Int. J. Odontostomat.,
3(2):163-166, 2009.

Craniofacial Asymmetries in Subadults with Hydrocephalus

Asimetrías Craneofaciales en Subadultos con Hidrocefalia

Iván Suazo Galdames[*] ; Daniela Zavando M.[**] & Priscila Russo[***]

SUAZO, G. I.; ZAVANDO, M. D. & RUSSO, P. Craniofacial asymmetries in subadults with hydrocephalus. ***Int. J. Odontostomat., 3(2)***:163-166, 2009.

ABSTRACT: Hydrocephalus is a disorder characterized by elevated intracranial pressure of cerebrospinal fluid causes an increase in cranial volume, especially the bones of the calvaria. There is no research that considers the effects of this pathology in the development of asymmetries in bones of the skull base. The purpose of this study was to determine the presence of asymmetries in the development of some elements of the skull base and craniofacial junction. We studied 7 subadult skulls of individuals who developed hydrocephalus, from the collection of the Universidade Federal de Sao Paulo, they identified the bilateral linear distance from the pharyngeal tubercle to a series of points on the skull base and craniofacial junction, calculated the asymmetry index. All skulls showed some level of asymmetry, mostly under 10%, with further development on the left side; only 1 skull presented a high level of asymmetry more than 21%. Our analysis suggests that the phase in which it develops hydrocephalus (prenatal, perinatal or postnatal) is important in the development of these asymmetries.

KEY WORDS: hydrocephalus, asymmetry, craniofacial development, skull.

INTRODUCTION

Hydrocephalus is a condition characterized by increased intracranial pressure of cerebrospinal fluid. 25% of cases are congenital hydrocephalus, the remaining percentage can develop after trauma, tumor or infection (Aufderheide & Rodríguez-Martín, 1998). Without treatment, 50% of individuals die before 5 years of life. When hydrocephalus occurs during prenatal or early postnatal development causes significant changes in the volume of the skull, due to the stimulation that the intracranial pressure exerted on the bones of the neurocranium of membranous ossification.

The magnitude of the increase in volume that hydrocephalus produces is inversely related to the development level of skull the sutures and caused a thinning of the bones that form the cavaria, this is for the differential diagnosis with other conditions that also increase the volume cranial as rickets and anemia, conditions that produce a thickening of the bones of the calvaria (Cunha & Antunez-Ferreira, 2008).

The appearance of asymmetries in skull development is well documented in cases of craniosynostosis, especially in the case of plagiocephaly (Kreiborg & Bjork, 1981; Czorny *et al.,* 1988; Cohen, 1995), but its description in individuals hydrocephalus has not been reported.

Against this background the purpose of this study is to analyze, in a retrospective case series of individuals who carried subadults hydrocephalus, the presence of asymmetries in the development of some elements of the skull base and craniofacial junction.

MATERIAL AND METHOD

We designed a cross-sectional study from a group of skulls from the collection of the Universidade Federal de São Paulo. Were selected skulls of

* Morfología, Universidad de Talca, Chile.
** Departamento de Morfología e Genética, Universidade Federal de Sao Paulo.

subadults individuals diagnosed with hydrocephalus, according to record, and morphological evidence of the presence of this dismorphosis. The skulls were examined and excluded those who had alterations in the bones of the skull base and the zygomatic arch, such as fracture, tissue loss, and so on.

The characteristics of individuals belonging to the 7 skulls that were the sample are in Table I.

The skulls selected were photographed in standard baseline, using a Casio Exilim EX-Z60 6.0 mega pixels and analyzed using a standardized procedure described by Moreira (2006) and Moreira *et al.* (2006).

Table I. Characteristics of individuals with hydrocephalus skulls analyzed. NB: newborn. Racial affinity/Skin color.

n Skull	Gender	Age	Racial affinity/Skin color
507	Male	11 months	Mulatto
244	Male	5 years	White
396	Male	10 months	White
304	Female	5 years	White
238	Female	9 months	White
188	Female	NB	White
496	Male	1 years	White

