ANTHROPOLOGIE IX/2 1971

GROWTH OF NEUROCRANIUM FROM 4 TO 6 YEARS OF AGE. (USE IN POSTOPERATIVE CONTROL OF CRANIOSTENOSIS)

K. HAJNIŠ, J. KÁRNÍKOVÁ

Only very few authors have occupied themselves with the growth of the neurocranium of older children of the preschool age (4 to 6 years) both in our country and abroad.

D o k l á d a l (1955, 1958 a, b, 1960) has occupied himself in great detail with the changes of the circumference of the neurocranium, its greatest length, breadth, and the resulting cephalic index in the children of Brno at that age within the scope of a broader study from their birth until 20 years of age. K u b í č e k (1950), in fact, studied the development of the circumference of the neurocranium in children until their 15th year of age, i.e. also between 4 and 6 years, but, unfortunately, presents his results irrespective of the sex, as we can find it in some cases with clinicians. The development of the greatest length and breadth and also of the circumference of the neurocranium is examined again within the scope of broader studies in the work by P r o k o p e c (1965). Besides the listed sources, data on the growth of the neurocranium at the age of 4 to 6 years in Czech and Slovak children do not exist.

These data are not numerous either, as has already been pointed out, in the neighbouring or near European populations. Polish children of Cracow were treated in this respect by S p i t z e r as early as 1915, but only in a perfunctory manner. Later, she was followed by J a s i c k i (1934) who was also interested in Jewish children from the same locality (1936). We have also been informed anew about the fundamental growth of the neurocrania of Bulgarian children in the before described period by reports stemming from the pen of K a c a r s k i and S t a n i s c o (1967). In the years 1967 to 1968, one of the authors of this study performed basic cephalometric examinations on West German children and juveniles (H a j n i š, prepared report). At present, F i g a l o v á is dealing with similar problems in children of Prague.

Somewhat more numerous are the data on the growth of the neurocranium in children up to 3 years of age and then in the period of compulsory school attendance, as well as in later years (for a detailed survey of the relevant literature see H a j n i š—prepared report).

DIAGNOSTICS OF INFANTILE CRANIOSTENOSIS

Craniostenosis is a phenomenon where, for reasons not quite well understood to this day, narrowing of the cranium from premature closure of the cranial sutures and subsequent obliteration of the latter occur. It is believed that the cause may be endocrine disturbances, trauma before and after delivery, developmental anomalies, effects of lues, rickets, meningitis, etc. If this closure takes place already in the period of intrauterine development, or in the course of about the first three years after birth, it may (if no correction is performed) lead to very serious and permanent neurological and psychical consequences for the afflicted child. The growth agent for the enlargement of the bony cranium is the growth of the brain proper, which, as generally known, reaches, at the age of four years, about 1000 g, i.e. roughly 70 per cent of the total weight of our men and 77 per cent of our women in the adult age.

The bones of the cranium grow to a thickness appositional of the periosteum; as to the other growth, it is realized from the connective tissue of the sutures, always perpendicular to their course (V i r c h o v, 1851; cit. according to M a r t i n 1928). If thus, for example, a premature closure of the coronal suture occurs, the neurocranium does not grow in the anterio-posterior direction, but only to the breadth and the height. Thus a very short skull flattened in the front and the rear arises, called acrobrachycephaly. In the case of premature fusion of the sagittal suture, the neurocranium does not grow in breadth and so-called scaphocephaly—a boat-shaped head—comes into being, which is narrow, long and, as a rule, in the median plane ridgelike. In the case of simultaneous premature fusion of the coronal and sagittal sutures arises a so-called turriculate, very short and mainly high skull (turricephaly, oxycephaly). Among the described basic types, various transitional forms may naturally arise. In special cases, some of the sutures may fuse only partly, resulting in various asymmetries in the shape of the skull. Moreover, it is necessary to point out that in some cases, especially those of apparent craniostenosis, only different abnormities of a ancestral character are involved and the neurocranium displays growth at repeated cephalometrie studies.

