Z. ŠMAHEL, P. FIGALOVÁ

DETERMINATION OF INTEROCULAR DISTANCE

Developmental anomalies of the interocular distance are encountered much more frequently than those of all other dimensions. The changes observed in human pathology vary within a wide range from almost laterally situated orbits to a single fused central orbit. However, these extreme pathological cases represent rare anomalies, while more or less pronounced changes of the interocular distance are associated with almost all types of developmental malformations. Thus an increased interocular distance has been described in numerous syndromes including: Apert's syndrome (acrocephalosyndactyly), Wardeburg-Klein's syndrome, Hurler's syndrome (mucopolysaccharidosis I.), Crouzon's syndrome (craniofacial dysostosis), Morquio-Ulrich's syndrome (osteochondrodystrophia deformans), the OFD syndrome (orofaciodigital dysostosis), Charlie M. syndrome, Whistling-face syndrome (our colleague Červenka and his co-workers, 1970, failed to confirm this association), frontonasal dysplasia and facial clefts with accompanying anomalies (Gorlin, Pindborg 1964; Gorlin 1969). It is typical of some forms of nanism (Cornelia de Lange syndrome, Donohue syndrome etc.). Further, it has been reported, e.g., in hydrocephalia and in cleidocranial dysostosis (Günther 1933 b), mandibulofacial dysostosis (Treacher-Collins syndrome, Gross 1956), craniostenosis (Lesný, Dittrich 1956), in gonosomal aberrations (Fuller, Weber 1961), autosomal aberrations, or in dental anomalies (Gorlin, Pindborg 1964) as well as in malformations involving distant sites. Thus it has been described in association with syndactyly (Chotzen 1932), brachydactyly (Reilly 1931), Sprengel's deformity (Reilly 1931; Slo-Bodkin 1936; MacGillivray 1957; James 1959), acromegaly (Günther 1933 b), heart defects (Reilly 1931), renal hypoplasia (Gross 1956) etc. The latter cases, however, most probably represent an accidental coincidence, though in some cases a genetic linkage might be possible. Higher values of the interocular distance were also noted in patients with cleft lip and palate (Moss 1965; Aduss et al. 1971; Farkaš, Lindsay 1972; Figalová et al. 1974; Müllerová-Havlová, Brejcha, in press) and their near relatives showed increased frequency of a wider interocular space (Fraser, Pashayan 1970), but we failed to disclose a tendency towards hypertelorism (Figalová, Šmahel 1971).

Mild form of hypertelorism in a patient with unilateral cleft lip and palate operated on in early childhood (intercanthal index = 45.35; circumference — intercanthal index = 7.43). X-ray examination confirmed the diagnosis.

Similarly a smaller interocular space is characteristic of some developmental anomalies. This holds true in the first place for the group of malformations designated as cyclopia — arrhinencephalia. It consist of simple trigonocephalia, arrhinencephalia, cebocephalia, ethmocephalia and cyclopia representing an increasing proximity of the two orbits or even their fusion (S i l v e r m a n 1965). But this proximity or fusion is not necessarily associated with corresponding anomalies of the covering soft tissues, and thus it is possible to see a cyclopia with two palpebral slits, as well as a trigonocephalia or arrhinencephalia with an increased distance between the two inner canthi. This might equally be observed in oculodentodigital dysplasia or in Down's syndrome, in which a reduced interorbital distance has repeatedly been demonstrated (K e r w o o d et al. 1954; S i l v e r m a n 1965; Š i l i n k o v á - M á l k o v á 1972), yet the soft tissues show a greater interocular space, which is mostly due to the presence of an epicanthal fold. Thus the distance between the inner and outer margins of the orbits, hereafter designated as interorbital or biorbital, should be distinguished from the distance between the inner or outer eyelid angles (canthi), hereafter designated as the interentocanthal (or only intercanthal) and as the interectocanthal (or bicanthal) distance. The terms interocular and biocular are used as synonyms of intercanthal and bicanthal but are less accurate.

G r e i g described in 1924 an extreme increase of interocular distance and used for the first time the term hypertelorism. The syndrome defined by this researcher is designated at the present time as Greig's hypertelorism and is distinguished from simple hypertelorism. This term has been used for all forms of greater interocular distance associated with a variety of malformations (see above). The lack of a precise distinction between the meaning of the two terms has been and still is the cause of many errors. These errors are further caused by the fact that Grieg's syndrome has not been strictly defined. Apparently this term has been used to the designation of all kinds of malformations which were not clearly assigned into a certain category and were associated with an increased interocular distance. Thus, e.g., G a a r d (1961) carried out a revision of four cases with the diagnosis of this syndrome and ascertained that definite Grieg's hypertelorism was present in one case only. He estimated that the incidence of Grieg's syndrome is 1 per 100.000 births.

As we have already mentioned, hypertelorism occurs mostly as an inherent part of a variety of malformations, while in other cases its occurence represents only more or less chance coincidence. According to G r o s s (1956) it is possible that even the simple form might be correlated with a slight degree of another malformation. Hypertelorism is characteristic of Greig's syndrome, representing a clinical entity which should include only those forms of hypertelorism where the enlargement of the interocular space is due to a primary embryonal disorder. But this is very difficult to ascertain. There are only a few reports on the familial occurence of this syndrome (e.g. A b e r n e t h y 1927; M o n t f o r d 1929; B o j l e n, B r e m s 1938; F r i e d e 1954). The heredity is autosomal dominant (M c K u s i c k 1968).

Thus an excessive intercanthal distance mostly represents the sequelae of another malformation as demonstrated in a certain number of unilateral anomalies which were described e.g. by F r i d o l i n (1890), L i g h t w o o d, S h e l d o n (1928) and D i v r y, E v r a r d (1935). They resulted from marked cranial asymmetries (plagiocephalia) and developed only the affected side. Hypertelorism is frequently associated with mental deficiency, which is due rather to some other concomitant anomaly (J a m e s 1959, found a reduced capacity of the frontal lobes). In other cases neurologic sings or symptoms are only slight or even nil. It was suggested that hypertelorism might reflect a tendency towards the doubling of facial structures (G a a r d 1961).

The pathogenesis of hypertelorism is not yet fully understood. G r e i g (1924) believed that it represents an anomaly of the sphenoid bone consisting of premature ossification and excessive growth of the lesser wings, which are larger than the great wings. Prior to the Second World War this theory was generally accepted. But later some differing opinions were also advanced. F r i e d e (1954) stated that the face of a fetus is regularly hyperteloric and that the persistence of this state is due to a disturbance of growth and development within the above mentioned region. G r o s s (1956) considered as a possible cause craniocerebral dysrrhaphia, J a m e s (1959) suggested that hypertelorism might be due to a temporary retardation of the development of the chordal portion of the base of the skull, while the development of the praechordal portion proceeds normally, and M o s s (1965) ascribed the enlarged interocular space in patients with clefts to a dysplasia of the entire nasal capsule (delimited by the hard palate, orbital walls and the anterior cerebral fossa). According to T e s s i e r and his co-workers (1967) hypertelorism results from an enlargement of the ethmoid bone. They believe that severe forms are of cranial origin (cranial malformations), while the slighter forms are of facial origin. In the Czech literature this problem was discussed by L e s n ý and D i t t r i c h (1956) who believed that hypertelorism represents a developmental anomaly of the skull as a whole. Thus none of the above-mentioned theories provides a full explanation of its origin. On the other hand hypertelorism might also be acquired (tumour, trauma).

A pathologic reduction of the intercanthal distance is designated as hypotelorism. An extreme degree of hypotelorism is encountered in the group of the already mentioned cyclopia-arrhinencephalia where the primary disorder consists of brain malformations. These malformations are associated with mental deficiency (holoprosencephalia is characteristic of cyclopia). An intermediary form, i.e. a slightly smaller interocular space, is designated as stenopia, while a corresponding enlargement is called euryopia. We think that neither are pathologic conditions. Mesopia designates the range of normal. Since the determination of individual forms on the basis of the interorbital distance does not necessarily correspond to the values obtained on the basis of the distance between the inner canthi, it is essential to discriminate between these values and to designate the former as the interorbital distance and the latter as the intercanthal distance.

