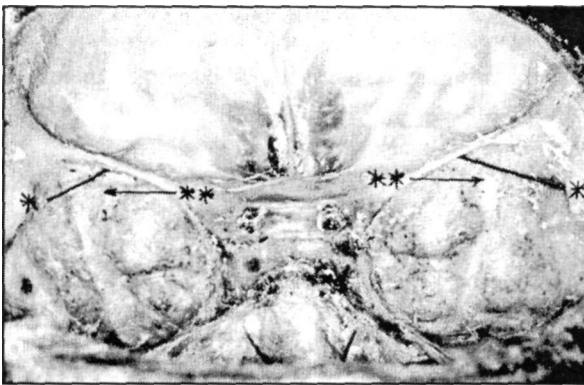


Figure 3. Bilaterally presence of the H-foramen (*) and meningo-lacrimal groove on dried skull (**)

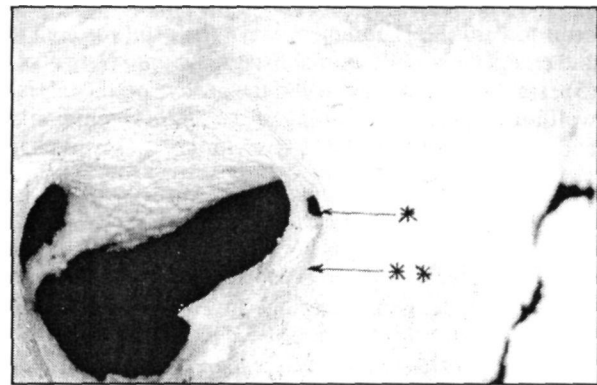


Figure 4. Dried skull left orbit. Groove (**) on the lateral of the orbit which extends from the inferior orbital fissure to the H-foramen (*)

tracranial. Gradually, intraorbital part of the superior branch merges with the trunk of the opthalmic artery, near the optic nerve, and together with lacrimal artery gives the definitive lacrimal artery. Anastomosis between intraorbital and intracranial part of the superior branch mostly involves. However, the part of this anastomosis can left as connection between the system of the internal carotid artery and external carotid system. The branch is known as "ramus supraorbitahs" of the middle meningeal artery, or anonymous branch of the lacrimal artery (15). Inferior branch usually anastomoses with the trunk of the external carotid artery and builds in main trunk of the middle meningeal artery, while, intracranial part of the superior branch builds in intracranial part of the middle meningeal artery. It has anterior and posterior part. Anterior part communicates with orbit, and it coincides the front terminal branch of the middle meningeal artery in the postnatal period. Communicating branch for the lacrimal artery, which can go through the superior orbital fissure or H-foramen, is the branch of this anterior part of the PSA (9). This branch can divide into these two branches proximal to the H-foramen (3). One branch runs through the foramen and is named as meningo-lacrimal artery, while the 2nd artery runs through the lateral end of the superior orbital fissure and is named as sphenoidal artery (9). Meningo-lacrimal artery represents homologue of the PSA superior branch, while sphenoidal artery represents innovation in the ontogenesis of

the human. In case that meningo-lacrimal artery divides more proximally, 2 to 3 superposed H-foramens might exist (1, 17, 10) on the greater wing of the sphenoid bone, or sphenofrontal suture (8).

Incidence of the H-foramen in 43,3% of our cases can compare with 45% that was cited by Shimada et al. (7). Mysorekar and Nandedkar (6) established the presence of the H-foramen in 76% of the India population, with equal presence on the left and right side. Erturk et al. (8) established the presence of the H-foramen in the 82,95% of the cases in Turkish population, and higher incidence of its bilateral position. However, during the investigation of 50 left and 50 right orbits in Brazilian population, Santo Neto et al. (5) established the presence of the H-foramen in three cases on the left and three cases on the right side. Georgiou Cassel (10) detected the presence of the H-foramen in the 50% of the American population.

Although, that there are different data in the literature about the H-foramen incidence between different populations, suggestion of Berry and Berry (18) that wide spectar of bone variations can be used to calculate statistical distance between different population specimens. Mysorekar and Nandedkar (6) described the presence of meningo-lacrimal groove in the 63% bilaterally, in 13% on the left and 10% on the right side. Simultaneous existence of the H-foramen and meningo-lacrimal groove in 76,9% of cases indirectly point out to later obliteration of the PSA on one

side, more exactly that simultaneous bilateral obliteration of this primitive artery does not exist. In cases where meningo-lacrimal groove wasn't present on the inner surface of the greater wing of the sphenoid bone, average H-foramen diameter was bigger than the average value of all H-foramens, and it is likely in regard to caliber of the persistent artery.

