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An Appraisal of Plastic Reconstruction of the External Nose

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ABSTRACT: The association between the morphometric dimensions of the external nose, including the thickness of the soft tissues, and various craniometric measurements has been examined on a sample of lateral radiographs of 154 males and 199 females from Vienna, Austria. In addition, the influence of age on morphometric dimensions and the soft tissue cover was tested. Multiple stepwise regression analysis revealed that nasal height and nasal length are best predicted by the dimensions of the skull, whereas nasal depth and the thickness of the soft tissues is greatly influenced by age. In males, over 50% of the variance of nasal height and nasal length were accounted for by the height of the bony nose and the prominence of the ossa nasalia, and in females it was about 40%. Although the thickness of the soft tissue is dependent on exogenous factors, such as nutrition, mimicry, and so forth, the dimensions of the bony nose apparently also influence the skin depths to some extent. High and prominent noses were found to have a thinner layer of soft tissue over the nasal bones than short and less prominent ones. It thus seems as if there is a tendency of the soft tissue cover to adjust to disharmonies of the bony profile.

KEYWORDS: physical anthropology, plastic reconstruction, tissues (biology), external nose, soft tissue

More than one century ago the first attempt was undertaken to reconstruct the face on a human skull [*1*]. Since then many studies have been made on cadavers to obtain reliable measurements of the skin thickness over certain bony landmarks for later plastic reconstruction. The technique mostly employed was first presented by His [*2*] and, modified, by Kollmann and Büchly [*3*]. Thereafter, this method was again modified several times and, in recent years, there has been a resurgence of this technique in forensic anthropology [*4-9*].

These studies revealed useful information about the thickness of the soft tissues in various populations and races and age classes, as well as by sex [*5,8,10-17*]. However, the reliability of most of the reconstructions still remains doubtful, especially for the external nose.

Gerasimov [*4*, see also *18*] postulated that the tip of the nose can be easily predicted by the prominence of the ossa nasalia and the spina nasalis anterior. He stressed that, in drawing a line through the endpoints of the nasal bones and the spina nasalis anterior in the lateral view, the pronasal point can be correctly determined. Leopold [*19*] located the pronasal point where a line from the sutura nasofrontalis, which is two and one-half times longer than the length of the ossa nasalia, intersects with a line coming from the spina nasalis anterior, which is three times as long as the distance from nasospinale to spina nasalis anterior. Although many authors theoretically agree with the method presented by Gerasimov, they, however, refer to intuition for their plastic reconstructions [*6-8,18,20-22*].

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However, only limited empirical investigations concerning the reconstruction of the external nose have been made. Virchow [23,24] emphasized that the prominence of the nose cannot a priori be predicted by the bony nose, although the spina nasalis anterior seems to be of some importance for the prominence of the external nose [25]. Tandler [26], on the other hand, stressed the importance of rhinion for reconstructions and called it a punctum fixum. The first "multivariate" approach to predict the dimensions of the external nose by several dimensions of the skull, including some angles, was undertaken by Goldhamer in 1926 [27]. As his sample was relatively small and the statistics used were limited, he was not able to prove his hypothesis.

In the present study, Goldhamer's hypothesis was tested on a selected set of craniometric and cephalometric data collected on a series of radiographs. The aim was to find out whether, and to what extent, the dimensions of the nose are predictable by craniometric variables.

Material and Methods

The sample of lateral radiographs used was provided by the Clinic of Dental and Plastic Surgery, University of Vienna. After having excluded all those individuals that showed an anomaly of the teeth or jaws or both, 15 measurements were taken from the remaining head films of 154 males and 199 females. All individuals were well nourished, the ages ranging from 21 to 83 years. As the contours of the soft tissue profile was not clearly distinguished in all of the radiographs, some measurements, especially those of the depths of the skin, were not taken into account for the present analyses to keep inaccuracy at a minimum.