ASSESSMENT OF THE INTEROCULAR DISTANCE

An assessment of the changes of the interocular distance by visual inspection is both inexact and liable to subjective errors. A deviation interpreted by one investigator as euryopia or as hypertelorism might be considered by another the upper limit of the norm and vice versa. Visual inspection is influenced mainly by the morphological aspects of the orbital region of the face, where, e.g. a flat radix nasi, small epicanthi or a smaller distance between the outer canthi might create the impression of euryopia, which may be excluded subsequently by measurements. Similarly a narrow and high radix nasi or an increased biocular distance create the impression of stenopia. These apparent types are designated as pseudoeuryopia and pseudostenopia. In this group can further be included the deviations caused by blepharophimosis, myxoedema etc. Of interest is the study of Pauli (1955). Among 800 children she found euryopia in 91 probands on the basis of visual inspection, while measurements revealed euryopia in 122 children. Thus visual inspection resulted in an underestimation of the frequency of euryopia by 1/4 of the cases.

The above mentioned observations confirm that the use of objective diagnostic methods is essential for the assessment of changes of the intercanthal distance. This type of method is represented by anthropometry. However, it would be desirable to reach an agreement on the use of an uniform method which would allow the comparison of the results of individual investigators. The measurements of the distance between the inner canthi (or of the interorbital distance on X-ray films) are most commonly used. The pathologic forms are classified on the basis of the deviation from the norm by a given number of standard deviations. But opinions vary widely. The measurement of the interpupilar distance is even less convenient since it requires the co-operation of the individual examined which is not always possible with smaller children or with mentally deficient individuals (yet, in spite of this, some studies have yielded satisfactory results — Kerwood and his co-workers, 1954). Friede (1954) studied the intercanthal distance in adult Austrians and found that stenopia varied between 21 and 24 mm, mesopia between 25 and 33 mm and euryopia between 33 and 53 mm. The range of the norm for the distance between the inner and outer canthi and for the bipupilar distance in children and adults was described by Gorlin and Pindborg (1964).

But the main drawback of the dimensions obtained by direct measurements is the fact that they do not provide the possibility of determining the proportional interrelations or the changes occurring within a given investigated region. Therefore during an assessment of deviations of the intercanthal distance, the other facial dimensions, especially the values obtained by horizontal measurements, should always be taken into consideration as well. A variety of indices is used for their determination. Thus Romanus (1953) proposed the interocular — biorbital index expressing the bitemporal distance of orbital margins in per cent of the value of the intercanthal distance. However, most commonly a reversed ratio is used, i.e. the smaller dimension is expressed in per cent of the greater dimension. A satisfactory test proved to be e.g., the interocular-bizygomatic index, but most convenient are considered the two following indices: the intercanthal index (the distance between the two inner canthi expressed in per cent of the distance between the outer canthi) and the circumference-intercanthal index (the distance between the inner canthi expressed in per cent of the circumference of the neurocranium).

The two indices were proposed by Günther as early as in 1933 (a, b, c) and were subdivided by the author into several categories according to their size. They are presented in the following table containing values obtained by the measurement of the bony framework, as well as of the morphologic soft tissue structures (Günther 1933 b).

	Range of the norm*)	
	Males	Females
Intercanthal distance	26.5—38.5	25.5—36.5
Bipupillar distance	59.0—71.5	58.0—70.5
Intercanthal index	28.4—38.0	28.4—38.0
Circumference-intercanthal index	4.9— 6.8	4.9— 6.8
Interorbital distance	19.5—30.7	18.5—29.5
Interorbital index	20.0—31.0	19.0—31.0
Circumference-interorbital ind.	3.7— 5.9	3.7— 5.9

*) *higher values denote euryopia, and lower values stenopia*

The data are calculated on the basis of the examination of adult North German probands, as well as of smaller number of skulls, and are compared with the results obtained in other studies (Günther 1933 a). According to this author the range of the norm varies within ± 2 standard deviations from the mean value. An intercanthal index below 28.4 index units (further on i) and a circumference-intercanthal index below 4.9 i are characteristic of stenopia; while a value above 38 i and above 6.8 i resp. show the presence of euryopia. In a subsequent study Günther (1933 c) suggested as the boundary for hypertelorism an intercanthal index of 42 i, and a circumference-intercanthal index of 8 i. He concluded on the basis of his studies that the two indices do not differ between the two sexes and that their values were not substantially influenced by age. Thus they can be used regardless of the age and sex of the individuals examined. However, the evidence that both indices are not influenced by age is not conclusive, since it is based

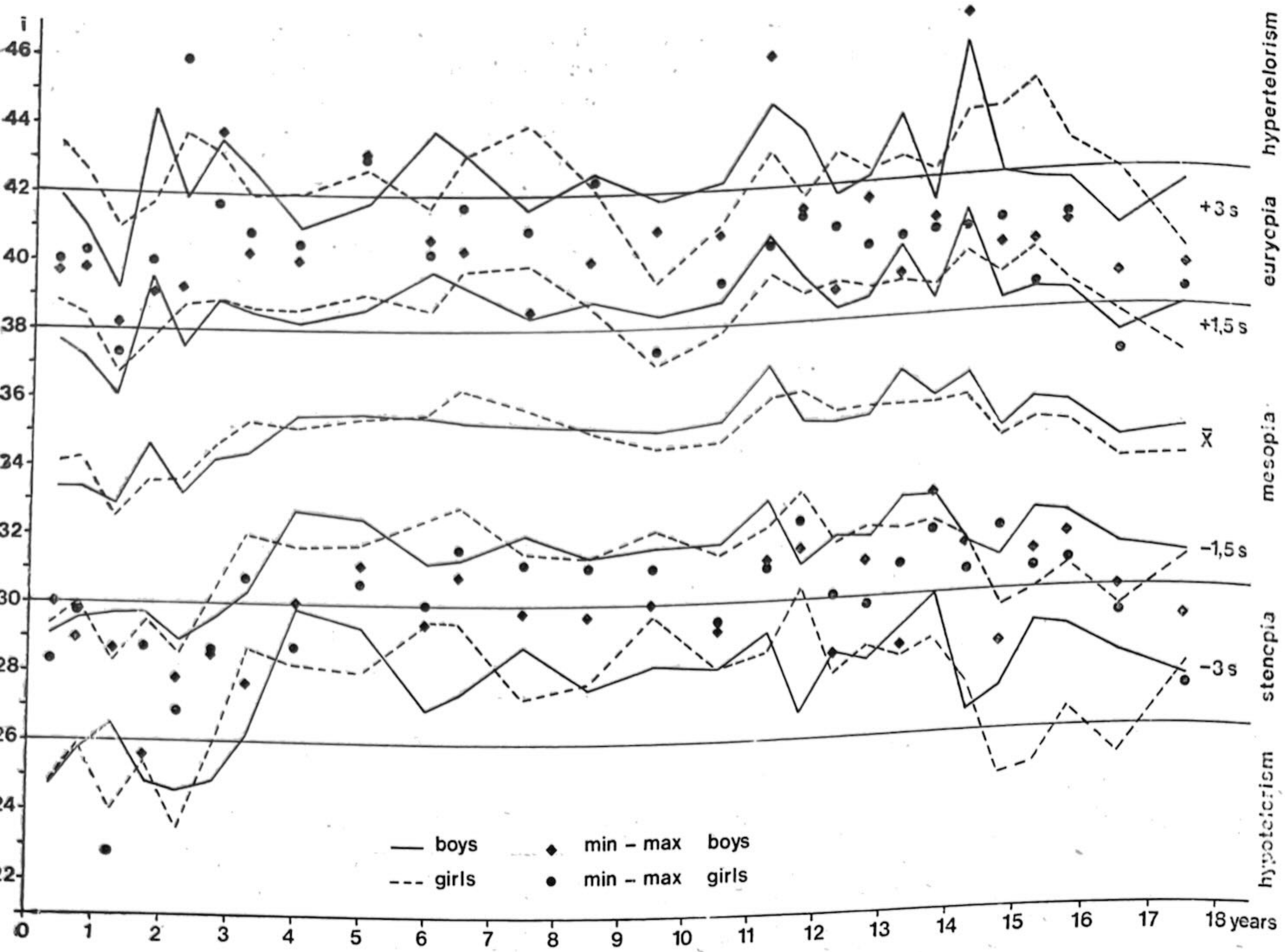


FIG. 1.
The age dependance of the intercanthal index. The values $\bar{X} \pm 1.5$ SD and $\bar{X} \pm 3$ SD and the boundaries of hypertelorism, euryopia, stenopia and hypotelorism for the Middle European population are given (according to Günther the upper limit of stenopia is 28.4 i). The minimum and maximum values ascertained in both sexes are presented.

only on the examination of a relatively small number of skulls from children and on the knowledge that the two dimensions of the circumference-intercanthal index in newborns correspond approximately to 59—60 per cent of the ultimate value ascertained in adults. This does not necessarily imply, however, that they show a constant growth rate throughout their development (the prerequisite of a stable index).