Groove on the lateral wall of the orbit, toward the posterior end of the inferior orbital fissure, can attach on the foramen. It originates from the anastomosis between infraorbital and middle meningeal artery with lacrimal artery (4). According to the second position, two variations are of great importance - absence of the foramen spinosum on the sphenoid bone and middle meningeal artery origin from the third topographic part of the maxillary artery. In that case this branch of maxillary artery enters the orbit through posterior end of the inferior orbital fissure, runs across the lateral wall of the orbit toward the H-foramen, leave the orbit through it and enters the middle cranial fossa (2). Santo Neto et al. (5) established the presence of the groove on the lateral wall in 24 of 50 right and 21 of the 50 left hemispheres and have never associated it H-foramen. Mysorekar

and Nandedkar (6) detected groove in 30% of the cases, but only in one case established its connection with H-foramen. According to that, only one case of groove on the lateral wall of the orbit in our work denies its connection with H-foramen.

Conclusion

1. Variable H-foramen was established in 43,3% of the cases, mostly unilaterally on the greater wing of the sphenoid bone.

2. Simultaneous existence of the H-foramen and meningo-lacrimal groove in more than half of the cases, indirectly points to later obliteration of the primitive stapedial artery on the same side.

3. The existence of the orbital groove does not coincide.

4. Dependence between the size of the H-foramen diameter and distance from the foramen spinosum or from the lateral end of the superior orbital fissure, was not established.

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VARIJABILNI HYRTL-OV OTVOR HUMANE LOBANJE

Ivan Jovanović, Ljiljana Vasović, Slađana Ugrenović, Dejan Zdravković,
Slobodan Vlajković, Marija Daković-Bjelaković i Vesna Stojanović

Varijabilni otvor na velikom krilu klinaste kosti, koji je istovremeno i dopunski, komunikacioni otvor između očne duplje i srednje lobanjske jame, može se naći upolje od gornje orbitalne pukotine, ispod zadnje ivice malih krila klinaste kosti, jednostrano ili obostrano. Svrha rada je bila da se na maloj seriji lobanja ustanovi incidenca varijabilnog otvora između očne duplje i srednje lobanjske jame, i da se opišu neke morfološke karakteristike u slučajevima gde postoji. Materijal je predstavljalo 30 humanih lobanja (15 maceriranih i 15 nemaceriranih) iz kolekcije Instituta za anatomiju i Instituta za sudsku medicinu Medicinskog fakulteta u Nišu. Naziv varijabilnog otvora i žleba su dati kao predlog autora u radu; otvor na velikom krilu klinaste kosti je imenovan kao Hyrtl-ov ili H-otvor (foramen H); žleb na velikom krilu klinaste kosti koji se pruža do ovog otvora označen je kao meningolakrimalni žleb. U 13 (43,3%) slučajeva utvrđeno je prisustvo Hyrtl-ovog otvora, pri čemu se u 11 (36,7%) otvor nalazio jednostrano (5 na levoj i 6 na desnoj strani), a u 2 slučaja (6,7%) obostrano. Inspekcijom je uočeno da se radi o otvoru pretežno okruglog oblika ili ređe, elipsoidnog oblika. Otvor je makroskopski bio vidljiv na unutrašnjoj strani velikog krila klinaste kosti macerirane lobanje kao i na gornjem kraju spoljnog zida očne duplje ili orbite, na varijabilnoj udaljenosti od spoljnog kraja gornje orbitalne pukotine. Varijabilni H-otvor ustanovljen je u 43,3% slučajeva, i uglavnom jednostrano na velikom krilu klinaste kosti. Istovremeno postojanje H-otvora i meningolakrimalnog žleba u više od polovine slučajeva indirektno ukazuje na kasniju obliteraciju primitivne stapedijalne arterije na strani otvora i žleba. Postojanje orbitalnog žleba ne koincidira sa postojanjem H-otvora. Međuzavisnost između veličine prečnika H-otvora i udaljenosti od otvora sfenoidalne bodlje ili od spoljnog kraja gornje orbitalne pukotine nije ustanovljena. *Acta Medica Medianae 2003; 42(1).1-5.*

Ključne reči: H-otvor, klinasta kost, očna duplja, srednja lobanjska jama