A number of investigators, especially in the English-speaking world, have occupied themselves for a long time, but without result, with the diagnostics of infantile craniostenosis. A generally minute survey of literature dealing with this problem up to the year 1945 is given by Boyd (1945) and also by Ingraham (1948) and Ingraham, Eben and Matson (1948). It is of interest to note that in the mentioned diagnostics, roentgenograms cannot be used. Roentgen-ray photographs, as a matter of fact, possess various shortcomings and often show that the suture is open. As has been subsequently ascertained during autopsy in the case of exitus, it is, in fact, already closed. The changed structure of the bone in the site of the suture namely is responsible for the latter to be seen in the X-ray pictures also then, if, in fact, it has already fused.

Therefore, it can, without doubt, be regarded as a great succes of Czechoslovak anthropologists and infantile neurologists that they have succeeded in solving the mentioned diagnostics of infantile craniostenosis. Already in 1956, Dittrich and Fetter read a lecture on the importance of craniometry in infantile neurology at the National Congress of Neurologists in Jeseník (Gräfenberg). In 1957, Dittrich, Lesný, Fetter and Tošovský and, in 1958, Fetter and Dittrich published the first studies in which they drew attention to the possibility of diagnosing infantile craniostenosis in the suckling and infant periods with the aid of repeated cephalometry. At least after one month measurement of the cranium performed for a longer time indicate whether the skull grows in all directions, or whether growth somewhere stagnates. After verification of growth stabilization of the neurocranium in some direction, identifying, as a rule, the fused suture, it is possible to recommend discision of the skul in its neighbourhood.

Later, further works by Czech authors dealing with this problem have been published (e.g. Dittrich, Erbenová, Fetter, Tošovský 1968; Fetter 1970, and others).

In order to facilitate diagnosing of infantile craniostenosis and to be able to estimate already at the first cephalometric examination the condition of the development of the cranium, growth norms for neurocrania from birth to the 3rd year of age have been worked out (Hajnišová, Hajniš 1960). With their aid we can already today, immediately after the first examination, determine in what direction the growth of the neurocranium stagnates and how many of its individual dimensions differ from the norm of the respective age class. According to the established condition, we either immediately recommend surgery, or call for further cephalometric examinations repeated after a certain period.

Not infrequently does it happen that discision performed in the neighbourhood of the fused suture disappears again and a situation similar to the preoperative state arises. For this reason a postoperative control examination is necessary. Our growth table quoted in the preceding (Hajnišová, Hajniš 1960) naturally serves for this purpose as well. But since it is necessary to follow, for preventive reasons, the postoperative growth, especially in some cases after the third year of life, it was imperative to work out an aid also for this purpose. We availed ourselves, therefore, of the anthropological research performed in November and December 1959 on the entire territory of the State for other objectives for obtaining, among others, also data and material for the growth of the cranium of Czech and Slovak children aged 4 to 6 years.

MATERIAL AND METHODS

For the determination of the growth norm of the principal signs of infantile neurocrania from the beginning of the 4th to the 6th year of life we used the data from 570 boys and 579 girls from the territory of the entire Czechoslovakia. Involved was a crosssectional examination realized in November and December 1959. The collection of data was performed, among others, by M. Prokopec (Slovakia) and Ch. Troníček (Bohemia) as heads of two out of three teams, whom we wish to express our thanks on this occasion for making available a part of the records and data for this study. The number of examined persons in the individual age classes can be seen from the tables.

The determination of the localities where research was carried out and the necessary number of examined persons for obtaining nation-wide valid results of measurements was performed by the method of two-stage selection by Dr. Hájek of the Institute of Mathematics, Czechoslovak Academy of Sciences, Prague. After the experiences we had gained with the growth of the cranium of younger children (Hajnišová, Hajniš 1960), we formed in the present study broader age classes of older children. The examined persons in the 4th year of life were, in fact, subdivided into four three-month classes, as it was the case with the children in the second and the third year in our cited work, while the children in the 5th and the 6th year of life were grouped into half-year intervals. Here, too, we proceeded from the practical determination of the age by a physician, when forming the age classes, and, therefore, the presented norms always comprise children, e.g. between $3-3^1/_4$, $3^3/_4-4$, $5-5^1/_2$ years, etc. The determination of the age was performed according to the dates of birth and examinations, each child thus being able to be compared in a simple manner with the respective norm as well.

