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Relationship Between Pterygopalatine Fossa Volume and Cephalic and Upper Facial Indexes

Relación Entre el Volumen de la Fosa Pterigopalatina y los Índices Cefálico y Facial Superior

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SUMMARY: The maxilary nerve can be block in the pterygopalatine fossa, entering from oral cavity via greater palatine canal. The aim of this study was to analyse the volume of the pterygopalatine fossa and its relationship with upper facial height and cephalic indexes. In 71 human adults skulls, without sex distinction, was determined the volume of the pterygopalatine fossa and cephalic and upper facial height indexes. Through a t test ($p < 0.05$) were compared the average volume between cephalic and facial types. The average volume of the pterygopalatine fossa was 1.2 ml (DS 0.297), were not found differences according to the cephalic or facial type.

KEY WORDS: Pterygopalatine fossa; Cephalic index; Upper facial index; Maxillary anaesthesia.

INTRODUCTION

Pterygopalatine fossa (PPF) is a common cavity in the skull and the face; its neurovascular content and communication path making them crucial in odontoestomatology (Daniels *et al.*, 1983, 1998; Singh *et al.*, 2001; Bleier & Mirza, 2006; Roberti *et al.*, 2007).

The maxillary nerve may be blocked in its passage through the PPF by anaestethic infiltration via the greater palatine canal (Mercuri, 1979), achieving a deep regional maxillary anaesthesia in the area inervated by the second trigeminal nerve division. It has also been recommended as a method of anaesthesia to the posterosuperior alveolar nerve (Moiseiwitsch & Irvine, 2001). Their indication is given in full-mouth maxillary restorative, extensive local infection or trauma in the maxilla, and variations in the courses of the posterior, middle, and anterior superior alveolar nerves possibly requiring a second-division block (Slavkin *et al.*, 1966), dentofacial deformities (Apinhasmit *et al.,* 2005), maxillary sinus surgery and diagnostic or therapeutic in second trigeminal branch neuralgic cases (Seltsam, 1956).

Therefore, intraoperative bleeding during endoscopic sinus surgery and septorhinoplasty is reduced and posterior epistasis is controlled (Douglas & Wormald, 2006).

The technique describes the infiltration of two tubes of anesthesia 1.8 ml each and has as complications the diplopia caused by the dissemination of the anaesthetic through the inferior orbital fissure (Jorgensen & Hayden, 1982; Tima, 1995).

The PPF volume may be influenced by different factors, resulting in variations in anthropometric facial index (Adak, 2004; Bharati *et al.* 2005; Farkas *et al.* 2005; Guyot *et al.*, 2006).

Establishing a relationship between cephalic or facial type and PPF volume is of great significance in clinical practice because we would have an external indicator that can easily determine the maximum amount of anaesthetic to be deposited in the fossa.

The purpose of this study was to determine the relationship between PPF volume and the cephalic and upper facial height indexes.

MATERIAL AND METHOD

Seventy-one human adult skulls, without sex distinction, were obtained from the Department of Normal

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Anatomy of the Universidad de Talca, the Universidad de Los Andes, and the Universidad de Chile. The following measurements were done.

· Maximum anteroposterior diameter or maximum length of the skull-i.e, the largest diameter in the medium level anterior determined by Glabella and posterior by the more prominent point in the occipital bone upper to the foramen magnus (del Sol, 2005; 2006).

· Maximum transverse diameter of the skull-the largest horizontal diameter and transversal that it could measure, which, as shown in previous studies, coincides with the biparietal diameter (del Sol, 2005; 2006).

· Facial widthestablished between the most outstanding points in the zygomatic arch (zygion-zygion) (Spinalle & McNamara, 1989).

· Facial height-determined by the distance between Nasion and Prostion points.

We calculated cephalic index by dividing the maximum transverse diameter by the maximum anteroposterior diameter, multiplied by 100. On the basis of this index, skulls were classified as hyperdolichocephalic, dolichocephalic, mesocephalic, brachycephalic, and hyperbrachycephalic.