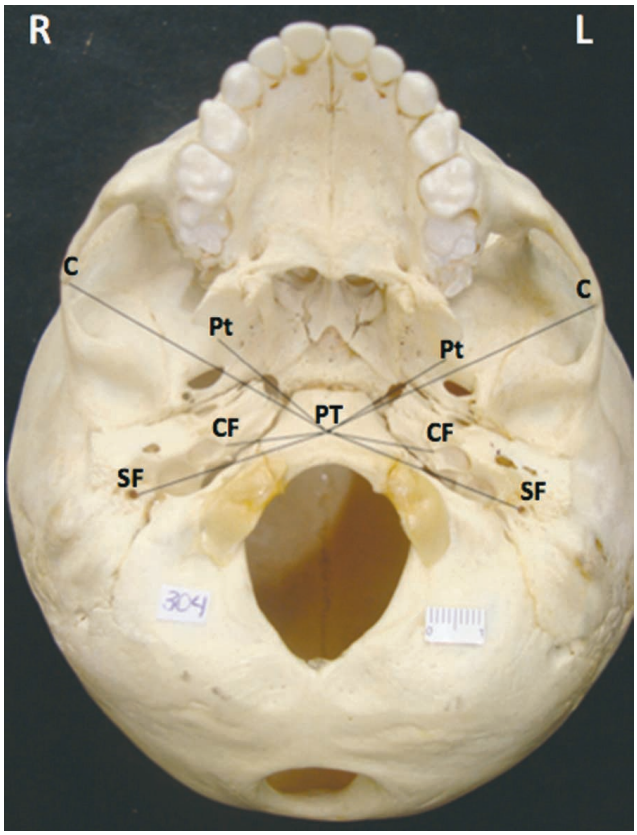

Fig. 1. Photo standardized of female skull individual 5 years of age diagnosed with hydrocephalus. PT: pharyngeal tubercle. Pt: Lateral plate of pterygoid process. CF: carotid foramen. C: Zygomatic arch. SF: Stylomastoid foramen.

Determination of the points.

Medium Point. Pharyngeal tubercle (PT): medium point located on the underside of basilar portion of the occipital bone, give attachment to the superior pharyngeal constrictor muscle and pharyngobasilar fascia. This serves as a reference point from which lines are drawn to the lateral points.

Lateral points. Lateral plate of pterygoid process (Pt): Bilateral Point located at the junction of the posterior border of the lateral plate of ptergoides process and the underside of the greater wing of the sphenoid bone.

Zygomatic arch (C): Bilateral point located in the medial portion of the junction of the zygomatic process of the temporal bone and the temporal process of zygomatic bone.

Carotid foramen (CF): Bilateral point located in the medial portion of the inferior opening of the carotid canal.

Stylomastoid foramen (SF): Point bilateral located centrally of stylomastoid foramen.

Linear distances were determined between the point PT and Pt lateral points, C, CF and SF, in the manner as shown in Figure 1.

The dimensions obtained were compared and calculated the asymmetry index (AI) between right and left sides, expressed as a percentage. The formula for calculating the asymmetry index is in Figure 2.

$$\text{Asymmetry Index} = \frac{\text{Right side - Left side}}{\text{Right side}} \times 100$$

Fig. 2. Formula to calculate the asymmetry index. PT: pharyngeal tubercle. Pt: Lateral plate of pterygoid process. CF: carotid foramen. C: Zygomatic arch. SF: stylomastoid foramen. AI%: Asymmetry index expressed in percentage.

RESULTS

Most of the linear dimensions analyzed in the 7 sub-adult skulls of individuals with hydrocephalus were higher in the left side, which meant that the asymmetry index is negative in 4 out of 4 dimensions (skull 496), 3 of the 4 dimensions (skulls 507, 244, 238) and 2 of the 4 dimensions (skull 396 and 304). Only in the skull no 188 all dimensions were greater on the right side.

The largest asymmetries were found in the skulls 188 (with ranges between 21.09 and 1.22) and 396 (between -6.14 and 9.58). The detail of the measured dimensions between the PT and Pt, C, CF and SF, as well as asymmetry indices calculated for each case is in Table II.

Table II. Dimensions measures between the PT and Pt, C, CF and SF and asymmetry index calculated in 7 subjects subadult skulls with hydrocephalus.

	Pt			C			CF			FS		
Skull	**Right**	**Left**	**AI %**	**Right**	**Left**	**AI%**	**Right**	**Left**	**AI**	**Right**	**Left**	**AI %**
507	37.25	38.23	-2.63087	21.7	21.98	-1.29032	18.57	19.43	-4.63113	33.39	33.1	0.868524
244	50.92	51.32	-0.78555	23.14	22.93	0.907519	19.89	20.31	-2.11161	33.8	35.58	-5.26627
396	38.39	40.75	-6.14743	26.08	27.07	-3.79601	15.72	14.96	4.834606	27.96	25.28	9.585122
304	49.86	48.65	2.426795	23.64	23.45	0.803723	17.98	19.03	-5.83982	33.75	34.35	-1.77778
238	36.07	36.6	-1.46937	25.54	23.92	6.342991	19.2	19.63	-2.23958	27.64	29.34	-6.15051
188	25.41	21.65	14.79732	50.49	49.87	1.227966	21.33	16.83	21.09705	25.69	22.9	10.86026
496	44.36	45.86	-3.38142	22.52	24.1	-7.01599	15.48	17.7	-14.3411	29.82	30.93	-3.72233

DISCUSSION

In our study we found low levels of asymmetry in most of the skulls of immature individuals hydrocephalus analyzed (6 /7, with levels below to 10%), the exception was a case that presented high levels, reaching 21% of bilateral asymmetry in point inferior opening of the carotid canal, with greater development in the right side.