On the basis of our own experience with diagnosing and the performance of postoperative control examinations we believe that for the current estimate of growth dynamics and the shape of the neurocranium a smaller number of signs than we had anticipated in our original work of 1960 will suffice. That is why we quote only the growth norms of the greatest length (g-op) and the greatest breadth (eu-eu) of the neurocranium, the smallest breadth of the forehead (ft-ft), the breadth of the cranial base (t-t), of the transversal arch (t-v′-t) and the circumference of the neurocranium measured via the points g and op. All the signs, with the exception of the arch t-v′-t, were measured according to Martin (M a r t i n, S a l l e r 1957) with the aid of a cephalometer and a medical tape measure.

Since the described research work, from which the presented data were obtained, was meant for an other purpose, the arch t-v-t was not examined so as we measured it in our work for the creation of the growth norm for the neurocranium in younger children (H a j n i š o v á, H a j n i š 1960). In this case the tape measure ran across the vertex with a dash (v′), which we defined as a point on the cranial vault at the intersection point of the medial-sagittal plane of the head and the plane running perpendicularly to it through both points of the tragion (t). The auxiliary point v′ thus lies, as a rule, ahead of the real vertex and, therefore, the arch measured via this point is shorter than in measurements via the real point of the vertex (v).

With regard to various data in the relevant literature (L e s n ý, D i t t r i c h 1954; F e t t e r, D i t t r i c h 1958, and others) which maintain that in craniostenosis certain changes on the splanchnocranium (hypertelorism, flattening of the maxilla, etc.) can also be found, further signs were examined as well. For lack of room it is, however, not possible to give their growth values in this paper, but since they may complete the picture of anomalies studied, we shall publish them in an other communication.

From the measured values some indices, of which we are quoting three, because they may be of a certain significance for estimating the pathological and physiological abnormities of the neurocranium, were calculated. They are: the cephalic index, the frontoparietal index (M a r t i n, S a l l e r 1957), and the cranial vault index $\left(\frac{(t-t) \times 100}{t-v'-t}\right)$.

The estimation of the size and the shape of the neurocranium with regard to the presented norm should be performed with regard to the standard error both in diagnosing craniostenosis and in the case of postoperative control, as generally known.

ANALYSIS OF GROWTH

The growth changes of all the examined distances are given in the Tables 1—9. The changes of the mean values of the directly measured distances are also to be seen from Fig. 1.

If we compare the growth dynamics of all the examined distances with one another, we can see that the greatest increments are displayed by the circumference of the neurocranium and by its transversal arch as well. Of the direct dimensions, the breadth of the cranial base of boys grew most in the period under study, while in girls the maximal length of the neurocranium. On the whole, as can be seen mainly from Fig. 1, too great an enlargement of the neurocranium does not occur between 4—6 years.

When comparing the mean values of our 37 to 39 months (3—3¼ years) age class with the data