Günther's classification of the two indices is generally used both in Europe and in North America (Gorlin, Pindborg 1964). Yet even Günther admitted the occurrence of geographical differences and since an acceleration of the growth rate of the neurocranium provided evidence of secular differences it should be verified whether his classification applies for contemporary Middle European population and whether it actually can be used regardless of the age in all individuals examined. There are already some discrepancies, thus Pauli (1955) found euryopia in 15.25 per cent of the children from the region of the Ruhr, while Günther (1933) anticipated that in the case of a symmetric distribution of the sign it should theoretically occur in 2.3 per cent of individuals.

MATERIAL AND METHODS

The present communication is based on a cross-section examination of 1471 physically and mentally normal children from Prague (751 boys and 720 girls) ranging in age from three months to six and half years. The growth rate of the neurocranium and of the face has been described in more detail in a separate paper (Figalová, Šmahel 1973, 1974) including exact data. The subdivision according to age and the numbers of probands in individual age groups are presented in tabular form. We have also used the data reported by Hajnišová (1968) who examined 1812 children and adolescents from Prague ranging in age from 6 to 18 years (the two programmes of study were planned jointly). The data obtained by Hajnišová are presented only in graphical form (Fig. 1 and 4).

For the verification of Günther's classification of stenopia, euryopia and hypertelorism on the basis of the intercanthal index and of the circumference-intercanthal index we have used the measurements obtained in the earlier mentioned study (Figalová, Šmahel, 1973, 1974) for the calculations of these two indices. The mean values and other

FIG. 2

The distribution of the intercanthal index according, to the size in children aged 0—3 years and 3—6 years. The suggested classification of the index is illustrated graphically; the perpendicular dashed line shows the upper limit of stenopia according to Günther's classification ($\bar{X}$ = mean values).

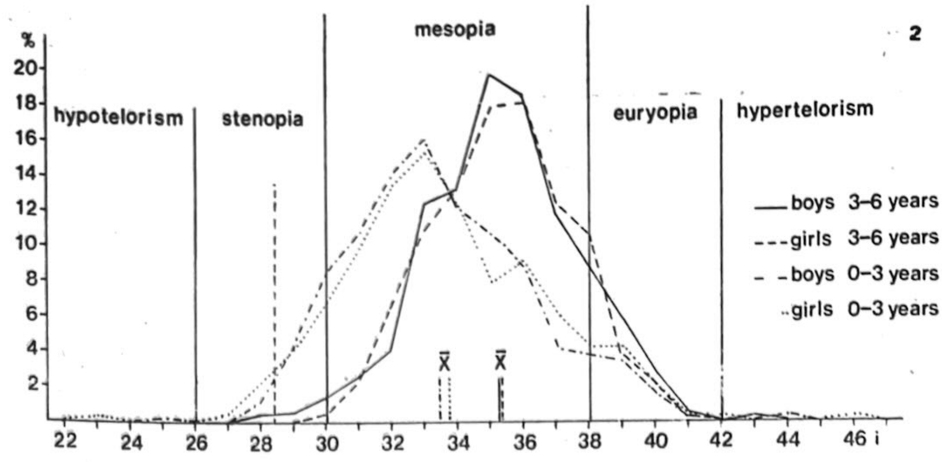


FIG. 3

The age dependance of the circumference-intercanthal index (individual computed values).

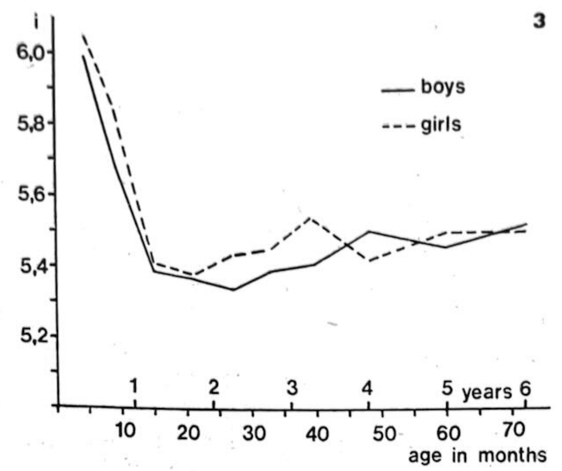
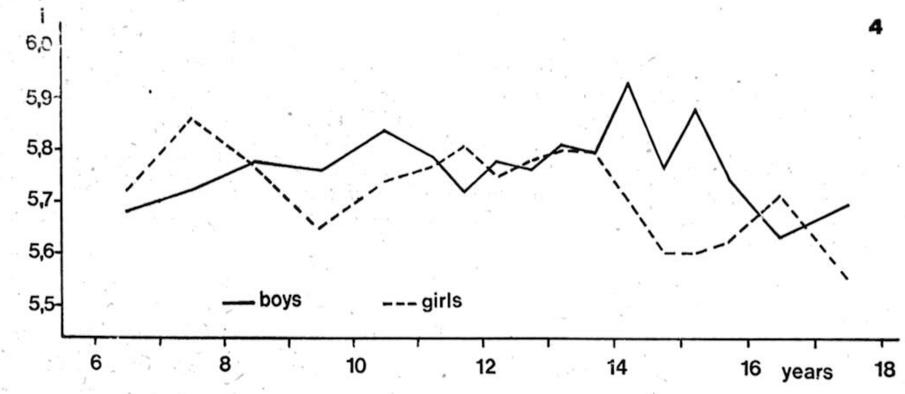


FIG. 4

The age dependance of the circumference-intercanthal index according to the data reported by Hajnišová (calculated on the basis of the mean values of the pertinent signs).



statistical characteristics, as well as the formulae used for the computations, are presented in tables 1 and ($\bar{X}$ = mean value, s = standard deviation, $s_{\bar{x}}$ = mean error, v = variation coeficient, n = number of cases). H a j n i š o v á (1968) also used in her study the intercanthal index and her results obtained with school children and adolescents are in good agreement with our data. They are presented jointly in *Fig. 1,* together with the values $\bar{X} \pm 1.5$ SD and $\bar{X} \pm 3$ SD and with the ascertained maximum and minimum values. Hajnišová did not calculated the second index and therefore we use for its computation the mean values of the pertinent dimensions *(Fig. 4).* Both experience and calculations of other indices showed that the resulting inaccuracy is negligible. Individually computed values of this index obtained during the examination of children aged 0—6 years are presented in *Fig. 3* and in *Fig. 5,* together with the bounderies $\bar{X} \pm 1.5$ SD and $\bar{X} \pm 3$ SD and with ascertained maximum and minimum values (for the other data see the note). The distribution of the intercanthal index according to its size in children aged 0—3 years and 3—6 years is illustrated in *Fig. 2.* This subdivision was carried out on the basis of the results obtained in idividual age groups *(Tab. 1).* They provide evidence that in children up to three years of age the values of the index are

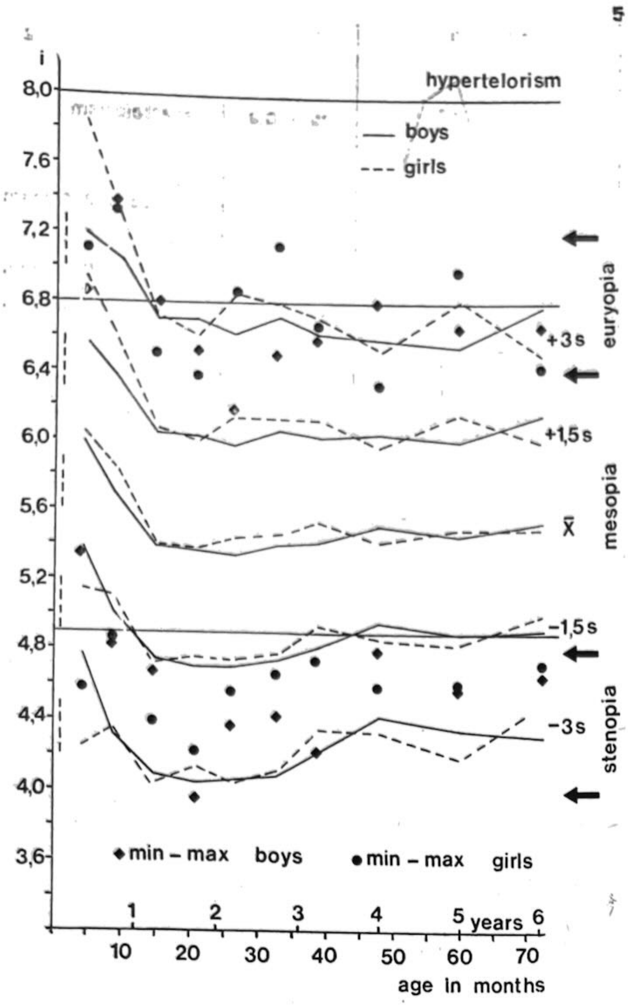


FIG. 5

The circumference-intercanthal index. The values $\bar{X} \pm 1.5$ SD, $\bar{X} \pm 3$ SD and the minimum and maximum values are given. The dashed line along the ordinate between 5.6 and 5.9 i delimites the range of values calculated on the basis of the data obtained by Hajnišová in children and adolescents aged 6—18 years. The range of the variations of the values $\bar{X} \pm 1.5$ SD and $\bar{X} \pm 3$ SD is marked in a similar way. A full horizontal line illustrates Günther's classification of the index and arrows indicate the suggested classification for the Middle European population.

