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SYMPOSIUM

Anthropological study for the determination of the Europid and Negroid characteristics on facial bones of human fetuses+

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ABSTRACT During my 3-month long scholarship in the Smithsonian Institute in 1991, I carried out metric and comparative anatomical (anthropological) examinations on the collection of fetal/newborn skeletons of the Anthropological Institute of the National Museum of Natural History, Washington, D.C. I determined 85 sizes of 50 characteristic bones of about 350 complete fetal/new-born skeletons in standardized conditions. In the study of facial bones and during the mathematical-statistical analyses, the data of 37 Europid and 27 Negroid and 47 mixed (Mulatto) skeletons were taken into account. According to my analyses the facial bones of the two human races differ significantly in both forms and sizes. The most characteristic formal anthropological features can be identified on the frontal process of the maxilla, the surface of the palate of the maxilla, the plate forming the nasal septum (vomer), the os zygomaticum and the mandibe.The applied mathematical-statistical methods (multiple comparison (Bonferroni), variance analysis, regression and correlation analysis and multivariant discriminant analysis) confirmed the anthropological characteristics and the varied formal differences that are visible to the naked eye. In the forensic medical and the anthropological practice, the possibility of the discrimination of the characteristics of the two main races (and possibility of the determination of the Europid and the Negroid characteristics) can be used with reasonable professional accuracy.
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KEY WORDS

forensic fetal osteology
mathematical-statistical evaluation of the facial bone measurements
Europid and Negrid subracial differences of the human fetal facial bones

The forensic anthropological methodology and the forensic application of the study of fetal bones were laid down in our monograph entitled "Forensic Fetal Osteology" (1978). In this encyclopaedic study we summarized the fundamental information that was available in our own metrical studies and in the literature that may be necessary to take into account during the identification and forensic medical study of human fetal/newborn bones and skeletons of unknown origin in order to acquire the most important theoretical and practical knowledge (Fazekas and Kósa 1978).

In the present study we proposed a model for the determination of body length and actual age on the basis of the sizes of bones for forensic medical and anthropological practice with statistic charts, regressive diagrams and so-called multipliers that determine the body length and with other methods. This practice has become a well-known basic method and it is widely applied.

For a long time the means of proving in forensic anthropology were restricted in the case of fetal and newborn skeletal bones as well as skeletons as compared to the efficiency in the study of adult skeletons (Kósa 1969, 1974, 1978, 1979, 1990a,b, 1993a, 1995a, 1997, 1998a,b, 1999; Kósa and Fazekas 1969, 1972a,b, 1973a,b,c,d,).

Whereas at least 4 individual characteristics can be identified during the forensic anthropological identification of adult skeletons, *i.e.* the actual height of the body, the age, the sex and the main racial characteristics, for a long time it was only an uncertain question in case of fetal/newborn bones. There was no reliable method available on the basis of which the sex and the dominant racial characteristics of fetal/newborn skeletons could have been determined without doubt (Fazekas and Kósa 1965a,b, 1966a,b,c,d, 1967a,b,c, d, 1969, 1978).

In co-operation with my colleagues, using modern statistical methods, we have recently achieved new results regarding the more accurate determination of bone sizes and body height (Huxley 1998; Huxley and Kósa 1999) (Arizona team), the study of fetal sexual dimorphism (Adalian 2001; Adalian et al 2001a,b; Piercecchi-Marti et al 2002) on fetal/newborn skeletons (Marseille team) as well as the study of the morphological characteristics (Casellana and Kósa 1999, 2001a,b,) of the human fetal vertebra which we did not study before (Barcelona team); and regarding the study of racial morphological characteristics and sizes which I carried out on the collection of fetal skeletons in the Anthropological

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+Dedicated to Professor Gyula Farkas on the occasion of his 70th birthday.