Then, we determined the upper facial height index, dividing facial height by facial width, and multiplying the quotient by 100. Using the upper facial index, the skulls were classified as hypereuryene, euryene, mesene, leptene, and hyperleptene.

Determination of pterygopalatine fossa volume. PPF volume was determined by the injection of lightweight condensation silicone, with a known density of 1.12 g/ml, with the use of dental equipment. The communication ends of the fossa were previously sealed with wax. Once silicone was plotted, it was removed and the mass calculated immediately in an electronic balance (0.000 1 g). Volume was determined by dividing mass by density.

Using the SPSS program for Windows 11.5, we calculated descriptive statistics for fossa volume, distinctly for the right and the left. To determine whether any cephalic type or facial height presented a PPF volume significantly different from another, each cephalic or facial type was correlated with volume of its fossa. Comparing the respective means, thestatistical differences were analyzed by the t test for independent samples, at $p < 0.05$.

RESULTS

Of the 71 skulls used, it was not possible to determine the volume of the left fossa in one; in another, upper facial index cannot be determined. The right PPF volume had a mean of 1.19 ml (SD 0.29), whereas the left fossa had 1.2 ml (SD 0.30). These differences were not significant ($p < 0.05$).

Of the skull samples analyzed, the most frequent type found was mesocephalic (N = 25), followed by dolichocephalic (N = 21), then by brachycephalic (N = 18), hyperbrachycephalic (N = 5), and hyperdolichocephalic (N = 2). The extreme types were less frequent in the analyzed sample. Values of PPF volume according to cephalic type are shown in Table I.

Table I. Left and right pterygopalatine fossa volume calculated in 71 skull, according to cephalic type.

Cephalic type/fossa volume		Right	Left
Hyperdolichocephalic	Mean	1.13	1.16
	N	2	2
	SD	0.21	0.43
Dolichocephalic	Mean	1.14	1.21
	N	21	21
	SD	0.28	0.30
Mesocephalic	Mean	1.26	1.23
	N	25	25
	SD	0.32	0.31
Brachycephalic	Mean	1.16	1.16
	N	18	17
	SD	0.25	0.34
Hyperbrachycephalic	Mean	1.13	1.14
	N	5	5
	SD	0.39	0.10
Total	Mean	1.19	1.2
	N	71	70
	SD	0.29	0.30

As to upper facial type, the most common was mesene (N = 31), then euryene (N = 24), and hypereuryene (N = 11). less frequently found was leptene (N = 4) and hyperleptene was not found. Table II lists the PPF volume of various upper facial types.

The mean differences in PPF volume of the cephalic and upper facial types were not significant, at a confidence interval of 95%.

Table II. Pterygopalatine fossa volume in 70 human skulls classified according to upper facial index.

Facial type/ Fossa volume		Right	Left
Hypereuryene	Mean	1.13	1.21
	N	11	11
	SD	0.37	0.21
Euryene	Mean	1.24	1.26
	N	24	24
	SD	0.26	0.41
Mesene	Mean	1.13	1.14
	N	31	30
	SD	0.27	0.23
Leptene	Mean	1.44	1.30
	N	4	4
	SD	0.36	0.18
Total	Mean	1.18	1.20
	N	70	69
	SD	0.29	0.30

DISCUSSION

The anaesthetic technique as used in the maxillary nerve via the greater palatine canal is widely accepted in odontostomatology (Seltsam; Slavkin *et al*.; Moiseiwitsch & Irvine; Methathrathip *et al*., 2005; Apinhasmit *et al.;* Douglas & Wormald).

The aim of the technique is to gain entry from the oral cavity and deposit the contents of two tubes of anaesthesia in the PPF, with the purpose of reversing the blockageof the maxillary nerve while passing through this region, thereby allowing a wide area of anaesthesia in the middle third of the face.

The PPF volume is crucial in explaining some of the complications of this technique. In our study, the mean volume of the PPF was 1.2 ml (DS 0.297),the differences between the right and left sides not being significant. Other authors had described a volume of 2 ml of lidocaine to 1 or 2% as sufficient for adequate anesthesia in the area corresponding to the PPF (Seltsam; Douglas & Wormald).