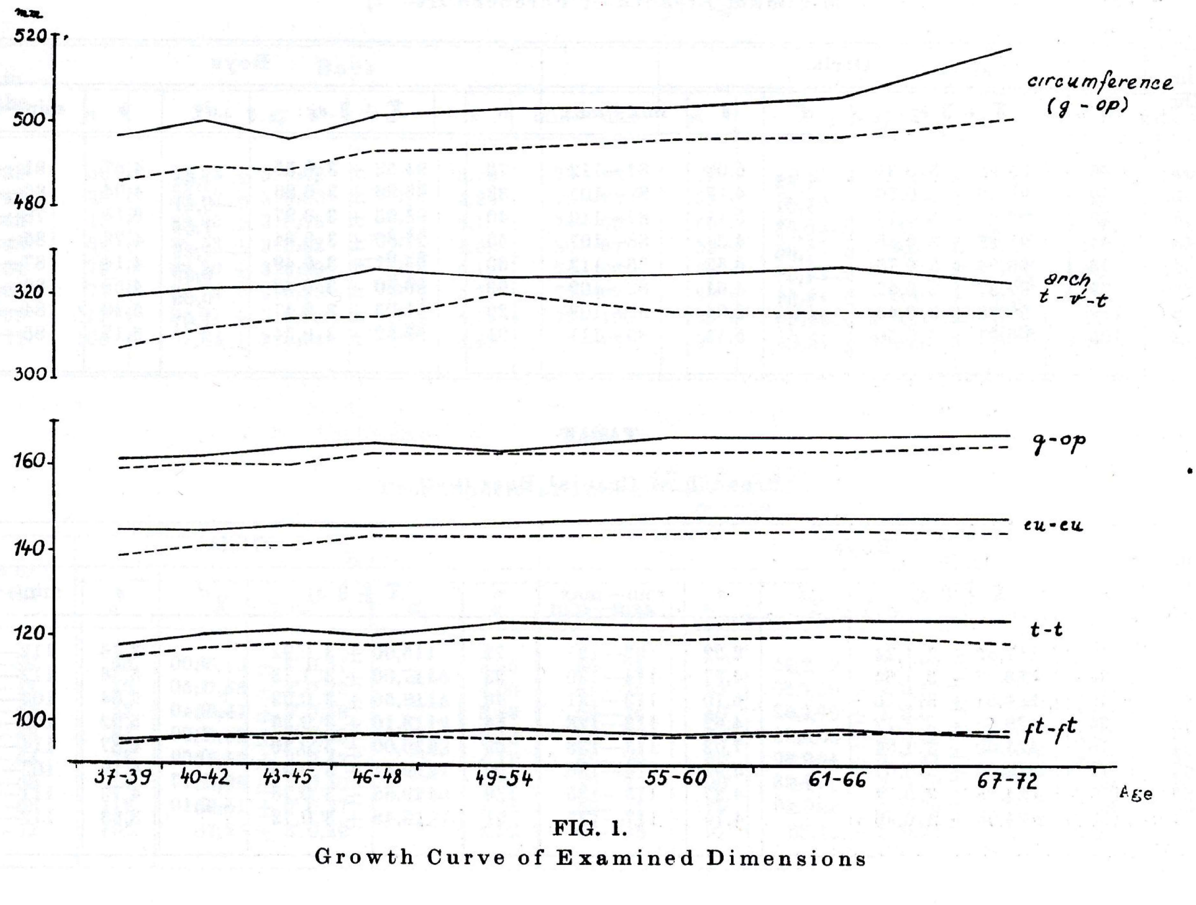

FIG. 1.
Growth Curve of Examined Dimensions

TAB. 1

Maximum Length of Neurocranium (g—op)

Age in months	Boys					Girls				
	n	$\bar{X} \pm 3 . s_{\bar{x}}$	d	s	min—max	n	$\bar{X} \pm 3 . s_{\bar{x}}$	d	s	min—max
37—39	56	160,96 ± 3.0,88	0,88	6,29	152—187	72	159,13 ± 3.0,77	1,61	6,41	143—176
40—42	30	161,84 ± 3.0,91	2,03	6,73	154—186	33	160,54 ± 3.0,97	—0,62	5,57	149—172
43—45	43	163,87 ± 3.0,84	1,53	5,49	151—172	40	159,92 ± 3.0,75	2,80	4,71	151—171
46—48	64	165,40 ± 3.1,23	—1,94	7,10	149—178	55	162,72 ± 3.0,78	0,42	5,83	151—173
49—54	76	163,46 ± 3.0,83	3,65	7,96	152—180	69	163,14 ± 3.0,67	0,29	5,53	152—176
55—60	77	167,11 ± 3.0,68	0,04	6,05	154—186	90	163,43 ± 3.0,66	0,42	6,31	153—179
61—66	119	167,15 ± 3.0,64	1,10	6,84	145—188	129	163,85 ± 3.0,48	1,61	5,42	153—178
67—72	105	168,25 ± 3.0,64		6,61	147—186	91	165,46 ± 3.0,57		5,50	153—177

TAB. 2

Maximum Breadth of Neurocranium (eu—eu)

Age in months	Boys					Girls				
	n	$\bar{X} \pm 3 . s_{\bar{x}}$	d	s	min—max	n	$\bar{X} \pm 3 . s_{\bar{x}}$	d	s	min—max
37—39	56	144,54 ± 3.0,91	0,36	4,93	136—163	72	138,51 ± 3.1,11	2,61	4,37	127—152
40—42	30	144,90 ± 3.1,08	1,06	5,92	134—157	33	141,12 ± 3.0,51	0,05	6,38	123—153
43—45	43	145,96 ± 3.0,67	0,13	6,06	135—159	40	141,17 ± 3.1,17	2,52	7,45	129—158
46—48	64	146,09 ± 3.0,70	0,67	5,66	133—160	55	143,69 ± 3.0,74	—0,23	5,52	127—155
49—54	76	146,76 ± 3.0,75	1,35	6,58	135—163	69	143,46 ± 3.0,68	0,70	5,71	129—156
55—60	77	148,11 ± 3.0,56	0,10	4,97	137—160	90	144,16 ± 3.0,61	0,81	5,87	123—155
61—66	119	148,21 ± 3.0,46	0,29	5,02	131—163	129	144,97 ± 3.0,45	—0,40	5,23	130—156
67—72	105	148,50 ± 3.0,56		5,80	131—169	91	144,57 ± 3.0,59		5,70	133—156