Following radiographic practices, the reference line used was the nasion-sella plane (NS). Some of the measurements taken were based on the reference points described by Martin and Saller [28] (head length, nasal height, length, and depth) and by Goldhamer [27]. The variables concerning the thickness of the soft tissues were taken according to publications dealing with the depths of the skin, for example, Ref 5. Head length was included as it represents a general dimension of the skull. Figure 1 shows the dimensions of the bony nose taken.

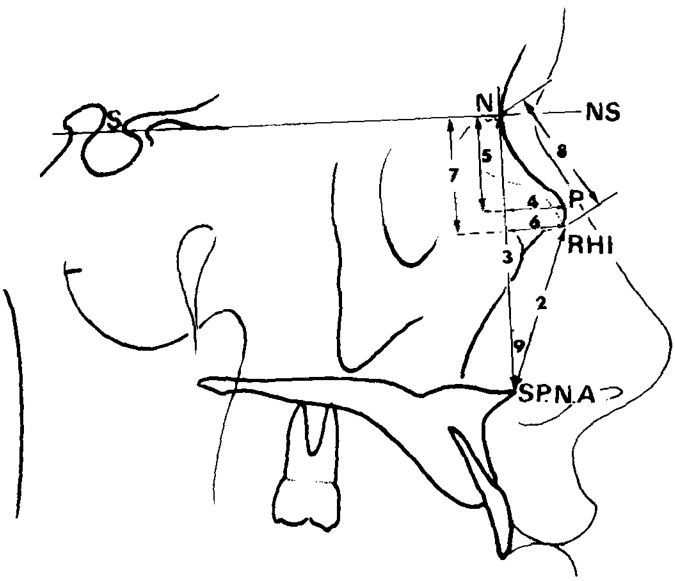
With regard to age changes in morphometric variables, the sample was divided in age classes of ten-year intervals and analyses of variance were used to test the effects of age on morphometric dimensions. Tables 1 and 2 give the mean values and standard deviations for all measurements, by sex, and the results of the analysis of variance.

To estimate the relative contribution of each morphometric feature on the observed dimension of the external nose, partial correlations and multiple stepwise regressions were employed (Tables 3, 4, and 5).

Results

Tables 1 and 2 give the mean values and standard deviations for males and females, respectively. Analysis of variance yielded no significant changes with age in craniometric features, whereas the dimensions of the external nose and the skin depths changed with advanced age. The height dimensions of the nose increased, and so did the thickness of the soft tissues in the area of the nasion and along the nasal bones. Only the distance from subnasion to nasospinale progressively decreased with age in the present study.

Because no significant age changes were observed in craniometric dimensions, the data thus were pooled for further analyses. Age (in years) were introduced as an independent variable.



No.	Description of Measurement
2	height of the apertura piriformis (rhinion to spina nasalis anterior)
3	height of the bony nose (nasion to spina nasalis anterior)
4	distance from reference plane nasion-spina nasalis anterior to the most prominent point along the ossa nasalia ('P maximum')
5	height of 'P maximum' in relation to nasion (P max. proj.)
6	prominence of rhinion in relation to the plane nasion-spina nasalis anterior
7	height of rhinion
9	angle between the plane spina nasalis anterior-nasion and the spina nasalis anterior-rhinion plane

FIG. 1—*Diagram of a lateral radiograph of the area examined and some of the measurements taken (numbers as used in tables).*

Partial Correlations

As the profile line of the nose apparently changes its appearance with age, partial correlations were computed (Table 3). Furthermore, sexual dimorphism in anthropometric features was also taken into account, and thus, the correlation coefficients were adjusted for the effects of age and sex simultaneously.

Partial correlations between craniometric variables revealed that the length of the head was positively associated with the height dimensions of the bony nose and the height of the apertura piriformis, while it varied inversely with the size of the angle. Therefore, long-headed persons seem to have also high faces but relatively less prominent bony noses. However, the coefficients were very low and thus should not be overemphasized.