on average below 34 i and in older children approximately at the level of 35 i (the former group includes six age groups and the latter four age groups; both are presented in tables 1—3). Tables 2 and 3 show the frequency of euryopia and stenopia in individual age groups determined on the basis of the intercanthal index, according to the classification proposed by Günther, as well as according to the suggested classification. The corresponding values of the circumference-intercanthal index are presented in Tables 5 and 6 together wtih the data on the occurrence of hypotelorism and hypertelorism.

Besides the two reports whose results were used in the present study (Hajnišová 1968; Figalová, Šmahel, 1973, 1974) there are some other communications presenting numerical values of the interocular distance or computations of indices. Thus we would like to draw attention to the study of Hajniš (in press) presenting also the values of the intercanthal index in children and adolescents from Western Germany. The age of the probands ranged from newborns to young adults. The reported values are at the level of 34 index units and thus up to three years of age are in agreement with our results, while later they are rather lower. It would certainly be useful if further analysis of their values were to proceed.

Besides the measurements of the soft tissue structures (canthi) more attention should be paid to the simultaneous use of X-ray study of the orbital region. The results of the latter are of particular value for the diagnosis, but their drawback consists in the high cost involved in the setting-up of a series of controls. The unnecessary exposure of very young children to X-rays should also be avoided. A very good study of the growth of the interorbital distance was reported by Morin and his co-workers (1963). Cameron (1931 a, b, c) published a series of papers dealing with the contribution of craniometry. This author investigated among other problems the correlation of the interorbital distance with certain facial dimensions and paid particular attention to racial differences. Hajnišová and Hajniš (1960) made attempts to measure the interorbital and biorbital distance intra vitam by palpation of the outer and inner margins of the orbits. This procedure for the determination of the inner orbital margins, however, is not exact and in smaller children is practically impossible. A measure compromise is the report of Leastadius et al. (1969), who measured the distance between the inner canthi and outer orbital margins. Such a procedure might be a useful adjuvant, supplementing the methods of study based on the measurements of morphologic soft tissue and osseous structures. The strict discrimination between the measurements of soft tissue and osseous structures is also necessary for the nomenclature.

RESULTS

On the basis of the intercanthal index, Günther (l.c.) determined for the German population that euryopia varies within the range of 38—42 index units, and that values above 42 i are characteristic for hypertelorism, and values below 28.4 i for stenopia. Thus mesopia varies within the range 28.4 to 38 i i.e. 2 standard deviations from the mean value according to Günther (see 'Assessment of the Interocular Distance'). The validity of this classification for the Czech population was verified by the results of the two growth studies including probands ranging in age from 0 to 18 years (see Methods). *Table* 1 presents mean values and other statistical characteristics of the index in children up to 6 years of age (investigated by the authors). For reasons mentioned under methods two age groups were also used: the first included probands from 0 to 3 years and the second children from 3 to 6 years. The data are presented in graphical form in *Fig. 1*, together with the data reported by Hajnišová

TAB. 1 *Index intercanthalis* $\frac{(en - en) \cdot 100}{ek - ek}$

Age in years	Boys					Girls				
	n	$\bar{X} \pm 3 \cdot s_{\bar{x}}$	s	v	min – max	n	$\bar{X} \pm 3 \cdot s_{\bar{x}}$	s	v	min – max
1/4 – 1/2	27	33.30 ± 3 . 0.54	2.83	8.50	30.00 – 39.71	30	34.03 ± 3 . 0.58	3.11	9.14	28.35 – 40.00
1/2 – 1	57	33.30 ± 3 . 0.36	2.54	7.63	28.95 – 39.76	62	34.19 ± 3 . 0.36	2.78	8.13	29.85 – 40.26
1 – 1 1/2	75	32.83 ± 3 . 0.26	2.13	6.49	28.75 – 38.03	64	32.47 ± 3 . 0.37	2.83	8.71	22.73 – 37.33
1 1/2 – 2	77	34.61 ± 3 . 0.37	3.29	9.51	25.32 – 39.19	65	33.52 ± 3 . 0.36	2.72	8.11	28.75 – 40.00
2 – 2 1/2	79	33.16 ± 3 . 0.33	2.90	8.74	27.85 – 39.19	81	33.57 ± 3 . 0.38	3.40	10.13	26.92 – 45.95
2 1/2 – 3	81	34.16 ± 3 . 0.35	3.13	9.16	28.40 – 43.75	78	34.54 ± 3 . 0.33	2.88	8.34	28.57 – 41.67
3 – 3 1/2	78	34.36 ± 3 . 0.31	2.76	8.03	27.63 – 40.26	76	35.29 ± 3 . 0.26	2.20	6.23	30.67 – 40.85
3 1/2 – 4 1/2	92	35.43 ± 3 . 0.19	1.86	5.25	30.00 – 40.00	87	35.11 ± 3 . 0.25	2.31	6.58	28.66 – 40.54
4 1/2 – 5 1/2	89	35.53 ± 3 . 0.22	2.06	5.80	31.08 – 43.24	80	35.39 ± 3 . 0.28	2.46	6.95	30.56 – 43.21
5 1/2 – 6 1/2	96	35.44 ± 3 . 0.29	2.83	7.98	29.35 – 40.70	97	35.51 ± 3 . 0.21	2.04	5.74	30.00 – 40.28
0 – 3	396	33.44 ± 3 . 0.14	2.83	8.46	25.32 – 43.75	380	33.73 ± 3 . 0.15	3.00	8.89	22.73 – 45.95
3 – 6	355	35.23 ± 3 . 0.12	2.34	6.64	27.63 – 43.24	340	35.32 ± 3 . 0.12	2.24	6.34	28.66 – 43.21

TAB. 2 *Frequency of euryopia and stenopia determined on the basis of the intercanthal index (suggested classification).*

Age in years	n ♂♂	Euryopia		Stenopia		n ♀♀	Euryopia		Stenopia	
		abs	%	abs	%		abs	%	abs	%
1/4 – 1/2	27	4	14.81	1	3.70	30	4	13.33	2	6.67
1/2 – 1	57	4	7.02	2	3.51	62	6	9.68	2	3.23
1 – 1 1/2	75	3	4.00	6	8.00	64	1	1.56	10	15.63
1 1/2 – 2	77	5	6.49	8	10.39	65	6	9.23	3	4.62
2 – 2 1/2	79	5	6.33	11	13.92	81	9	11.11	7	8.64
2 1/2 – 3	81	11	13.58	4	4.94	78	11	14.10	3	3.85
3 – 3 1/2	78	9	11.54	5	6.41	76	10	13.60	0	—
3 1/2 – 4 1/2	92	9	9.78	0	—	87	7	8.05	2	2.30
4 1/2 – 5 1/2	89	6	6.74	0	—	80	11	13.75	0	—
5 1/2 – 6 1/2	96	16	16.67	1	1.04	97	10	10.31	0	—
0 – 3	396	32	8.08	32	8.08	380	37	9.74	27	7.11
3 – 6	355	40	11.27	6	1.69	340	38	11.18	2	0.51

Hypertelorism — 2 boys (0.27 %) and 2 girls (0.28 %) = 0.27 %
Hypotelorism — 1 boy (0.13 %) and 1 girl (0.14 %) = 0.14 %

(l.c.). This figure confirms that the values of the index are not substantially influenced by age and that there are not differences between the two sexes. Thus it is possible to use a uniform classification of this index in both sexes and in all age groups examined. It appears, however, that the mean values in adults are slightly lower than those obtained in children. A greater interocular distance in children is also mostly described on the basis of visual inspection and the low mean values noted in our study in probands up to 3 years of age are not due to a greater intercanthal distance but rather to a greater distance between the outer canthi which influences the values of the index in a similar way.