TAB. 3

Minimum Breadth of Forehead (ft—ft)

Age in months	Girls					Boys				
	n	$\bar{X} \pm 3 . s_{\bar{x}}$	d	s	mix—max	n	$\bar{X} \pm 3 . s_{\bar{x}}$	d	s	min—max
37—39	56	95,28 ± 3.0,81	1,32	6,08	84—112	72	94,52 ± 3.0,55	1,84	4,57	81—104
40—42	30	96,60 ± 3.0,76	1,01	4,17	89—107	33	96,36 ± 3.0,86	—0,41	4,94	86—104
43—45	43	97,61 ± 3.0,77	—0,33	5,11	87—110	40	95,95 ± 3.0,97	1,55	6,15	78—109
46—48	64	97,28 ± 3.0,56	1,56	4,54	88—107	55	97,50 ± 3.0,64	—1,29	4,76	85—118
49—54	76	98,84 ± 3.0,75	—1,47	6,52	85—113	69	96,21 ± 3.0,49	0,39	4,14	87—105
55—60	77	97,37 ± 3.0,52	1,31	4,61	86—109	90	96,60 ± 3.0,48	0,65	4,58	86—109
61—66	119	98,68 ± 3.0,45	—1,77	5,04	82—109	129	97,25 ± 3.0,47	1,07	5,40	84—109
67—72	105	96,91 ± 3.0,50		5,15	89—111	91	98,32 ± 3.0,54		5,17	85—111

TAB. 4

Breadth of Cranial Base (t—t)

Age in months	Boys					Girls				
	n	$\bar{X} \pm 3 . s_{\bar{x}}$	d	s	min—max	n	$\bar{X} \pm 3 . s_{\bar{x}}$	d	s	min—max
37—39	56	117,42 ± 3.1,24	2,95	8,32	92—127	72	115,00 ± 3.0,92	2,00	3,76	112—122
40—42	30	120,37 ± 3.1,65	1,50	4,67	114—130	33	117,00 ± 3.1,13	1,50	5,36	112—122
43—45	43	121,87 ± 3.1,15	—1,52	6,10	113—131	40	118,50 ± 3.0,92	—0,40	6,64	104—125
46—48	64	120,35 ± 3.1,12	3,25	4,62	113—128	55	118,10 ± 3.0,35	1,90	5,92	109—128
49—54	76	123,60 ± 3.1,84	—0,60	7,03	113—138	69	120,00 ± 3.0,26	—0,59	4,87	114—130
55—60	77	123,00 ± 3.0,67	1,28	5,91	114—136	90	119,41 ± 3.0,98	1,17	5,19	103—130
61—66	119	124,28 ± 3.0,72	—0,20	4,27	115—135	129	120,58 ± 3.0,78	—2,10	4,73	111—131
67—72	105	124,08 ± 3.0,98		4,74	117—133	91	118,48 ± 3.0,72		3,88	112—127

TAB. 5

Circumference of Neurocranium (across g and op)

Age in months	Boys					Girls				
	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max
37—39	56	496,86 ± 3.1,82		13,55	460—525	72	486,52 ± 3.1,68		14.09	442—530
40—42	30	500,50 ± 3.2,58	3,64	14,18	473—533	33	489,69 ± 3.2,48	3,17	14,18	465—513
43—45	43	496,54 ± 3.1,93	—3,96	12,84	475—520	40	489,11 ± 3.2,23	—0,58	13,92	470—520
46—48	64	502,00 ± 3.1,66	5,46	13,33	460—525	55	493,59 ± 3.1,87	4,48	13,92	457—528
49—54	76	503,58 ± 3.0,55	1,58	15,10	470—539	69	494,23 ± 3.1,48	0,64	12,36	470—523
55—60	77	503,96 ± 3.1,40	0,38	12,30	475—532	90	497,05 ± 3.1,58	2,82	15,06	467—530
61—66	119	506,39 ± 3.1,26	2,43	13,74	455—560	129	497,30 ± 3.1,21	0,25	13,88	459—522
67—72	105	518,21 ± 3.1,52	11,82	15,58	482—559	91	501,75 ± 3.1,47	4,45	14,10	470—536