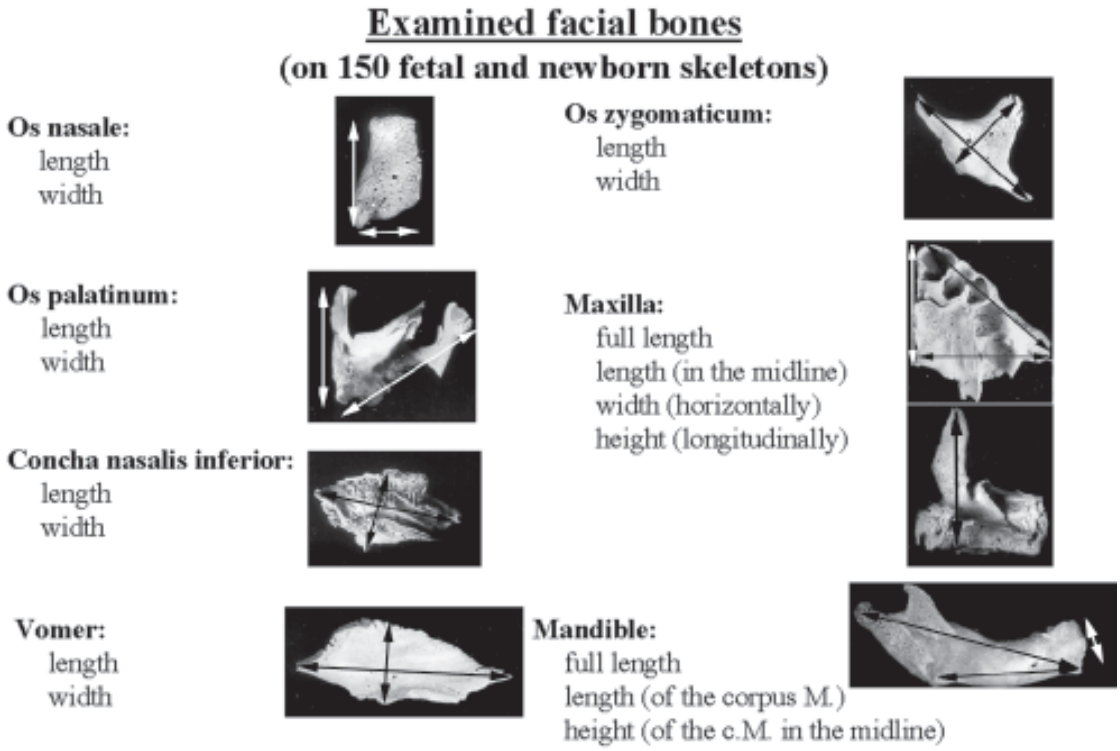

Figure 1.

Institute of the National Museum of Natural History, Washington, D.C. in 1991 (Kósa 1991a,b, 1992, 1993b, 1994a,b, 1995b, 1998a,b, 2000a,b).

In this study I would like to present the morphological racial characteristics of facial bones and the results of statistic evaluations to distinguish between the Europid and Negroid characteristics.

Figure 2.

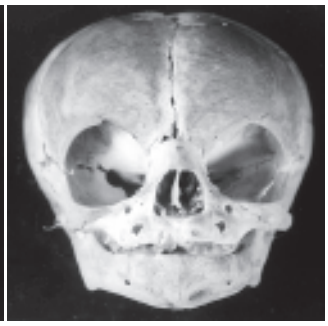

Figure 3.

Figure 4.

Figure 5.

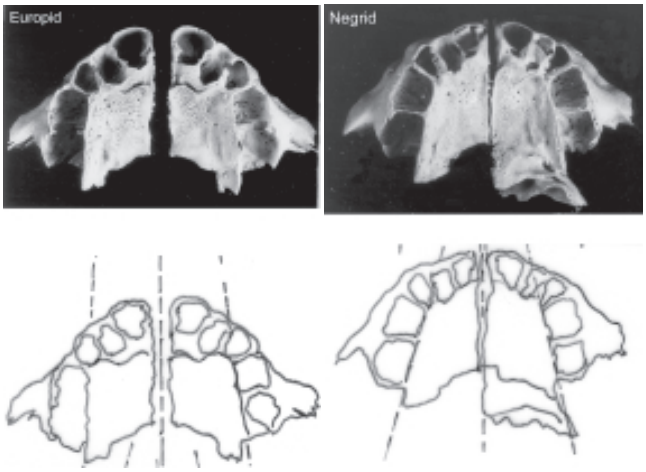

Figure 6.