Figure 1 further shows that, in both sexes, the level of 38 i approximately corresponds to the mean plus 1.5 SD and the level of 42 i to the mean plus 3 SD. The lower limit of euryopia 38 i, i.e. $\bar{X} + 1.5$ SD, is thus in agreement with the classical categorization of anthropological indices, as well as with current opinions on the use of standard deviation for the assement of proportional characteristics of bodily dimensions. The level of 42 units, i.e. $\bar{X} + 3$ SD, thus corresponds to the margin of a pathological condition — hypertelorism. The maximum values ascertained are also mostly within the range of euryopia (in three girls they reveal the presence of mesopia), and only in 4 boys and 3 girls are they already within the range of hypertelorism. This holds true for 0.21 per cent of the 3283 children included into the two studies. It is obvious, therefore, that the original range of values characteristic of euryopia and of hypertelorism accordind to Günther can be used for the contemporary Middle European population also.

Tab. 2 shows the frequency of individual morphologic types of euryopia in our series. The values ascertained in individual age groups of girls are

TAB. 3 *Frequency of stenopia determined on the basis of the intercanthal index (Günther's classification*)*

Age in years	Boys			Girls		
	n	abs	%	n	abs	%
1/4 — 1/2	27	0	—	30	1	3.33
1/2 — 1	57	0	—	62	0	—
1 — 1 1/2	75	0	—	64	3	4.69
1 1/2 — 2	77	3	3.90	65	0	—
2 — 2 1/2	79	2	2.53	81	2	2.47
2 1/2 — 3	81	1	1.23	78	0	—
3 — 3 1/2	78	2	2.56	76	0	—
3 1/2 — 4 1/2	92	0	—	87	0	—
4 1/2 — 5 1/2	89	0	—	80	0	—
5 1/2 — 6 1/2	96	0	—	97	0	—
0 — 3	396	6	1.52	380	6	1.58
3 — 6	355	2	0.56	340	0	—

8 boys = 1.07 %
6 girls = 0.83 % } *14 children = 0.95 %*

*) *the frequency of euryopia is similar as in Tab. 2.*

about 10 per cent, with the exception of 1.56 per cent found in the 3rd age group. The values ascertained in boys show greater variations (4.00 to 16.67 per cent), but the mean value is also approximately 10 per cent (in the case of a symmetric distribution of the character the theoretically anticipated value is 6.5 per cent). In agreement with the growth curve pattern of this index the frequency of euryopia is lower in children up to three years of age than in older children. We encountered hypertelorism in two boys and in two girls (0.27 %). In three of them it was due to an excessive intercanthal distance, while in the fourth case it was caused by the reduction of the bicanthal distance. P a u l i (1955) found hypertelorism (without signs of Greig's syndrome) only in one of 900 probands, while euryopia was present in 15,25 per cent of 800 normal children and in 16 per cent of 100 probands attending schools for metaly retarded children.

The upper limit of stenopia, 28.4 i, established by Günther is too low for the Czech population. Within the age group from 2 to 15—16 years it corresponds to the mean value minus 3 SD *(Fig. 1). Table 3* illustrates, equally, that in our population this classification would yield only a few cases of stenopia, about 1 per cent of the individuals examined. But this does not correspond to the concept of stenopia as the opposite of euryopia, not even in the presence of an asymmetric distribution of this character with a smaller number of the types characterized by a smaller intercanthal distance. On the basis of the assessment of the results obtained and on comparison with the data reported by other Czech investigators (K á r n í k o v á 1964), the upper limit 30 i is considered most adequate for the Middle European population. The substraction of 4 index units yields the hypothetic upper limit of hypotelorism. This value is hypothetical and auxiliary, since the determination of hypotelorism on the basis of the intercanthal distance is problematic and can be used in some cases only. In our series this situation was found in two individuals, i.e. in 0.14 per cent (compared to none in the series of H a j n i š o v á l.c.). This morpohological condition was due to the decreased interocular distance (minus 2.5 SD and minus 2 SD) and to the increased distance between the outer canthi (plus 1 SD and plus 3 SD). The values are presented in Tab. 1 as the minimum values obtained (in one boy and in one girl). The minimum values ascertained in the other age groups represent borderline values between stenopia and mesopia.

The frequency of stenopia estimated by means of the suggested classification is illustrated in Table 2. We succeeded in ascertaining the difference between the children under three years of age and older children, where stenopia occurred only exceptionally. The higher frequency in children under three years of age is not due to a decreased distance between the inner canthi, but rather to an increased distance between the outer canthi. The difference between the frequency of stenopia and euryopia is produced partially by an asymmetric distribution of the character and partially by the suggested classification. After thorough studies and after a comparison with the results of other investigators it was concluded that it was not necessary to change the original upper limit of stenopia stated by Günther by more than 1.6 i (the Middle European population shows a slight shift towards euryopia).

Fig. 2 shows the distribution of the intercanthal index according to its size in children aged 0—3 years and 3—6 years. The asymmetric distribution is evident only in the first group. The perpendicular broken line represents the upper limit of stenopia according to Günther's classification and confirms that this classification is not adequate for our population. The distribution of this sign in children aged 3—6 years is in agreement with the results obtained by H a j n i š o v á (l.c.) in the age groups ranging from 6—16 years. In adults there is again a slight shift of the distribution curve to the left (indicated by the mean values ascertained at the age of 16—18 years). The suggested classification is indicated on this figure.

The circumference-intercanthal index proved equally satisfactory for the assessment of variations of the intercanthal distance. G ü n t h e r (l.c.) used this index for the determination of the upper limit of stenopia as 4.9 i, the lower limit of euryopia as 6.8 i, and the lower limit of hypertelorism as 8.0 i. These values were under the assumption that there are no differences between the two sexes and that the index does not show marked variations according to age. *Tab. 4* contains the computed statistical data in children up to 6 years of age, the mean values are presented on *Fig. 3.* The results confirm Günther's assumption that the differences between the two sexes are negligible. His second assumption, however, has some limitation. During the first year of life the growth rate of the neurocranium is more intense than that of any other dimension of the face and thus the circumference-intercanthal index shows

TAB. 4 *Index circumference — intercanthalis* $\frac{(en - en) \cdot 100}{\text{circumference of the neurocranium}}$

Age in years	Boys					Girls				
	n	$\bar{X} \pm 3 \cdot s_{\bar{x}}$	s	v	min—max	n	$\bar{X} \pm 3 \cdot s_{\bar{x}}$	s	v	min—max
1/4— 1/2	27	5.99 ± 3 . 0.08	0.40	6.68	5.35—6.86	30	6.05 ± 3 . 0.11	0.60	9.92	4.58—7.12
1/2—1	57	5.69 ± 3 . 0.06	0.46	8.08	4.88—7.38	62	5.86 ± 3 . 0.06	0.51	8.70	4.88—7.32
1 —1 1/2	75	5.39 ± 3 . 0.05	0.44	8.16	4.68—6.82	64	5.41 ± 3 . 0.06	0.45	8.32	4.40—6.51
1 1/2—2	77	5.37 ± 3 . 0.05	0.45	8.38	3.96—6.53	65	5.38 ± 3 . 0.05	0.41	7.62	4.22—6.38
2 —2 1/2	79	5.34 ± 3 . 0.05	0.43	8.05	4.38—6.19	81	5.44 ± 3 . 0.05	0.47	8.64	4.57—6.87
2 1/2—3	81	5.40 ± 3 . 0.05	0.44	8.15	4.42—6.50	78	5.46 ± 3 . 0.05	0.45	8.24	4.68—7.14
3 —3 1/2	78	5.41 ± 3 . 0.05	0.40	7.39	4.24—6.60	76	5.54 ± 3 . 0.04	0.39	7.04	4.74—6.67
3 1/2—4 1/2	92	5.51 ± 3 . 0.04	0.36	6.53	4.81—6.80	87	5.42 ± 3 . 0.04	0.37	6.83	4.60—6.33
4 1/2—5 1/2	89	5.46 ± 3 . 0.04	0.37	6.78	4.60—6.67	80	5.50 ± 3 . 0.05	0.44	8.00	4.60—7.00
5 1/2—6 1/2	96	5.53 ± 3 . 0.04	0.41	7.41	4.66—6.67	97	5.50 ± 3 . 0.03	0.33	6.00	4.75—6.41

TAB. 5 *Frequency of euryopia and stenopia determined on the basis of the circumference — intercanthal index (Günther's classification)*