TAB. 6

Transversal Arch (*t—v'—t*)

Age in months	Boys					Girls				
	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max
37—39	56	319,14 ± 3.2,51		9,40	303—331	72	307,41 ± 3.2,92		10,11	293—323
40—42	30	321,41 ± 3.2,63	2,27	10,86	300—340	33	312,00 ± 3.1,53	4,59	4,59	293—340
43—45	43	322,00 ± 3.2,49	0,59	7,07	310—334	40	314,50 ± 3.5,58	2,50	19,30	280—335
46—48	64	326,00 ± 3.3,65	4,00	11,54	313—340	55	314,89 ± 3.3,61	0,39	15,72	281—345
49—54	76	324,00 ± 3.3,48	—2,00	13,49	296—348	69	320,57 ± 3.1,66	5,68	6,20	310—330
55—60	77	325,05 ± 3.3,29	1,05	13,96	300—349	90	316,64 ± 3.2,66	—3,93	13,94	300—347
61—66	119	327,08 ± 3.2,02	2,03	12,14	293—350	129	316,85 ± 3.2,30	0,21	13,63	293—340
67—72	105	323,77 ± 3.2,54	—3,31	11,95	305—352	91	316,24 ± 3.2,06	—0,61	11,05	282—340

TAB. 7

Cephalic Index $\frac{(eu — eu) \times 100}{g — op}$

Age in months	Boys					Girls				
	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max
37—39	56	89,24 ± 3.0,49		3,68	79—95	72	89,61 ± 3.0,45		3,78	81—95
40—42	30	88,82 ± 3.0,80	—0,42	4,28	79—96	33	88,43 ± 3.0,73	—1,17	4,23	80—97
43—45	43	89,95 ± 3.0,76	1,13	5,10	79—99	40	88,47 ± 3.0,67	0,04	4,19	79—97
46—48	64	88,53 ± 3.0,52	—1,42	4,09	80—97	55	88,35 ± 3.0,58	—0,12	4,28	79—98
49—54	76	88,20 ± 3.0,59	—0,33	5,19	74—96	69	88,09 ± 3.0,51	—0,26	4,28	77—97
55—60	77	88,74 ± 3.0,49	0,54	4,37	77—99	90	88,51 ± 3.0,42	0,46	4,03	80—99
61—66	119	88,91 ± 3.0,37	0,17	4,09	79—100	129	88,59 ± 3.0,37	0,08	4,17	75—100
67—72	105	87,84 ± 3.0,44	—1,07	4,49	70—98	91	88,21 ± 3.0,39	—0,38	3,76	79—97

TAB. 8

Frontoparietal Index $\frac{(ft — ft) \times 100}{eu — eu}$

Age in months	Boys					Girls				
	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max
37—39	56	65,10 ± 3.0,51		3,85	56—73	72	67,12 ± 3 0,37		3,15	61—74
40—42	30	67,56 ± 3.0,73	2,46	4,00	61—75	33	67,90 ± 3.0,57	0,78	3,30	61—74
43—45	43	66,41 ± 3.0,58	1,15	3,88	59—76	40	67,70 ± 3.0,67	—0,20	4,22	55—75
46—48	64	66,53 ± 3.0,39	0,12	3,13	59—73	55	68,03 ± 3.0,52	0,33	3,95	57—82
49—54	76	67,16 ± 3.0,47	0,63	4,12	56—79	69	67,01 ± 3.0,41	—1,02	3,47	60—75
55—60	77	65,85 ± 3.0,40	—1,31	3,53	57—78	90	66,92 ± 3 0,36	—0,09	3,50	56—78
61—66	119	66,51 ± 3.0,37	0,66	4,05	55—81	129	67,04 ± 3.0,30	0,12	3,49	60—75
67—72	105	67,25 ± 3.0,29	0,74	3,03	60—75	91	68,12 ± 3.0,37	1,08	3,58	59—77