Figure 7.

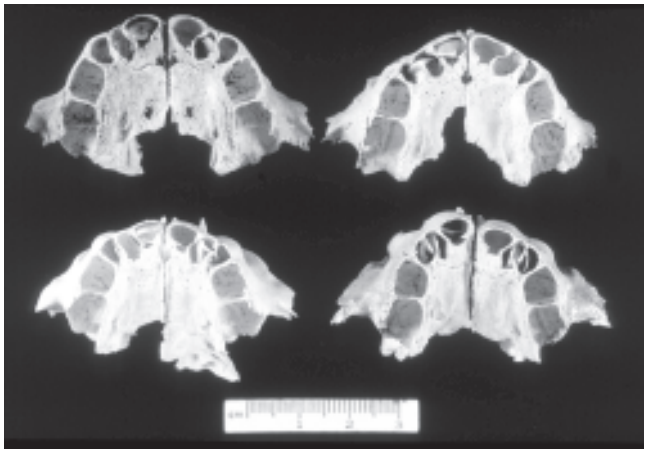

Figure 8.

Materials and Methods

During my 3-month long scholarship in the Smithsonian Institute in 1991, I carried out metric and comparative anatomical (anthropological) examinations on the fetal skeleton collection of the Anthropological Institute of the National Museum of Natural History, Washington, D.C.

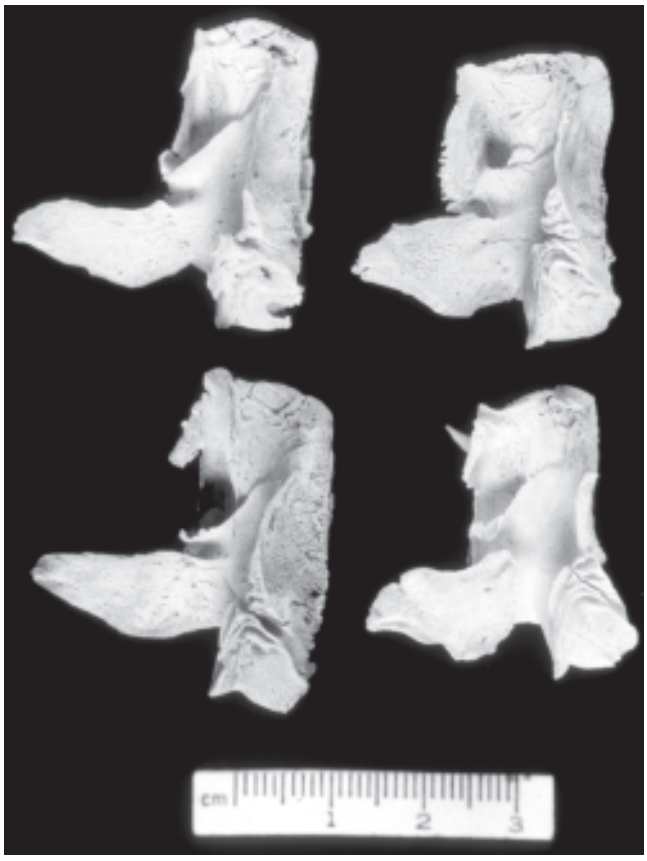

Figure 9.

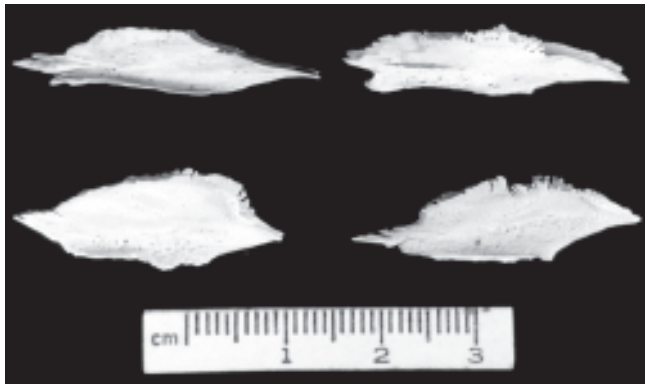

Figure 10.