Age in years	n ♂♂	Euryopia		Stenopia		n ♀♀	Euryopia		Stenopia	
		abs	%	abs	%		abs	%	abs	%
1/4— 1/2	27	2	7.41	0	—	30	3	10.00	1	3.33
1/2—1	57	2	3.51	1	1.75	62	2	3.23	1	1.61
1 —1 1/2	75	1	1.33	8	10.67	64	0	—	9	14.06
1 1/2—2	77	0	—	11	14.29	65	0	—	7	10.77
2 —2 1/2	79	0	—	12	15.19	81	1	1.23	11	13.58
2 1/2—3	81	0	—	10	12.35	78	1	1.28	10	12.82
3 —3 1/2	78	0	—	8	10.26	76	0	—	4	5.26
3 1/2—4 1/2	92	0	—	2	2.17	87	0	—	5	5.75
4 1/2—5 1/2	89	0	—	3	3.37	80	1	1.25	6	7.50
5 1/2—6 1/2	96	0	—	3	3.13	97	0	—	2	2.06
Total	751	5	0.67	58	7.72	720	8	1.11	56	7.78

No case of hypertelorism or hypotelorism

TAB. 6 *Frequency of euryopia and stenopia determined on the basis of the circumference — intercanthal index (suggested classification).*

Age in years	n ♂♂	Euryopia		Stenopia		n ♀♀	Euryopia		Stenopia	
		abs	%	abs	%		abs	%	abs	%
1/4— 1/2	27	4	14.81	0	—	30	7	23.33	1	3.33
1/2—1	57	5	8.77	0	—	62	6	9.68	0	—
1 —1 1/2	75	2	2.67	6	8.00	64	1	1.56	6	9.38
1 1/2—2	77	2	2.60	8	10.39	65	0	—	5	7.69
2 —2 1/2	79	0	—	9	11.39	81	2	2.47	6	7.41
2 1/2—3	81	2	2.47	7	8.64	78	1	1.28	6	7.69
3 —3 1/2	78	1	1.28	3	3.85	76	2	2.64	3	3.95
3 1/2—4 1/2	92	3	3.26	0	—	87	0	—	4	4.60
4 1/2—5 1/2	89	2	2.25	1	1.12	80	3	3.75	5	6.25
5 1/2—6 1/2	96	3	3.13	2	2.08	97	1	1.03	2	2.06
Total	751	24	3.20	36	4.79	720	23	3.19	38	5.28

Hypertelorism — 1 boy (0.13 %) and 1 girl (0.14 %) = 0.14 %
Hypotelorism — 1 boy (0.13 %) and no girl = total 0.07 %

a decrease (from 6.0 i to 5.4 i). During the subsequent periods of life no marked changes occur, as was shown by th evalues calculated on the basis of the study of Hajnišová (l.c.) which are higher than our data *(Fig. 4)*.

Fig. 5 illustrates, similarly to Fig. 1, the dependence of the index values on age as well as the boundaries $\bar{X} \pm 1.5$ SD, $\bar{X} \pm 3$ SD and the ascertained minimum and maximum values. It was not possible to compare our data with the results of Hajnišová who did not use the circumference-intercanthal index and we have, therefore, computed for our purposes the values of this index on the basis of the mean values of the two dimensions (see methods). The dashed line along the ordinate, in the segment between 5.6 and 5.9 i, shows the range of variations of these computed values for children and adolescents aged 6—18 years *(Fig. 4)*. On the basis of the results obtained it was possible to make a rough estimation of the range of the values $\bar{X} \pm 1.5$ SD and $\bar{X} \pm 3$ SD, which is marked by a dashed line drawn along the ordinate. The horizontal line at the levels of 4.9 i, 6.8 i and 8.0 i shows Günther's classification of the index, the arrows on the right side show the limits of the range of the classification suggested for the Czech population. In contrast to the range of norm $\bar{X} \pm 2$ SD proposed by Günther, we have used the value $\bar{X} \pm 1.5$ SD similarly as in the former index, and for the determination of hypertelorism and hypotelorism the deviation $\bar{X} \pm 3$ SD from norm. An exception is the first year of life, when it is not possible to use this index. The results obtained by Hajnišová (l.c.) are included in the assessment.

As illustrated schematically in Fig. 5 the pertinent values used by Günther for the determination of the modifications of the intercanthal distance should be reduced for the Czech population. In addition to geographical differences a certain role is also played by accelerated development and by secular differences. There is approximate agreement in the determined upper limit of stenopia, which we have on the basis of our results reduced by 0.1 i, i.e. to 4.8 i. As the hypothetic boundary of hypotelorism we take 4.0 i, representing in all age groups the mean value minus 3 standard deviations. The minimum values are regularly within the range of stenopia, with the exception of one case, where it was even lower (as the result of an intercanthal distance decreased by minus 2 SD and of an increase of the circumference of the neurocranium by plus 3 SD).

Tab. 5 presents the frequency of stenopia in our series according to the classification of Günther and Tab. 6 the corresponding value determined by the suggested classification. Occasional incidence was observed within the first year of life. In our opinion it is not possible to use this index during this period of early life. The low frequency of stenopia is actually due to the relatively small circumference of the head. After the first year of life its frequency varies mostly about 10 per cent (according to the classification of Günther, between 10 and 15 per cent). After the age of three years it again shows a decrease (occuring on average in 4.7 per cent of boys and in 3.6 per cent of girls, compared to 5 per cent according Günther's classification).

The lower limits of euryopia, 6.8 i, and of hypertelorism, 8.0 i, suggested by Günther (l.c.) are excessively high the Czech population. In *Fig. 5* the value 6.8 represents the average ascertained in individual age groups plus 3 standard deviations and *Tab. 5* confirms that the use of this classification results only very rarely in the detection of euryopia after the first year of life. But this is not in agreement with the above defined conception of euryopia or with its classification according to the intercanthal index. On the basis of our results, as well as of the data reported by Hajnišová (l.c.) we consider as an adequate lower limit of euryopia 6.4 i, and as an adequate lower limit of hypertelorism 7.2 i (the difference of 0.8 i corresponds to the range of values characteristic of stenopia). The maximum values ascertained are regularly within the range of euryopia, but for two cases which are within the range of hypertelorism (one boy and one girl — in both the anomaly was due solely to the increase of the intercanthal distance).

The frequency of euryopia in our series according to the suggested classification is presented in *Tab. 6*. With the exception of the first two age groups (where the use of the index is not appropriate) the values obtained in boys vary mostly between 2—3 per cent and are slightly lower in girls.

The comparison of the basic data on the intercanthal distance and on the circumference of the neurocranium reported by investigators in our country and abroad, including North America, (wich are quoted in the above mentioned study: Figalová, Šmahel, l.c.) confirms the justification of the reduction of the values delimiting individual forms of the variations of the intercanthal distance in the classification based on this index. The boundary of hypertelorism 8.0 i established by Günther (1933 c) corresponds to severe forms of this anomaly only and not to the current conception of hypertelorism as an abnormally increased interocular distance. According to this classification even some cases of Grieg's syndrome are not designated as hyperteloric. Thus of the four cases described by Reilly (1931) the values of the circumference-intercanthal index are above 8 i only in two cases and are lower in the two other probands (7.69 i and 7.21 i).

DISCUSSION

The evaluation of the indices investigated showed that our results are in agreement with Günther's classification on the basis of the intercanthal index in the determined lower limits of euryopia and hypertelorism and on the other hand in the determined upper limit of stenopia according to the circumference-intercanthal index. We differ to a more marked degree in the assessment of the latter index where we consider the lower limits of euryopia and hypertelorism suggested by Günther unduly high.