The high correlation coefficients between the prominence of the rhinion and the most prominent point along the profile line of the nasal bones were not surprising, as those points were often very close to each other and sometimes even concordant (Fig. 1). Accordingly, the correlation between the angle—which is a measure of the relative prominence of rhinion in relation to the height of the bony nose—and the prominence of the ossa nasalia was not unexpected (correlation coefficient [r^2] = 0.84 for "P maximum" (maximum prominence)

TABLE 1—*Mean values and standard deviations of each measurement for the total sample and for each age class, males. Results of analysis of variance are also given.*

No.	Measurements	Total			21-30 yrs.			31-40 yrs.			41-50 yrs.			51-60 yrs.			>61 yrs.			Anal. Var.
		N	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	
1	Head length	154	192.96	7.13	35	192.80	5.70	40	191.30	7.23	35	193.76	8.26	20	193.77	6.78	24	194.10	7.40	
2	Rhi.-sp.n.a.	154	36.41	2.54	35	35.91	2.67	40	36.27	2.31	35	37.20	2.43	20	35.80	2.54	24	36.69	2.76	
3	Nas.-sp.n.a.	154	56.43	3.33	35	56.19	3.12	40	56.31	2.80	35	57.39	3.74	20	56.65	3.28	24	55.42	3.74	
4	P max.	153	11.95	2.18	35	11.64	2.14	40	12.14	2.51	34	11.87	2.12	20	11.57	1.99	24	12.54	1.89	
5	P max. proj.	154	20.09	3.19	35	19.64	2.52	40	19.62	3.61	35	20.63	3.40	20	20.75	2.86	24	20.21	3.29	
6	Rhi. promin.	153	12.60	2.41	35	12.43	2.61	39	12.73	2.28	35	12.37	2.45	20	12.35	2.47	24	13.21	2.25	
7	Rhi. ht.	153	22.45	3.30	35	22.34	3.03	39	21.95	3.33	35	22.87	3.62	20	23.47	3.60	24	21.98	2.88	
8	Os. n.leng.	154	26.44	3.94	35	25.93	3.36	40	26.68	4.37	35	26.63	4.33	20	27.15	4.18	24	25.94	3.27	
9	Angle	154	21.08	4.79	35	20.76	4.75	40	21.70	5.35	35	20.56	4.21	20	20.70	5.20	24	21.63	4.54	
10	Nasal height	154	57.60	4.26	35	55.87	3.34	40	57.81	3.79	35	57.97	5.06	20	58.22	4.58	24	58.73	4.28	
11	Nasal length	154	52.47	5.14	35	50.70	4.26	40	52.55	4.56	35	52.76	6.05	20	52.42	4.80	24	54.54	5.60	
12	Nasal depth	154	22.40	2.38	35	21.14	2.54	40	22.67	2.13	35	22.66	2.01	20	21.97	2.23	24	23.75	2.38	*[a]
13	Nasion-nasion	142	9.37	2.05	32	8.92	1.62	40	9.41	1.85	32	9.53	2.31	15	10.23	1.56	23	9.15	2.67	
14	Os n.(min.th.)	154	3.16	0.87	35	2.90	0.83	40	3.16	0.83	35	3.09	1.07	20	3.35	0.65	24	3.46	0.76	
15	N.spin.-subn.	153	15.59	2.23	35	16.43	1.81	40	15.77	2.30	35	15.46	2.14	20	15.17	2.68	23	14.54	2.00	**[b]

[a]* = significant at the 5% level.
[b]** = significant at the 1% level.