TAB. 9

Cranial Vault Index $\frac{(t-t) \times 100}{t-v'-t}$

Age in months	Boys					Girls				
	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max	n	$\bar{X} \pm 3.s_{\bar{x}}$	d	s	min—max
37—39	56	36,85 ± 3.0,70	0,27	2,63	30—40	72	38,00 ± 3.0,52	—1,10	1,73	35—40
40—42	30	37,12 ± 3.0,66	0,08	1,89	35—41	33	36,90 ± 3.0,98	—0,07	3,25	28—39
43—45	43	37,20 ± 3.0,61	0,32	1,94	34—40	40	36,83 ± 3.0,82	0,64	2,84	33—42
46—48	64	37,52 ± 3.0,32	0,61	1,35	35—42	55	37,47 ± 3.0,56	0,46	2,44	32—43
49—54	76	38,13 ± 3.0,47	—0,25	1,84	35—41	69	37,93 ± 3.0,60	—0,40	2,34	36—44
55—60	77	37,88 ± 3.0,38	—0,17	1,64	35—42	90	37,53 ± 3.0,48	0,18	2,58	31—42
61—66	119	37,71 ± 3.0,33	0,68	1,97	34—42	129	37,71 ± 3.0,28	—0,34	1,66	33—40
67—72	105	38,39 ± 3.0,38		1,87	34—42	91	37,37 ± 3.0,37		2,00	33—42

we obtained from the 34—36 months ($2^3/_4$—3 years) old children of Prague in our already cited paper ((H a j n i š o v á, H a j n i š 1960), we find that, besides the arch $t - v' - t$, there exists a relatively good correlation. Minor differences and dissimilarities appearing here can be explained by the fact that in the study of 1960 children of Prague were involved, while the present paper is based on data obtained from the entire territory of the State. In the case of the transversal arch ($t - v' - t$) more marked differences appear between the two described sets, these differences being due to different measuring techniques, as has already been mentioned in the aforegoing text. Despite the fact that for the dimension $t - v' - t$ we do not dispose of a worked out growth norm for children younger than 3 years, we are giving the calculated mean values for older children of preschool age, i.e. from 4 to 6 years, and recommend this sign to be used in postoperative control examinations as well.

POSTOPERATIVE CONTROL OF CRANIOSTENOSIS

As can be seen from what has been said, the presented growth values of the main dimensions of the neurocranium can be regarded as a norm, applicable, among others, also for postoperative control of growth.

According to the date of birth and examinations we rank the child into the respective age class so that, for example, among $3^1/_2$—$3^3/_4$ years of age belongs the patient that has reached at least the age of 42 months and 1 day, but has not yet exceeded 45 months, and the like. Thus, children in the first, second, third, and fourth quarter of the fourth year, in the second half of the fifth or the first half of the sixth year, etc. are involved.

After the cephalometric examination, which should be done in those cases, where no anthropologist performs it, twice one after another for the sake of verification, a comparison with the published values is possible. The measured data should naturally be treated according to the principles of biometric work. This means that we have got to find out by how many standard errors the dimension differs in the positive or negative sense from the mean value of the respective age class. The sizes that fall within the range of ± 1 s (standard error) from the mean of the dimension are always considered quite normal.

In this way it can be ascertained whether the surgical intervention has brought the desired correction and whether the retarded dimension or dimensions already exhibit a growth tendency. The verification can be performed already within a few weeks after the surgical intervention; but we recommend to perform it later and, if need be, also repeatedly. It often happens that the bones after performed discision very quickly fuse again and surgery remains without a lasting effect.

With regard to the fact that the brain (and thus perhaps, to a certain extent, the neurocranium, too) of our populations grows until about 25 to 30 years (H a j n i š 1959) and until about 14 years of age does not reach 95 per cent of the total weight in the adult age (D i t t r i c h et al. 1957), we recommend several times repeated postoperative cephalometric controls at least till the age of 6 years.

SUMMARY

The present paper deals with the growth norm for the main dimensions of the neurocranium of Czech and Slovak children aged 4 to 6 years. The authors have found that in this period there exists already an essentially minor growth than in children aged 0 to 3 years, who were examined by H a j n i š o v á and H a j n i š in 1960.

The presented growth norms are to serve for the postoperative control of size and shape conformations of the neurocrania of infantile patients with surgically treated craniostenosis. The authors recommend the first control after the performed surgical intervention to be carried out already within a few weeks after surgery, followed by repeated controls done according to possibilities, preferably regularly, at least until the sixth year of age is reached.