The importance and curiosity of one of the largest fetal/newborn collection of 350 skeletons (Gindhart 1989) that was collected to be a standard for scientific purposes is that about one-third represent Europid, one-third Negroid and less than a third mixed type (Mulatto) anthropological characteristics. During my studies there I determined 85 sizes of 50 characteristic skeletal bones with standardized measurements. Thus, I acquired 4,250 bone sizes altogether. In recent years I have been publishing data on these bone sizes of different body parts, mainly describing the characteristics of the cranial bones.

In this study I performed the mathematical-statistical analyses of the facial bones on the sizes of 32 Europid, 27 Negroid and 57 mixed (Mulatto) skeletons. The bone sizes were systematically determined by measuring points applied in previous studies (largest bone and width measurements and diameters). In order to express a special anthropological characteristic of a bone metrically, I also used different techniques of measurement.

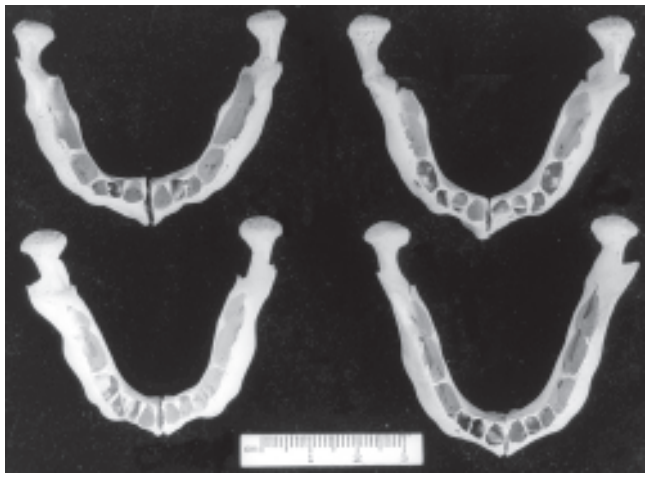

Figure 11.

Multiple comparisons (Bonferroni)

Os zygomaticum (length)	europid-negrid	p<0,037
	negrid-mulatto	p>0,05
	europid-mulatto	p>0,05

Figure 12.

Multiple comparisons (Bonferroni)

Mandible (length of the corpus M.)	europid-negrid	p<0,043
	negrid-mulatto	p<0,074
	europid-mulatto	p>0,05

Figure 14.

In the present study I measured the bones indicated in Figure 1. The arrows indicate the measured distances and the examined bone sizes. During the mathematical-statistical evaluation of the bone sizes the following methods were used: multiplex comparison (Bonferroni), variance analysis, regression and correlation analysis and multivariant discriminant analysis.

Results and Discussion

According to our studies the racial morphological differences within the two races (Europid and Negroid) can be detected as early as in fetal and newborn ages (Kósa 1991a,b, 1992, 1993b, 1994a,b, 1995b, 1998a,b, 2000). The most characteristic racial differences can be detected on the squama of the temporal bone, the frontal process of the maxilla or its palatine surface, the vomer, the lateral plate of the cranial part of the occipital bone and the basal area of the plate of the squama occipitalis.

As stated in our previous publication (Kósa 1996) the intact white and black fetal skulls also show characteristic anthropological differences. These results were achieved on specially prepared newborn skulls in the collection of the NMNH, Washington, D.C., during the preparation of which the soft parts of the skeletons were removed from the bones but the plates and ligaments of interstitial tissues between the sutures that hold together and fixed the calvarial and facial bones in their original position were left intact. Thus, from a didactic point of view, it was managed to prepare newborn skulls that bore the anatomical and anthropological conditions of their original forms.

In order to demonstrate the main racial characteristics, two photographs are shown that were taken in A-P directions. In one of the two photographs (Fig. 2) the skull and the cranial bones of a Europid fetus are illustrated frontally and those of a Negroid one are illustrated frontally in the other (Fig. 3). On the draft about the skulls, the most characteristic anthropological features are indicated (Figs. 4 and 5). While the transversal diameter of the orbitalis aditus is greater than

Multiple comparisons (Bonferroni)

Mandible (full length)	europid-negrid	p<0,001
	negrid-mulatto	p<0,011
	europid-mulatto	p>0,05

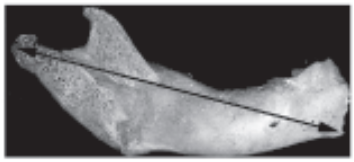

Figure 13.