TABLE 2—*Mean values and standard deviations of each measurement for the total sample and for each age class, females. Results of analysis of variance are also given.*

		Total			21-30 yrs.			31-40 yrs.			41-50 yrs.			51-60 yrs.			>61 yrs.			
No.	Measurements	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	*N*	Mean	SD	Anal. Var.
1	Head length	199	182.57	5.68	34	182.46	6.83	41	181.73	5.41	34	182.26	5.17	40	182.31	4.89	50	183.77	5.98	
2	Rhi.-sp.n.a.	199	32.83	2.34	34	32.76	2.53	41	32.79	2.35	34	33.35	2.67	40	32.86	2.01	50	32.52	2.25	
3	Nas.-sp.n.a.	199	52.44	2.67	34	52.45	2.48	41	52.65	2.54	34	53.04	3.23	40	52.10	2.09	50	52.08	2.91	
4	P max.	199	10.91	1.82	34	10.63	1.68	41	10.93	1.58	34	10.96	1.86	40	11.19	2.09	50	10.83	1.89	
5	P max. proj.	199	20.04	3.00	34	20.46	2.53	41	19.57	3.47	34	20.63	3.32	40	20.05	2.62	50	19.72	2.93	
6	Rhi. promin.	199	11.45	2.05	34	11.15	2.00	41	11.48	1.80	34	11.47	2.16	40	11.67	2.35	50	11.44	1.99	
7	Rhi. ht.	199	21.98	2.78	34	22.18	2.80	41	21.49	3.15	34	22.51	2.97	40	21.95	2.39	50	21.93	2.64	
8	Os. n.leng.	199	25.28	2.97	34	24.88	2.88	41	25.20	2.92	34	25.63	3.26	40	25.25	2.63	50	25.40	3.18	
9	Angle	199	20.94	4.17	34	20.41	4.25	41	20.84	3.88	34	20.71	4.53	40	21.45	4.22	50	21.13	4.15	
10	Nasal height	199	53.25	3.58	34	51.59	3.01	41	53.34	3.25	34	54.24	3.87	40	53.65	3.16	50	53.32	4.03	*[a]
11	Nasal length	199	48.17	3.82	34	46.84	3.95	41	48.33	3.14	34	49.34	3.86	40	47.17	3.19	50	48.96	4.32	**[b]
12	Nasal depth	199	21.46	2.21	34	19.72	1.71	41	21.33	2.18	34	22.07	1.73	40	22.01	2.59	50	21.89	1.95	**
13	Nasion-nasion	180	8.56	2.03	32	7.69	1.46	37	8.07	1.46	32	8.70	1.83	32	9.28	2.08	47	8.97	2.53	**
14	Os n.(min.th.)	199	2.54	0.71	34	2.32	0.59	41	2.37	0.61	34	2.48	0.66	40	2.66	0.82	50	2.76	0.73	*
15	N.spin.-subn.	194	12.72	2.12	34	13.60	1.56	41	13.19	1.42	33	12.94	1.90	39	12.49	1.96	47	11.69	2.77	**

[a]* = significant at the 5% level.
[b]** = significant at the 1% level.

TABLE 3—*Partial correlation coefficients by sex, age, and level of significance.*