TAB. 7 *Frequency of euryopia and stenopi adetermined on the basis of both indices; included are only cases defined by both indices as euryopia or stenopia (suggested classification).*

Age in years	n ♂♂	Euryopia		Stenopia		n ♀♀	Euryopia		Stenopia	
		abs	%	abs	%		abs	%	abs	%
1/4 – 1/2	27	2	7.41	0	—	30	3	10.00	1	3.33
1/2 – 1	57	3	5.26	0	—	62	4	6.45	0	—
1 – 1 1/2	75	1	1.33	0	—	64	0	—	5	7.81
1 1/2 – 2	77	0	—	4	5.19	65	0	—	2	3.08
2 – 2 1/2	79	0	—	6	7.59	81	2	2.47	3	3.70
2 1/2 – 3	81	1	1.23	2	2.47	78	1	1.28	2	2.56
3 – 3 1/2	78	1	1.28	1	1.28	76	0	—	0	—
3 1/2 – 4 1/2	92	2	2.17	0	—	87	0	—	1	1.15
4 1/2 – 5 1/2	89	2	2.25	0	—	80	3	3.75	0	—
5 1/2 – 6 1/2	96	2	2.08	0	—	97	1	1.03	0	—
Total	751	14	1.86	13	1.73	720	14	1.94	14	1.94

No case of hypertelorism or hypotelorism

Because of the discrepancies between these classifications the frequency of euryopia and stenopia according to Günther's classification on the basis of both indices (i.e. in cases where the two indices yield similar results) is unduly low — below 1 per cent (*Tab. 8*). Yet even the use of the suggested classification yields a frequency of euryopia and stenopia averaging less than 2 per cent *(tab. 7)* and these findings are not in agreement with the concept of the enlargement or narrowing of the interocular space occurring within the range of values which are not yet pathological. It is therefore not possible to use simultaneously the two indices in the determination of euryopia and stenopia, since a slightly increased or decreased interocular distance is not reflected similarly in their values. We consider the intercanthal index as more convenient for the evaluation of the above mentioned variations of the interocular distance. It provides a more exact characterization of the interrelations within the orbital region and invariably discloses any proportional deviations. At the same time, however, it is necessary to take into consideration the dimensions concerned, since a decrease of the bicanthal distance also results in an increase of the value of this index (though less commonly). In this case the circumference-intercanthal index may be used for the verification of the results obtained.

In agreement with other investigators (P a u l i 1955, G a a r d 1961, G o r l i n, P i n d b o r g 1964) we believe, on the contrary that, for the determination of the presence of hypertelorism both indices should be used. Hypertelorism represents a pathological condition characterized by an excessive interocular distance which is necessarily reflected by their values. In this way it is possible to exclude questionable cases, as well as those where the high values of the indices are due to other causes (decreased biocular distance in the intercanthal index and a small circumference of the neurocranium in the circumference-intercanthal index). Under these conditions we failed to disclose in our series any case of hypertelorism (according to the intercanthal index there were four cases and according to the circumference-intercanthal index there were two cases); this hold true even when the lower limit of hypertelorism by the circumference — intercanthal index was reduced to 7.2 i. This index is considered more valuable by most authors because of the high values which suggest hypertelorism (P a u l i, 1951, found hypertelorism in five per cent of 800 normal probands according to the intercanthal index and in no case according to the second index. This confirms the discrepancy between Günther's criteria for the evaluation of the two indices). The lower limit of 7.2 i suggested in our proposed classification is more suitable for the diagnosis of a pathological enlargement of the interocular space, as well as for its evaluation according to the intercanthal index. The assessment of the data reported by other investigators, both with regard to the range of norm and to the case reports dealing with pathological conditions, showed that this applies generally and not only for the Middle European population.

For the detection of hypotelorism both indices should also be used, but its determination on the basis of the intercanthal distance alone is of no practical value. The increased proximity of the two orbits is not regularly associated with correspond-

TAB. 8 *Frequency of euryopia and stenopia determined on the basis of both indices (Günther's classification).*

0 — 6 years total	n	Euryopia		Stenopia	
		abs	%	abs	%
Boys	751	4	0.53	5	0.67
Girls	720	7	0.97	6	0.83

No case of hypertelorism or hypotelorism ing changes of the covering soft tissues and it is therefore essential to study and evaluate the position of the orbits. The boundaries of 26 i and 4.0 i resp. are mentioned only for the sake of completness and may be used in some selected cases for rough orientation.

Similarly as we have verified whether it was possible to use in our population same boundaries proposed by Günther for the assessment individual forms of an increased or decreased interocular distance by means of indices calculated on the basis of direct cephalommetric measurements (i.e. of the intercanthal distance), it would be necessary to use the same procedure for the verification of the validity of Günther's classification for the measurements of the bony framework. This would contribute to a definite and uniform diagnosis, to the study of the interrelations between the soft and bony tissues, as well as to the evaluation of osteologic materials.

After the termination of the present study we were in a position to examine by cephalommetry a small control series of adult Czech men and women. The same dimensions as described above were studied in the ocular region and the results obtained are presented in tables 9 and 10. They confirmed the justification of the conclusions discussed in the preceding paragraphs. Table 9 reveals a slight shift towards euryopia in the Middle European population with a higher relative frequency of euryopic individuals. The data presented in table 10 document the justification of the corrections in the classification of the circumference-intercanthal index. We are aware of the fact that there are still certain discrepancies in the interpretation of the two indices investigated. The lower limits of euryopia and of hypertelorism detected on the basis of the intercanthal index should be replaced by slightly higher values. The original boundaries suggested by Günther, however, proved on the whole satisfactory and their use allows a comparison with the results obtained by other investigators.

The suggested interpretation of indices might represent a starting point towards an uniform classification of the Caucasian populations. In practice it could be applied for the assessment of the morphology of the ocular region (stenopia, mesopia, euryopia), as well as for the detection of hypertelorism. Because of the importance of the position of the orbits for the determination of hypertelorism, an X-ray film of the orbital region is essential. The findings are mostly in good agreement (in an opposite case the anomaly ascertained should be designated as pseudohypertelorism, e.g. in blepharophimosis, dystopia canthorum etc.). Thus, as was shown already by the studies of G ü n t h e r (1933 a, b, c) the suggested classification based on the morphology of soft tissues is convenient for general use. This was further confirmed by the widespread use of this method in current clinical practice (G o r l i n, P i n d b o r g, 1964 and other authors). This procedure is considered indispensable to an objective evaluation of the increased or decreased interocular distance.

S U M M A R Y

Our study aimed to verify the validity of Günther's classification (in North German populations) of euryopia, stenopia and hypertelorism, by means of the intercanthal index and of the circumference-intercanthal index, for the Middle European population. The verification was based on the examination of 1471 normal children from Prague ranging in age from 0—6 years (F i g a l o v á, Š m a h e l, 1973, 1974) as well as on the data reported by H a j n i š o v á (1968) in children and adolescents from Prague, ranging in age from 6 to 18 years (1812 probands examined). An additional group of controls consisted of normal adults. From the results it follows:

1. It is always necessary to discriminate between the position of the orbits and the morphology of the soft tissues. This discrimination is not reflected by the nomenclature which leads often to errors and confusions. It is therefore necessary to use for the former the designation interorbital width, biorbital width, interorbital index, circumference-interorbital index etc. and in the latter the terms intercanthal width, bicanthal (interectocanthal) width, intercanthal index, circumference-intercanthal index etc.

2. In agreement with G ü n t h e r (1933 a, b, c) we have determined 38 index units (i) as the lower limit of euryopia and 42 i as the lower limit of hypertelorism. Contrary to Günther's classification we have lifted the upper limit of stenopia by 1.6 i, i.e. to 30 i, and 26 i was determined as the hypothetic upper limit of hypotelorism (mesopia = 30—38 i). The relative frequency of individual forms of variations of the intercanthal distance in our series is illustrated in *Tab. 2* (we have noted a slight shift towards euryopia in the Middle European population).

3. According to the circumference-intercanthal index the upper limit of stenopia was determined as 4.8 i, the upper limit of hypotelorism as 4.0 i (hypothetical values), the lower limit of euryopia as 6.4 i and of hypertelorism as 7.2 i (mesopia = = 4.8—6.4 i). Compared to Günther's classification we have reduced the lower limit of euryopia and of hypertelorism, since they were not in agreement with the classification of these types by means of the intercanthal index, nor with the definition of these terms. It is not possible to use this index for the evaluation of probands during the first year of life, when the differences between the growth rate of the intercanthal width and that of the circumference of the neurocranium result in changes of its values (reduction). The relative frequency of individual forms of variations of the interocular distance in our series, established on the basis of this index, are illustrated in *Tab. 6.*

4. The use of the intercanthal index alone is recommended for the classification of a slight enlargement or narrowing of the interocular space, i.e. of euryopia or stenopia which are still not pathological conditions. A simultaneous use of the two indices is not possible since slight changes of the interocular

TAB. 9

The intercanthal index and the frequency of euryopia and stenopia in adults.

	n	$\bar{X} \pm 3 . s_{\bar{x}}$	s	V	min—max	Euryopia abs	%	Stenopia abs	%
Men	50	35.00 ± 3 . 0.31	2.20	6.29	29.89—40.91	4	8%	1	2%
Women	50	35.62 ± 3 . 0.28	2.04	5.73	30.76—40.96	5	10%	0	—

TAB. 10

The circumference-intercanthal index and the frequency of euryopia and stenopia in adults.

	n	$\bar{X} \pm 3 . s_{\bar{x}}$	s	V	min—max	Euryopia abs	%	Stenopia abs	%
Men	50	5.51 ± 3 . 0.06	0.41	7.44	4.55—6.50	2	4%	2	4%
Women	50	5.60 ± 3 . 0.05	0.39	6.96	4.74—6.65	3	6%	1	2%

distance are mostly not reflected similarly in the two indices (see the low frequency in *Tab. 7* and *Tab. 8*). The intercanthal index provides an exact characterization of the interrelations within the ocular region, but it is necessary to take into consideration the dimensions used in the index, since a decreased (increased) biocular distance results, equally, in an increase (decrease) of the index values (in this case the circumference-intercanthal index can be used for verification). But it represents a sensitive method for the detection of any proportional deviations (the mean frequency of euryopia in the Czech population is about 10 per cent — *Tab. 2, 9*).