Multiple comparisons (Bonferroni)

Mandible (height of the c.M. in the midline)	europid-negrid	p<0,020
	negrid-mulatto	p<0,030
	europid-mulatto	p>0,05

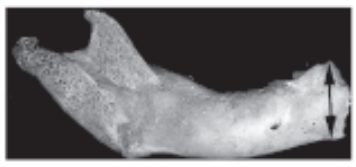

Figure 15.

Table 1. Multiple comparisons (Bonferroni) of the data.

Dependent variable	(I) R	(J) R	Mean difference (I-J)	Std. error	Sig.	95% Confidence interval Lower bound	Upper bound
VL	White	Black	-2.8720	1.6980	0.282	-7.0126	1.2687
		Colour	-0.6390	1.2417	1.000	-3.6670	2.3889
	Black	White	2.8720	1.6980	0.282	-1.2687	7.0126
		Colour	2.2329	1.5682	0.474	-1.5912	6.0570
	Colour	White	0.6390	1.2417	1.000	-2.3889	3.6670
		Black	-2.2329	1.5682	0.474	-6.570	1.5912
VW	White	Black	-1.1850	0.711	0.320	-2.9959	0.6259
		Colour	0.2977	0.6306	1.000	-1.3081	1.9035
	Black	White	1.1850	0.7111	0.320	-0.6259	2.9959
		Colour	1.4827	0.6737	0.108	-0.2328	3.1982
	Colour	White	-0.2977	0.6306	1.000	-1.9035	1.3081
		Black	-1.4827	0.6737	0.108	-3.1982	0.2328
ZL	White	Black	-4.2844*	1.6805	0.037	-8.3769	-0.1918
		Colour	-1.2916	1.2244	0.882	-4.2734	1.6903
	Black	White	4.2844*	1.6805	0.037	0.1918	8.3769
		Colour	2.9928	1.5622	0.175	-0.8117	6.7974
	Colour	White	1.2916	1.2244	0.882	-1.6903	4.2734
		Black	-2.9928	1.5622	0.175	-6.7974	0.8117
ZW	White	Black	-1.8500	1.2408	0.417	-4.8717	1.1717
		Colour	-3.5880E-02	0.9040	1.000	-2.2375	2.1657
	Black	White	1.8500	1.2408	0.417	-1.1717	4.8717
		Colour	1.8141	1.1534	0.357	-.9949	4.6231
	Colour	White	3.588E-02	0.9040	1.000	-2.1657	2.2375
		Black	-1.8141	1.1534	0.357	-4.6231	0.9949
XF	White	Black	-3.3281	1.5750	0.111	-7.1625	0.5062
		Colour	-1.9397	1.1399	0.276	-4.7148	0.8354
	Black	White	3.3281	1.5750	0.111	-0.5062	7.1625
		Colour	1.3884	1.4582	1.000	-2.1615	4.9383
	Colour	White	1.9397	1.1399	0.276	-0.8354	4.7148
		Black	-1.3884	1.4582	1.000	-4.9383	2.1615
XW	White	Black	-3.1500	1.3129	0.055	-6.3463	4.628E-02
		Colour	-1.6491	0.9502	0.257	-3.9624	0.6642
	Black	White	3.1500	1.3129	0.055	-4.63E-02	6.3463
		Colour	1.5009	1.2155	0.659	-1.4583	4.4601
	Colour	White	1.6491	0.9502	0.257	-0.6642	3.9624
		Black	-1.5009	1.2155	0.659	-4.4601	1.4583
XL	White	Black	-2.0562	1.1616	0.239	-4.8841	0.7716
		Colour	-1.6679	0.8407	0.150	-3.7145	0.3788
	Black	White	2.0562	1.1616	0.239	-0.7716	4.8841
		Colour	0.3884	1.0754	1.000	-2.2297	3.0065
	Colour	White	1.6679	0.8407	0.150	-0.3788	3.7145
		Black	-.3884	1.0754	1.000	-3.0065	2.2297
XH	White	Black	-3.3231	1.7786	0.194	-7.6539	1.0077
		Colour	-1.8103	1.2596	0.461	-4.8773	1.2567
	Black	White	3.3231	1.7786	0.194	-1.0077	7.6539
		Colour	1.5129	1.6525	1.000	-2.5109	5.5366
	Colour	White	1.8103	1.2596	0.461	-1.2567	4.8773
		Black	-1.5129	1.6525	1.000	-5.5366	2.5109
MF	White	Black	-9.3627*	2.4193	0.001	-15.2470	-3.4783
		Colour	-2.9358	2.0278	0.452	-7.8677	1.9961
	Black	White	9.3627*	2.4193	0.001	3.4783	15.2470
		Colour	6.4269*	2.1550	0.011	1.1856	11.6682
	Colour	White	2.9358	2.0278	0.452	-1.9961	7.8677
		Black	-6.4269*	2.1550	0.011	-11.6682	-1.1856
MW	White	Black	-2.5533*	0.9217	0.020	-4.7951	-0.3116
		Colour	-0.4024	0.7725	1.000	-2.2813	1.4765
	Black	White	2.5533*	0.9217	0.020	0.3116	4.7951
		Colour	2.1509*	0.8210	0.030	0.1541	0 .1477
	Colour	White	0.4024	0.7725	1.000	-1.4765	2.2813
		Black	-2.1509*	0.8210	0.030	-4.1477	-0.1541
ML	White	Black	-16.5580*	6.6504	0.043	-32.7331	-0.3829
		Colour	-3.0682	5.5740	1.000	-16.6252	10.4888
	Black	White	16.5580*	6.6504	0.043	0.3829	32.7331
		Colour	13.4898	5.9237	0.074	-0.9177	27.8973
	Colour	White	3.0682	5.5740	1.000	-10.4888	16.6252
		Black	-13.4898	5.9237	0.074	-27.8973	0.9177