No.	Measurements	Partial Correlation Coefficients														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Head length	*														
2	Rhi.-sp.n.a.	0.18^{++a}	*													
3	Nas.-sp.n.a.	0.18^{++}	0.52^{++}	*												
4	P max.	−0.04	0.09	0.25^{++}	*											
5	P max. proj.	0.07	−0.20^{++}	0.47^{++}	0.33^{++}	*										
6	Rhi. promin.	−0.09	0.05	0.19^{++}	0.95^{++}	0.15^{+b}	*									
7	Rhi. ht.	0.01	−0.29^{++}	0.51^{++}	0.41^{++}	0.75^{++}	0.44^{++}	*								
8	Os. n.leng.	−0.01	−0.22^{++}	0.51^{++}	0.62^{++}	0.61^{++}	0.64^{++}	0.89^{++}	*							
9	Angle	−0.12^{+}	−0.25^{++}	0.05	0.84^{++}	0.25^{++}	0.88^{++}	0.54^{++}	0.72^{++}	*						
10	Nasal ht.	0.09	0.34^{++}	0.63^{++}	0.39^{++}	0.25^{++}	0.39^{++}	0.38^{++}	0.45^{++}	0.027^{++}	*					
11	Nasal leng.	0.01	0.27^{++}	0.56^{++}	0.49^{++}	0.27^{++}	0.49^{++}	0.41^{++}	0.51^{++}	0.38^{++}	0.85^{++}	*				
12	Nasal dpt.	0.13^{+}	0.27^{++}	0.25^{++}	0.18^{++}	0.07	0.15^{+}	0.03	0.10	0.03	0.32^{++}	0.17^{++}	*			
13	Nas.-nas.	0.02	0.01	−0.02	−0.05	0.05	−0.04	0.04	0.01	−0.01	−0.38^{++}	−0.41^{++}	−0.02	*		
14	Os. n.(min.th.)	0.09	0.02	0.02	−0.39^{++}	−0.02	−0.38^{++}	−0.08	−0.20^{++}	−0.39^{++}	−0.09	−0.18^{++}	0.02	0.30^{++}	*	
15	N.spin.-subn.	0.05	0.18^{++}	0.09	0.14^{+}	−0.04	0.12^{+}	−0.03	0.04	0.11^{+}	0.17^{++}	0.09	−0.11^{+}	0.12^{+}	0.16^{++}	*

$^{a++}$ = significant at the 1% level.
$^{b+}$ = significant at the 5% level.

and 0.88 for the prominence of the rhinion). Furthermore, the size of the angle apparently tended to become greater with increase in height of the nasal bones ($r^2 = 0.54$) and more so with an increase in length of the ossa nasalia ($r^2 = 0.72$).

With regard to correlations between the dimensions of the external nose and the craniometric variables, which is of major interest for further reconstruction, analyses yielded statistically significant and relatively high correlations for nasal height and nasal length. Those two measurements correlated with all dimensions of the skull, except head length. The greatest values were obtained for analyses between nasal height and nasal length and the height of the bony nose ($r^2 = 0.63$ and 0.56, respectively). Furthermore, the prominence of the ossa nasalia also appeared to be of importance in determining nasal length. The coefficients were 0.49 for the correlation between nasal length and P maximum and the prominence of rhinion, respectively.

Despite the relative high values for nasal height and nasal length and the dimensions of the skull, surprisingly few significant correlation coefficients were obtained between nasal depth and the bony features. The highest values were found between nasal depth and the height of the apertura piriformis ($r^2 = 0.27$) and the height of the bony nose ($r^2 = 0.25$).

The correlation coefficient between nasal depth and the height of the external nose was 0.32. This implies that high noses are relatively more often associated with prominent nasal tips. In addition, nasal depth gave also statistically significant results with the length of the nose ($r^2 = 0.17$), but the coefficient was again very low.

The thickness of the soft tissue is greatly dependent on exogenous factors, for example, nutrition, mimicry, and so forth. However, some interesting relationships between the skin depths and the craniometric data on the one hand, and the dimensions of the external nose on the other, were obtained.

With regard to the craniometric variables, the skin depth in the area of nasion gave no significant results and the thickness over subnasion was similarily not very much influenced by craniometric dimensions. Only the height of the apertura piriformis seemed to be of some importance for soft tissue depth in the subnasion region ($r^2 = 0.18$). On the contrary, minimum thickness along the nasal bones appeared to be relatively much influenced by craniometric dimensions, especially by the prominence of the nasal bones. Prominent noses had relative small soft tissue depths along the profile line of the nasal bones and vice versa. The partial correlation coefficients for the minimum thickness and the prominence of the nasal bones were all negative, and −0.39 for P maximum, −0.38 for the prominence of rhinion, and −0.39 for the size of the angle.