The lack of similar studies do not allow us to compare our results with the literature, however they suggest that the development of asymmetries in patients with hydrocephalus may be related to congenital presence of this alteration, an example is the fact that the skulls with smaller asymmetry index coincided with older individuals of the cases examined (5 years). On the other skull asymmetry with the highest corresponded to newborn individual in which the development of the disturbance must be prenatal. This study presents the limitations of retrospective case reports, so it is suggested to explore this area with imaging examinations of patients in which it is possible to obtain more information. Yet we allow ourselves to draw some hypotheses regarding the findings in this investigation.

The presence of marked cranial asymmetry in individuals who developed prenatal hydrocephalus suggests that during the final stage of intrauterine development, the forces generated by intracranial stimulus, promotes the eccentric growth of neurocranium (brain growth, increased cerebrospinal fluid pressure) are offset by opposing forces, especially muscle, being this process shaped by the limitations of existing physical space in the uterus in late pregnancy. These limitations are removed in extrauterine life, so even when the muscles no scope to offset the growth stimulus presented by patients with hydrocephalus, it can play a shaping role in the bilateral and relatively symmetrical growth.

SUAZO, G. I.; ZAVANDO, M. D. & RUSSO, P. Asimetrías craneofaciales en subadultos con hidrocefalia. ***Int. J. Odontostomat., 3(2)***:163-166, 2009.

RESUMEN: La hidrocefalia es una patología caracterizada por la elevación de la presión intracraneal de líquido cerebroespinal que provoca un aumento de volumen craneal, especialmente de los huesos de la calvaria. No existen investigaciones que consideren los efectos de esta patología en el desarrollo de asimetrías de los huesos de la base de cráneo. El propósito de este estudio es determinar la presencia de asimetrías en el desarrollo de algunos elementos de la base de cráneo y de la unión craneofacial. Se analizaron 7 cráneos de individuos subadultos que desarrollaron hidrocefalia, pertenecientes a la colección de la Universidade Federal de Sao Paulo, en ellos se determinó la distancia lineal bilateral desde el tubérculo faríngeo a una serie de puntos en la base de cráneo y unión craneofacial, calculándose el índice de asimetría. Todos los cráneos presentaron algún nivel de asimetría, la mayoría bajo el 10%, con un mayor desarrollo en el lado izquierdo, sólo 1 cráneo presentó un nivel alto de asimetría mayor a 21%. Nuestro análisis sugiere que la fase en que se desarrolla la hidrocefalia (prenatal, perinatal o postnatal) tiene importancia en el desarrollo de estas asimetrías.

PALABRAS CLAVE: hidrocefalia, asimetría, desarrollo craneofacial, cráneo.

REFERENCES

Aufderheide, A. C. & Rodríguez-Martín, C. *The Cambridge encyclopedia of human paleopathology.* Cambridge, Cambridge University Press, 1998.

Cohen, M. M. Jr. Perspectives on craniofacial asymmetry. V. The craniosynostoses. *Int. J. Oral Maxillofac. Surg., 24*:191-4, 1995.

Cunha, A. S. & Antunez-Ferreira, N. *Antropología Forense.* 1ª Edición. Lisboa, Editorial Quid Juris, 2008.

Czorny, A.; Yettou, H.; Forlodou, P.; Issenuth, J.; Hazeaux, C. & Stricker, M. Plagiocephaly. Craniofacial asymmetry with variable curling-up. *Neurochirurgie, 34*:375-82, 1988.

Kreiborg, S. & Bjork, A. Craniofacial asymmetry of a dry skull with plagiocephaly. *Eur. J. Orthod., 3(3)*:195-203, 1981.

Moreira, R. S. *Biometria e assimetria do palato ósseo humano em diferentes grupos etários.* Tesis Maestrado, São Paulo, Universidade Federal de São Paulo, Escola Paulista de Medicina, 2006.

Moreira, R. S.; Sgrott, E. A.; Seiji, F. & Smith, R. L. Biometry of hard palate on digital photographs: a methodology for quantitative measurements. *Int. J. Morphol., 24*:19-23, 2006.

Correspondence to:
Prof. Dr. Iván Suazo Galdames
Morfología
Avenida Lircay s/n oficina N°104
Universidad de Talca
CHILE

Phone: 56-71-201576

Email: isuazo@utalca.cl

Received: 04-08-2009
Accepted: 17-10-2009