Kohase *et al*. (2002) described a method of local anaesthetic being injected intermittently or continuously through the use of an internal catheter directed to the PPF using a 1-ml dose of lidocaine 1%, achieving positive anesthesia in the area inervated by the second division trigeminal, with no complication or side effects intra- or postoperatively.

These data are of great clinical importance because it allows us to assume that, in all cases, the deposit of 3.6 ml of anaesthesia, as described in the technique (Jorgensen & Hayden; Tima), exceeds the volumetric capacity of the fossa in the dry skull, without considering that it is occupied by neurovascular elements and adipose tissue, which constitute the content of this cavity (Rouvière & Delmas, 1999; Figún & Garino, 2001; Latarjet & Ruiz-Liard, 2004), the anaesthesia could spread through communications of the PPF to other cavities, explaining some complications described in the technique such as intravascular injection, infraorbital nerve damage, and anesthesia, or damage of the orbital nerves (Douglas & Wormald; Methathrathip *et al.*).

Walker *et al.* (2004) described anaesthesia diffusing across the PPF and reaching the laterally located abducens nerve via the anterolateral extension of the inferior orbital fissure causing diplopia.

In our observations, there was similarity in volume of the PPF among subjects having different craneometric characteristics, so that the fossa volume appears not be influenced by the factors that determine the cephalic and upper facial indexes.

In looking at the PPF volume of the different facial types, wee noted higher values in leptene individuals (1.4 ml); the limited number of cases (N = 4) does not allow us to say that these results are significant. Similarly, it is interesting to observe that the extreme cephalic types hyperdolichocephalic (N = 2) and hyperbrachycephalic (N = 5) had very similar PPF, suggesting the need to analyze possible differences in major samples of these cephalic types.

On the basis of these observations, we suggest that clinical studies be conducted to determine the minimum amount of anaesthesia to be deposited in the PPF to achieve maxillary nerve block, thereby minimizing the risks of affecting orbital contents and important neurovascular elements in the interior of this anatomical cavity.

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RESUMEN: El nervio maxilar puede ser bloqueado en la fosa pterigopalatina, ingresando desde la cavidad oral vía canal palatino mayor. El objetivo de este estudio fue analizar el volumen de la fosa y su relación con los índices cefálico y facial superior. Se utilizaron 71 cráneos humanos adultos, sin distinción de sexo. Se determinó el volumen de la fosa pterigopalatina y los índices cefálico y facial superior. Mediante una prueba t ($p < 0.05$) se compararon las medias del volumen entre los tipos cefálicos y faciales. El volumen medio de la fosa fue de 1.2 ml (DS 0.297), no se encontraron diferencias de acuerdo al tipo cefálico o facial.

PALABRAS CLAVE: Fosa pterigopalatina; Índice cefálico; Índice facial superior; Anestesia maxilar.

REFERENCES

Adak, D. K. Variation in anthropometric characters and their relationship with climatic factors: a study on the peoples of Arunachal Pradesh, India. *Anthropol. Anz., 62(4)*:445-61, 2004.

Apinhasmit, W.; Chompoopong, S.; Methathrathip, D.; Sangvichien, S. & Karuwanarint, S. Clinical anatomy of the posterior maxilla pertaining to Le Fort I osteotomy in Thais. *Clin. Anat., 18(5)*:323-9, 2005.

Bharati, S.; Demarchi, D. A.; Mukherji, D.; Vasulu, T. S. & Bharati, P. Spatial patterns of anthropometric variation in India with reference to geographic, climatic, ethnic and linguistic backgrounds. *Ann. Hum. Biol., 32(4)*:407-44, 2005.

Bleier, B. S. & Mirza, N. Image guided transoral approach to the pterygopalatine fossa. *Laryngoscope, 116(10)*:1927-9, 2006.

Daniels, D. L.; Rauschning, W.; Lovas, J.; Williams, A. L. & Haughton, V. M. Pterygopalatine fossa: computed tomographic studies. *Radiology, 149(2)*:511-6, 1983.