5. For the detection of hypertelorism, on the other hand, the use of both indices is necessary, since they both invariably reflect a pathological increase of the interocular distance. Questionable cases, or those where high values of the index are due to other causes (decreased biocular distance of the intercanthal index and a small circumference of the neurocranium of the circumference-intercanthal index), are reciprocally excluded. Under these conditions no case of hypertelorism was detected in our series (using the intercanthal index alone 4 cases, and using the circumference-intercanthal index 2 cases). Thus hypertelorism is virtually absent in a normal population (in isolated forms suggesting the possibility of some further dysmorphogenesis a thorough examination is indicated).

The use of both indices is equally necessary for the detection of hypotelorism, since its determination on the basis of the intercanthal distance alone is problematic and of no practical value. The pertient bounderies are mentioned only for the sake of completness (there is a lack of agreement with the position of the orbits; therefore X-ray diagnosis is necessary). X-ray study is also necessary for the definite diagnosis of hypertelorism (for differentiation from pseudohypertelorism).

6. The suggested classification is satisfactory for the Middle European population. Knowledge on the circumference-intercanthal index is of more general character. The results cannot be used for ethnically differing populations without verification.

ZUSAMMENFASSUNG

In der vorliegenden Mitteilung wurde überprüft ob die von Günther bei der Norddeutschen Population verwendete Klassifikation der Euryopie, Stenopie, bzw. des Hypertelorismus an Hand des Interkanthalindex und Umfang — Interkanthalindex bei der gegenwärtigen Mitteleuropäischen Population verwendet werden kann. Die Kontrolle erfolgte an Hand der Untersuchungen von 1471 gesunden Prager Kindern im Alter von 0 bis 6 Jahren (Figalová, Šmahel 1973, 1974) unter gleichzeitiger Verwendung der von Hajnišová (1968) publizierten Daten, die bei 6—19 jährigen Kindern und Jugendlichen aus Prag ermittelt wurden (1812 untersuchte Probanden). Die angeschlossene Kontrollgruppe bestand aus Erwachsenen. Aus den Ergebnissen erfolgt:

1. Der Orbitalzustand muss stets von der Morphologie der deckenden Weichteile unterschieden werden. Diese Unterscheidung wird nicht nomenklatorisch eingehalten und daraus Irrtümer und zahlreiche Unklarheiten erfolgen. Deswegen müssen im ersten Fall die Bezeichnungen interorbitale Breite, biorbitale Breite, Interorbitalindex, Umfang-Interorbitalindex, und im zweiten Fall interkanthale Breite, bikanthale (interektokanthale) Breite, Interkanthalindex, Umfang-Interkanthalindex usw. angewandt werden.

2. Im Einvernehmen mit Günther (1933 a, b, c) wurde an Hand des Interkanthalindex die untere Grenze der Euryopia als 38, und die untere Grenze des Hypertelorismus als 42 festgelegt. Demgegenüber haben wir die obere Grenze der Stenopie gegenüber Günther's Klassifikation um 1,6 auf 30 erhöht, und die hypothetische obere Grenze des Hypotelorismus als 26 bestimmt. (Mesopie = 30—38). Die relative Vertretung der einzelnen Formen

der Variationen der interkanthalen Entfernung in unserem Untersuchungsgut wird in der *Tab. 2* wiedergegeben (bei der Mitteleuropäischen Bevölkerung wurde eine leichte Verschiebung in der Richtung der Euryopie verzeichnet).

3. An Hand des Umfang-Interkanthalindex wurde die obere Grenze der Stenopie als 4,8 und des Hypotelorismus als 4,0 (hypothetisch). die untere Grenze der Euryopie als 6,4 and des Hypertelorismus als 7,2 (Mesopie = 4,8—6,4) festgelegt. Im Vergleich zu Günther's Klassifikation wurde die untere Grenze der Euryopie und des Hypertelorismus beträchtlich herabgesetzt da diese weder der Klassifikation an Hand des Interkanthalindex noch ihrer Definition nicht entsprach.

Dieser Index kann in den Bewertungen der Kinder im ersten Lebensjahr nicht angewandt werden, da dessen Werte infolge der unterschiedlichen Wachstumsrate der interkanthalen Breite und des Gehirnschädelumfanges herabgesetzt werden. Die relative Vertretung von einzelnen Formen der veränderten interokularen Entfernung in unserem Untersuchungsgut nach diesem Index zeigt die Tab. 6.

4. Es wird empfohlen zur Klassifikation einer leichten Vergrösserung, bzw. Verengerung des interokularen Raumes, d. h. einer Euryopie, bzw. Stenopie die wir noch als physiologisch betrachten, nur den Interkanthalindex zu verwenden. Die gleichzeitige Anwendung beider Indexe ist deswegen nicht möglich, weil die leichteren Veränderungen der interokularen Breite in den beiden indexen nicht gleichmässig in Erscheinung treten (siehe die niedrige relative Vertretung in den *Tabellen 7* und *8*). Der Interkanthalindex charakterisiert gut die Verhältnisse in der okularen Gesichtsgegend, die aufeinander bezogenen Dimensionen sin jedoch zu berücksichtigen, da die herabgesetzte (erhöhte) biokulare Breite ebenfalls einen Anstieg (Herabsetzung) der Index-Werte verursacht. Der Umfang-Interkanthalindex kann dann als Kontrolle verwendet werden. Dieser ermöglicht jedoch stets eine sensitive Erfassung der proportionellen Abweichungen (die Häufigkeit der Euryopie beträgt in der tschechischen Bevölkerung durchschnittlich 10 % — *Tab. 2, 9*).

5. Zur Feststellung des Hypertelorismus ist demgegenüber die Verwendung von beiden Indexen unerlässlich, da sich in den beiden die pathologischen Vergrösserungen der interokularen Entfernung stets wiederspiegelt. Sowohl die umstrittenen Fälle. als auch diejenigen, bei denen die hohen Index-Werten durch andere Gründe verursacht werden (herabgesetzte biokulare Weite beim Interkanthalindex und ein kleiner Gehirnschädelumfang beim Umfang-Interkanthalindex) schliessen sich gegenseitig aus. Unter diesen Bedingungen haben wir in unserem Untersuchungsgut keinen einzigen Fall von Hypertelorismus verzeichnet (bei der Verwendung des Interkanthalindex 4 Fälle und des Umfang-Interkanthalindex 2 Fälle). In einer gesunden Population kommt der Hypertelorismus praktisch nicht vor (die isolierte Form weist auf die Möglichkeit einer anderen Dysmorphogenese hin und stellt eine Indikation zu einer eingehenden Untersuchung dar). Der Hypotelorismus muss ebenfalls an Hand der beiden Indexe festgestellt werden, jedoch dessen Bestimmung an Hand der interkanthalen Entfernung ist problematisch und hat keine praktische Bedeutung. Die entsprechenden Grenzen werden nur vollständigkeitshalber angeführt (es besteht keine Übereinstimmung mit dem Orbitalzustand — und deswegen ist eine röntgenologische Kontrolluntersuchung erforderlich). Die endgültige Diagnose des Hypertelorismus erfordert gleichfalls eine skiagraphische Erhärtung (zur Unterscheidung vom Pseudohypertelorismus).

6. Die vorgeschlagene Klassifikation gilt für die Mitteleuropäische Bevölkerung, die Erkenntnisse über den Umfang-Interkanthalindex haben einen allgemeineren Charakter. Die Ergebnisse können bei ethnisch unterschiedlichen Bevölkerungsgruppen ohne Überprüfung ihrer Gültigkeit nicht angewandt werden.

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