The soft tissue cover in the area of nasion correlated inversely with the dimensions of the external nose. The value for the analysis between skin depth in the area of nasion and nasal height was −0.38 and, for nasal length it was −0.41. Higher and longer noses thus appeared to have a relative thinner layer of soft tissue over the nasion. A similar pattern was revealed for the minimum thickness along the nasal bones which correlated significantly and negatively with nasal length ($r^2 = -0.18$). With regard to skin depth in the subnasion area, the highest significant correlation found was with nasal height ($r^2 = 0.17$); and the relation was positive. However, note that the coefficients were very low.

Surprisingly low values were also obtained for intercorrelations between soft tissue thicknesses. Nasion and subnasion depth gave significant results only at the 5% probability level. The highest correlation coefficient was between the thickness over the nasion and the minimum depth along the ossa nasalia ($r^2 = 0.30$).

Regression Analyses

Since some of the high correlations between craniometric and cephalometric measurement might have been due to intercorrelations between the craniometric dimensions, multivariate stepwise regression analysis were used to estimate the relative contribution of each

TABLE 4—*Multiple regression analysis: percentage of variance accounted for by various craniometric dimensions and multiple correlation coefficients, for males (m) and females (f). All coefficients are significant at the 0.1% level.*

Measurements		Contributions to the Regression Analyses										
		H.lng.	R-spi.	N-spi.	P max	P proj.	R prom.	R ht.	Os. n.lg.	Angle	Age	r^2
Nasal ht.	(m)	...	...	44.57	...	...	7.37	...	...	...	5.02	0.57
	(f)	...	...	30.45	...	...	6.93	...	...	...	2.00	0.39
Nasal leng.	(m)	...	...	32.04	...	...	13.74	...	...	...	6.31	0.52
	(f)	...	...	28.81	...	...	14.24	...	...	...	1.93	0.45
Nasal depth	(m)	...	10.55	...	...	...	...	...	...	...	7.32	0.18
	(f)	...	...	6.26	2.19	...	...	2.06	...	...	8.96	0.19
Nas.- nas.	(m)	...	...	...	4.10	...	...	...	...	...	...	0.04[a]
	(f)	...	...	...	...	6.58	...	...	...	...	7.37	0.14
Os. nas.	(m)	...	...	...	...	2.53	...	...	3.06	12.49	4.06	0.22
	(f)	...	...	...	...	...	18.05	...	...	...	5.95	0.24
Ns - sn	(m)	...	5.00	...	...	...	...	...	...	...	7.57	0.12
	(f)	...	2.50	...	...	...	...	...	...	2.01	10.35	0.15

[a]Significant at the 5% level.

cephalometric feature in determining the dimensions of the external nose. In addition, it was also aimed to predict the thickness of the soft tissues by all of the variables taken from the skull. The individual age in years was also used for computations as an independent variable. Tables 4 and 5 give the results for males and females, respectively.

The results were very similar in males and females, especially for the dimensions of the external nose, but slightly inconsistent with the thickness of the soft tissues. All multiple correlation coefficients were significant of a level less than 0.1%, except the male regression analysis for the thickness of the skin in the region of the nasion, which was significant at the 5% level (Table 4).

The previously observed importance of the height of the bony nose on nasal height was confirmed by multiple regression analyses. Of the variance of nasal height in males, 44.6% was explained by the height of the bony nose and, in females it was 30.5%. A further 7.4% of the variance in male nasal height was accounted for by the prominence of the rhinion and, in females, it was 6.9%. With regard to the nasal length, the findings were almost identical to those described above and the multiple correlation coefficients were similar. The height of the bony nose as well as the prominence of rhinion were the most important features in determining the length of the external nose. Both variables together accounted for 45.8% of the variance in males and 43.1% in females. Nevertheless, the influence of age also has to be taken into account for further reconstruction of the height and the length of the nose. In males, 5.0% of the variance of nasal height and 6.3% of the variance of nasal length were accounted for by age. The figures for females were 2.0 and 1.9%, respectively.