Daniels, D. L.; Mark, L. P.; Ulmer, J. L.; Mafee, M. F.; McDaniel, J.; Shah, N. C.; Erickson, S.; Sether, L. A. & Jaradeh, S. S. Osseous anatomy of the pterygopalatine fossa. *AJNR Am. J. Neuroradiol., 19(8)*:1423-32, 1998.

del Sol, M. Índice cefálico en un grupo de individuos mapuches de la IX Región de Chile. *Int. J. Morphol., 23(3)*:241-6, 2005.

del Sol, M. Índices faciales en individuos mapuche. *Int. J. Morphol., 24(4)*:587-90, 2006.

Douglas, R. & Wormald, P. J. Pterygopalatine fossa infiltration through the greater palatine foramen: where to bend the needle. *Laryngoscope, 116(7)*:1255-7, 2006.

Farkas, L. G.; Katic, M. J. & Forrest, C. R. Anthropometric proportion indices in the craniofacial regions of 73 patients with forms of isolated coronal synostosis. *Ann. Plast. Surg., 55(5)*:495-9, 2005.

Figún, M. & Garino, R. *Anatomía Odontológica Funcional y Aplicada.* 2ª ed. Buenos Aires, El Ateneo, 2001.

Guyot, L.; Richard, O.; Adalian, P.; Bartoli, C.; Dutour, O. & Leonetti, G. An anthropometric study of relationships between the clival angle and craniofacial measurements in adult human skulls. *Surg. Radiol. Anat., 28(6)*:559-63, 2006.

Jorgensen, N. & Hayden, J. *Anestesia Odontológica*. 3ª ed. México, Interamericana, 1982.

Kohase, H.; Miyamoto, T. & Umino, M. A new method of continuous maxillary nerve block with an indwelling catheter. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod., 94(2)*:162-6, 2002.

Latarjet, M. & Ruiz-Liard, A. *Atlas de Anatomía*. 2ª ed. Buenos Aires, Panamericana, 2004.

Mercuri, L. G. Intraoral second division nerve block. *Oral Surg. Oral Med. Oral Pathol., 47(2)*:109-13, 1979.

Methathrathip, D.; Apinhasmit, W.; Chompoopong, S.; Lertsirithong, A.; Ariyawatkul, T. & Sangvichien, S. Anatomy of greater palatine foramen and canal and pterygopalatine fossa in Thais: considerations for maxillary nerve block. *Surg. Radiol. Anat., 27(6)*:511-6, 2005.

Moiseiwitsch, J. & Irvine, T. Clinical significance of the length of the pterygopalatine fissure in dental anesthesia. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod., 92(3)*:325-8, 2001.

Roberti, F.; Boari, N.; Mortini, P. & Caputy, A. J. The pterygopalatine fossa: an anatomic report. *J. Craniofac. Surg., 18(3)*:586-90, 2007.

Rouvière, H. & Delmas, A. *Anatomía Humana Descriptiva, Topográfica y Funcional.* 10ª ed. Barcelona, Masson, 1999. V.3.

Seltsam, J. H. Mandibular and maxillary anesthesia; uses of the conduction technique. *Calif. Med., 85(6)*:406-12, 1956.

Singh, B.; Srivastava, S. K. & Dang, R. Anatomic considerations in relation to the maxillary nerve block. *Reg. Anesth. Pain Med., 26(6)*:507-11, 2001.

Slavkin, H. C.; Canter, M. R. & Canter, S. R. An anatomic study of the pterygomaxillary region in the craniums of infants and children. *Oral Surg. Oral Med. Oral Pathol., 21(2)*:225-35, 1966.

Spillane, L. M. & McNamara, J. A. Arch width development relative to initial transpalatal width. *J. Dent. Res. Abst., 68(1538)*:374, 1989.

Tima, M. *Anestésicos Locales: Uso en Odontología.* Concepción, Ediciones Universidad de Concepción, 1995.

Walker, M.; Drangsholt, M.; Czartoski, T. J. & Longstreth, W. T. Jr. Dental diplopia with transient abducens palsy. *Neurology, 63(12)*:2449-50, 2004.

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