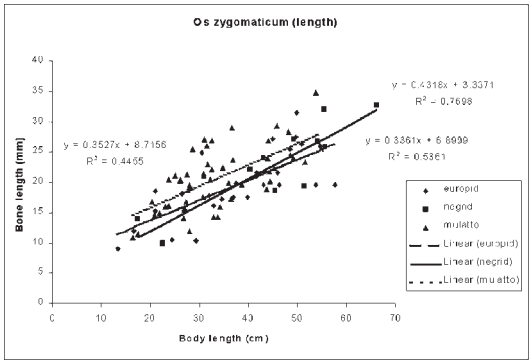

Figure 16.

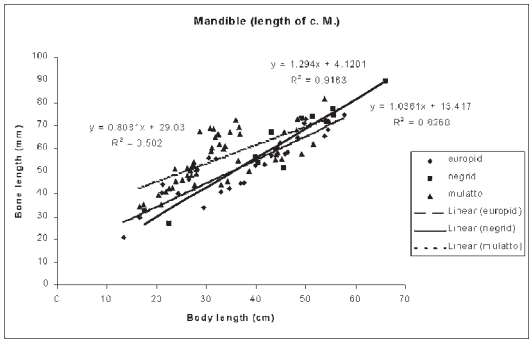

Figure 18.

the longitudinal one in white fetuses, it is just the opposite in black fetuses, namely it is elongated longitudinally. Therefore, the longitudinal size is greater than the transversal size. The bones forming the root of the nose are narrower in white fetuses, therefore, the orbits are nearer to each other. In black fetuses the orbits are wider, therefore, the opening of the nasal cavity is narrower in the upper part and wider in the lower part and is similar to a pear, whereas in black fetuses it has a rounded trapezoid shape. The body and length of the mandible in white fetuses is disproportionately smaller as compared to the cranium cerebrale, whereas it is more massive and more developed in black fetuses.

Little is known about the main racial anthropological characteristics of the intact skull in forensic medical practice. Their fields of application is also limited as the above mentioned morphological characteristics can mainly be recognized by X-ray examinations and not on the dissection table if the cranial bones that have to be studied in order to determine racial characteristics are still tied with ligaments and interstitial tissues.