The contributions of bony dimensions in determining nasal depth were moderate. The height of the apertura piriformis accounted for only 10.6% of the variance in males. In females, 6.3% of the variance were accounted for by the height of the bony nose. Age, on the other hand, was almost as important in the male regression analysis (7.3% of the variance) and even more important in females (9.0% of the variance).

Although the multiple regression coefficients for the thickness of the soft tissues were significant at the 0.1% level—except for the nasion area in males, which was significant at the 5% level—the total contributions of craniometric features on nasal dimensions did not exceed 25% (Table 4). Especially the thickness in the region of nasion and subnasion appeared to be largely independent of the underlying bony structures, but age played a major part in determining the thickness. For the subnasion depth, 7.6% of the variance was accounted for by age in males and, in females, it was 10.4%. In the nasion area, age was only important in females (7.4% of the variance).

With regard to the minimum thickness of the soft tissues over the ossa nasalia, the results of the multiple stepwise regression analysis were in accordance with the findings of the partial correlations. The prominence of the bony nose was of major importance for prediction of the skin depth along the nasal bones. In males, 12.5% of the variance were accounted for by the relative prominence of the rhinion (angle) and, in females, 18.1% of the variance were accounted for by the absolute prominence of rhinion. A further 4.1% in males and 6.0% in females were explained by age.

Table 5 gives the regression equations for the dimensions of the external nose. The residuals of each analysis were normally distributed, indicating that there is a linear relationship between each of the dependent variables and the craniometric data.

Discussion

Despite the fact that almost all of the results are statistically significant, the findings should not be overemphasized, since a correlation coefficient of 0.17 might be statistically significant if the sample sizes are large enough, but such results add little to our understanding about biological relationships. Thus, the findings of the present study will be discussed

TABLE 5—*Regression equations of the dimensions of the external nose (including the thickness of the soft tissues) on the cephalometric variables for males (m) and females (f), respectively.*

Measurements			Regression Analysis
Nasal height	(m)	=	4.43 + 0.79 (nas.-sp.n.a.) + 0.48 (rhi. promin.) + 0.06 age
	(f)	=	11.09 + 0.68 (nas.-sp.n.a.) + 0.46 (rhi. promin.) + 0.03 age
Nasal length	(m)	=	−2.99 + 0.74 (nas.-sp.n.a.) + 0.79 (rhi. promin.) + 0.08 age
	(f)	=	3.81 + 0.66 (nas.-sp.n.a.) + 0.71 (rhi. promin.) + 0.03 age
Nasal depth	(m)	=	9.69 + 0.30 (rhi.-sp.n.a.) + 0.04 age
	(f)	=	7.88 + 0.04 age + 0.23 (nas.-sp.n.a.) + 0.24 (P max.) − 0.13 (rhi.ht.)
Nas. - nas.	(m)	=	11.79 − 0.20 (P max.)
	(f)	=	3.41 + 0.03 age + 0.18 (P max. proj.)
Os. nas.	(m)	=	3.56 − 0.12 (angle) + 0.01 age + 0.11 (Os. n.leng.) − 0.06 (P max. proj.)
(min.th.)	(f)	=	3.77 − 0.15 (rhi. promin.) + 0.01 age
Ns - sn	(m)	=	9.93 − 0.04 age + 0.20 (rhi.-sp.n.a.)
	(f)	=	7.25 − 0.04 age + 0.18 (rhi.-sp.n.a.) + 0.08 (angle)

in terms of the practical implications they have for further plastic reconstruction of the external nose on the skull.