REFERENCES

BOYD J. D., 1945: Clinical appraisal of infants head size. — *Amer. J. Dis. Child. 69: 71—76.*

DITTRICH J., FETTER V., 1956: Význam kraniometrie v dětské neurologii (The Importance of Craniometry in Infantile Neurology). — *National Congress of Czechoslovak Neurologists, Jeseník (Gräfenberg).*

DITTRICH J., LESNÝ I., FETTER V., TOŠOVSKÝ V., 1957: Poznání, operační indikace a význam časné operace kraniostenos. *Čs. neurologie, 20: 263–276.*
DITTRICH J., ERBENOVÁ V., FETTER V., TOŠOVSKÝ V., 1968: Die Anwendung der Kraniologie bei der Heilung von Kraniostenosen. — *Anthropologie. 6.2: 63–65.*
DOKLÁDAL M., 1955: Základní znaky tělesného vývoje brněnských novorozenců. — *Čs. pediatrie. 10: 114–120.*
DOKLÁDAL M., 1958 a): Vývoj základních rozměrů hlavy od narození do 20 let. — *Čs. morfologie. 6.2: 103–115.*
DOKLÁDAL M., 1958 b): Hlavový index v prvních dvaceti letech života. — *Čs. morfologie. 6.3: 207–220.*
DOKLÁDAL M., 1960: Rozměry hlavy jako doplněk k ocenění celkového tělesného vývoje dítěte. — *Čs. pediatrie. 15.5: 448–459.*
FETTER V., 1970: Kraniostenosen und Kephalometrie. — *Ärztl. Jugendkunde. 61.4: 282–288.*
FETTER V., DITTRICH J., 1958: Kefalometrie jako diagnostická pomůcka při léčení pathologických lebečních deformit. — *Przegl. Anthrop. 24: 97–108.*
HAJNIŠ K., 1959: Váhový vývoj mozku dospělého obyvatelstva českých zemí. — *Čs. morfologie. 7.2: 157–162.*
HAJNIŠ K., prepared paper: Das Wachstum des Kopfes, der Ohrmuschel und der Hand bei der deutschen Kindern und Jugendlichen (Benützung bei den Operationen der angeborenen Missbildungen und nach den Unfällen).
HAJNIŠOVÁ M., HAJNIŠ K., 1960: Růst mozkové části dětské hlavy od narození do tří let. — *Acta Univ. Carol. Medica. 6: 531–592.*
INGRAHAM S., 1948: Anperimental observation in the treatment of Craniostenosis. — *Surgery, 23: 252–268.*
INGRAHAM S., EBEN A., MATSON D. D., 1948: Clinical studies in craniostenosis. — *Surgery, 24: 518–541.*
JASICKI B., 1934: Wzrastanie wymiarów głowy z wiekiem u młodzieży męskiej krakowskich szkól powszechnych i średnich. — *Spraw. Tow. Nauk. Warszawa. 27. IV: 41–42.*
JASICKI B., 1936: W sprawie typów morfologicznych i rozwoju mlodzieży żydowskiej miasta Krakowa. — *Spraw. Polskiej Akad. Um. XLI. 1: 23–24.*
KACARSKI M., STANISCO D., 1967: Sex dimorphism of head between age 3 to 17 in boys and girls of Plovdiv. — *Folia Medica. 9.2: 144–153.*
KUBÍČEK K., 1950: Měření a vážení dětí. — *Pediatr. listy. 5: 301–306.*
LESNÝ I., DITTRICH J., 1954: Význam a výklad hypertelorismu. — *Čs. neurologie. — 19. 2: 118–124.*
MARTIN R., 1928: Lehrbuch der Anthropologie. — *G. Fischer, Jena.*
MARTIN R., SALLER K., 1957: Lehrbuch der Anthropologie. — *G. Fischer. Stuttgart.*
PROKOPEC M., 1965: Specific characteristics of the growth of head and face from the age of one month to 18 years. — *Acta Univ. Carol. Biol. Supplementum. 43–52.*
SPITZER O., 1915: Untersuchungen an Krakauer Mädchen. — *Mitt. Anthrop. Gess. Wien. 45: 210–215.*

Doc. RNDr. Karel Hajniš, CSc.,
Dr. J. Kárníková,
Department of Anthropology
Charles University, Prague.