Certain bones of the skull also show characteristic anthropological differences in the two main races. The palatine surface of the maxilla in white fetuses form a regular semicircular arch. The line of the processus alveolaris is curved backwards semicircularly (Fig. 6), whereas in the Negroid type the initial part of the processus alveolaris of the palatum durum is curved in a semicircle but it follows a line diverging backwards from the canine tooth as far as the 5th grinder (Fig. 7).

The same characteristics can be traced in Figure 8, where the palatine surface of the four facial bones (maxilla) is shown. On the top left part a male fetus, on the top right part a female fetus, on the bottom left part a black male fetus and on the bottom right part a black female fetus can be seen.

The frontal process of the maxilla can be regarded as a characteristic anthropological feature between the two main races as the frontal process of the maxilla is longer and narrower in white fetuses whereas it is shorter and wider in black fetuses. In Figure 9, the anthropological characteristics and morphological differences can be seen on the medial surface of the one side of the facial bone (maxilla) of a male fetus on the top left, that of a white female fetus on the top right, that of a black male fetus on the bottom left and that of a black female fetus on the bottom right. The plate of the nasal septum (vomer) can be seen in the form of longer and narrower bones in Europid fetuses, whereas it is shorter and

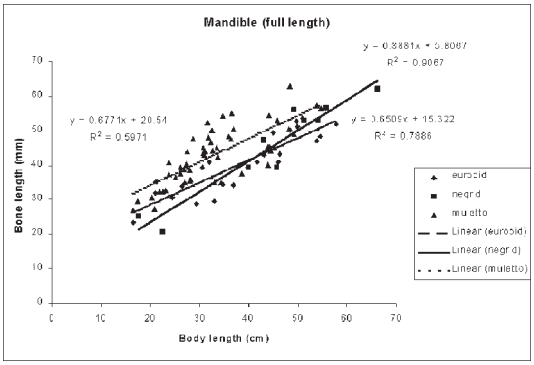

Figure 17.

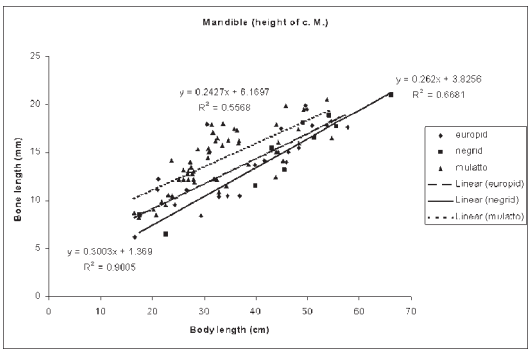

Figure 19.

higher in Negroid fetuses (Fig. 10). The mandible in Negroid fetuses is larger in comparison to the skull as a whole. It is considerably greater both in proportion and size as in white fetuses (Fig. 11).

During the mathematical-statistical analysis of the facial bones we found significant differences in sizes and characteristics not all of the main racial differences but of the easily detectable and visible main racial differences. The transversal size of the os zygomaticum, the full length of the mandible, the length of the body of the mandible, the length of the mandible at medium height both in white-black, white-mulatto and black-mulatto groups showed significant differences. In Table 1, the results of multiple comparisons are indicated. In Figure 12, the significant probability values (P) of the studied size of the os zygomaticum, and in Figures 13, 14 and 15, those of the mandible bone are shown.

Figure 16 shows the regressive lines and equations of the transversal size of the os zygomaticum. Figure 17 shows those of the full length of the mandible, Figure 18 those of the length ot the body of the mandible and Figure 19 those of the height of the mandible measured at medium height together with the regressive coefficients.

It could also be determined in regression analysis that the regression lines and equations differed from one another in the two main races but the regression line of the diagram was in a different position in the Mulatto type as well. However, the correlation coefficients indicated close relationship between the sizes of tested bones and body length. When analysing the linear regression in the three racial human groups (Europid, Negroid, Mulatto) it can be stated that the regression line of the Mulatto is between the Europid and Negroid lines proving a mixed status of the mutual anthropological characteristics.

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