The results of the study indicate that the nose changes its appearance with age, while no significant age changes were observed in craniometric dimensions. Hancke and Bernhard [*29*] have pointed out that the nasal septum in profile tends to sink down with age, a fact well known in forensic anthropology, where most of the work has been done on qualitative morphological traits [*30,31*]. Comparing the mean values of the third decade with those of individuals over 50 years of age (Tables 1 and 2), these previous findings can be confirmed, but no progressive increase of nasal length and nasal height with age was observed in the present study. Nevertheless, nasal height and nasal length are the dimensions best predicted by craniometric features, with age contributing relatively little. The height of the bony nose and the prominence of the ossa nasalia appear to be of major importance in determining the height and length of the external nose (Tables 3, 4, and 5). In males, those two measurements account for about 52% of the variance of nasal height, and for over 45% of the variance of the length. In females, the results were less satisfactory and only about 37% of the variance of nasal height and about 43% of those of the length are accounted for by the height and prominence of the bony nose. Furthermore, it seems as if age is more important in determining the height and length of the male nose than it is for females. While over 5% of the variance can be explained by age in males, the figure is only 2% in females. On the contrary, age appeared to be of greater importance in females in predicting nasal depth and the thickness of the soft tissues than in males. However, nasal depth is also determined by the height dimensions of the bony nose and of the apertura piriformis, but to an even greater extent by the height of the external nose (Table 3). High noses are often associated with prominent nasal tips; the nose seems to become even more prominent with advanced age (Tables 1 and 2). Thus, external nose height and age should be equally taken into account in predicting the depth of the nose.

Despite the fact that soft tissue thickness is considerably influenced by diet, mimicry, and so forth, the present findings suggest that the bony profile is similarily important although ". . . all parts of the soft tissue profile do not directly follow the underlying skeletal profile" [*32*, p. 504]. Merrifield [*33*] successfully demonstrated that the soft tissue cover tends to "compensate" for the imbalance of the bony profile and vice versa. Only with awareness of this fact are the present findings comprehensible.

There is a negative association between the minimum thickness of the soft tissues along the nasal bones and the prominence of the bony nose indicating that more prominent noses have a thinner layer of soft tissues than less prominent ones. However, not only the absolute prominence contributes in determining the soft tissue thickness, but also the relative one, which, in the present study, is represented by the angle.

With regard to the thickness over the nasion, partial correlation revealed that high and long noses are more likely to have a thinner soft tissue cover over the nasion than short ones; but, as the multiple correlation coefficients are very low and, for males, only significant at the 5% level, the results should not be overemphasized. Furthermore, concerning reconstruction of the thickness over the nasion it also has to be borne in mind that, in the facial profile, bony nasion is not concordant with soft tissue nasion. Again, the profile line tends to adjust to disharmonies in the bony profile.

The results for the thickness of the subnasion area are somewhat different, but also show the tendency of establishing a harmonious profile line. Partial correlations yielded significant results with the height of the external nose and nasal depth only. For the latter, the coefficient is negative. These findings are further confirmed by the regression analyses, where, in addition, age was found to be of relatively great importance for correct prediction. Almost 8% of the variance in males and over 10% of the variance in females are accounted for by the influence of age. With increase in age there is a progressive decrease in the soft tissue thickness. This phenomenon may be partly due to the fact that soft tissue profile increases in convexity with advanced age [*29*]. Furthermore, the thickness of the soft tissue in the subnasal area might be influenced by the structures of the jaws, by the occlusial relation of the teeth, and by tooth loss [*33,34*].

The findings of the present study suggest that it is possible to predict the morphometric dimensions of the nose with some certainty, especially the length and the height of the nose. As the residuals of the multiple regression analyses are normally distributed, and, in none of the analyses were more than a maximum of three individuals found to lie outside the range of 0, +3, the equations may be used as an aid in predicting the dimensions of the external nose (Table 5). Unfortunately, as bony and soft tissues can only be studied at the same time in lateral radiographs, it was not possible to give the influence of asymmetries on the results.

Despite the fact that prediction of the soft tissue cover on the basis of craniometric dimensions is almost impossible, the findings are not discouraging. The present findings seem to justify that, once the gross dimensions of the external nose are established, the soft tissue cover should be remodelled to adjust to functional and structural disharmonies or anomalies or both. Nevertheless, the nose is a complex feature, and although it might be possible to make predictions about the morphometric dimensions of the nose, nasal shape still remains a problem.

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