

# Processus Alveolaris Mandibulae Hominis

An osteometric study

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## I. INTRODUCTION AND METHODS

Certain intra-racial correlations in the profile of the human skeleton were pointed out by the present author in a previous work. The investigation was based on two triangular diagrams, viz. the facial and the mandibular triangles (see figs. 1 A and 1 B). Since the author's results with regard to the mandibular triangle form the basis of the discussions that follow below they will be briefly summarized here. The investigation yielded among other things the result that there are mutual positive correlations between the sides of the mandibular triangle, the length of the corpus (Go-Mt), the height of the ramus (Cd-Go), and the condylomental line (Cd-Mt). Negative correlations are furthermore demonstrated between the jaw angle, Go, and the angles Cd and Mt, respectively. The last-mentioned angles were found to be positively correlated to one another. The jaw angle (Go) shows negative correlations to the adjacent sides (Cd-Go and Go-Mt) but a positive correlation to the opposite side (Cd-Mt). The angle Cd has no correlation to one of the adjacent sides, Cd-Go, and is negatively correlated to the other, Cd-Mt. There is, however, a positive correlation between the angle Cd and the opposite side (Go-Mt). The angle Mt, finally, is positively correlated to the opposite side (Cd-Go) but lacks correlation to adjacent sides (Go-Mt and Cd-Mt). See table 1.

The aim of the present study is to *analyse the relations between the various dimensions within the processus alveolaris as well as the relations between these dimensions and the mandibular triangle.*

The study is based on two series of male Chinese lower jaws, the Hylam and Hokien series, each comprising 38 specimens. Both series are

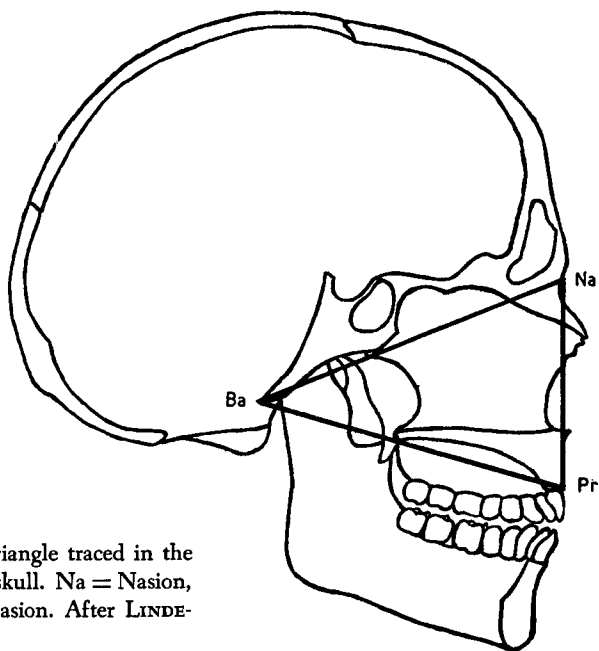


Fig. 1 A. The facial triangle traced in the median plane of the skull. Na = Nasion, Pr = Prosthion, Ba = Basion. After LINDEGÅRD 1951.

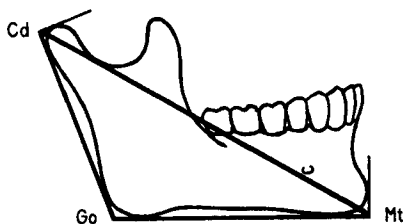


Fig. 1 B. The mandibular triangle traced in the median plane of the skull. Cd = Condylion medianum, Go = Gonion medianum, Mt = Mentale. After LINDEGÅRD 1951.

Table 1. Intra-racial relations between the different components of the mandibular triangle (after Lindegård 1951).

	Cd-Go	Go-Mt	Cd-Mt	Cd	Go	Mt
Cd-Go		(+)	+	o	-	+
Go-Mt	(+)		+	+	(-)	o
Cd-Mt	+	+		(-)?	(+)?	o
Cd	o	+	(-)?		-	+
Go	-	(-)	(+)?	-		-
Mt	+	o	o	+	-	

+ : significant positive correlation  
 - : " negative "  
 (+) : probable positive "  
 (-) : " negative "  
 (+)? : possible positive correlation  
 (-)? : " negative "  
 o : no correlation

measured and described by G. Harrower and the data given are obtained from his publications (HARROWER, 1928). For detailed information the reader is referred to the original papers. The following of Harrower's measurements were used in the present study (cf. figure 2):

- $m_2h$  the distance from the processus alveolaris, at the height of the middle of the second molar, to the basal plane of the corpus, measured by means of a mandibulometer.
- $p_1h$  the same as the foregoing, measured at the middle of the first premolar.
- $d_t h$  the same as the foregoing, measured from the infradentale.
- $g_n d_f$  the distance between the gnathion and the infradentale.
- $m_2 p_1$  the length of the alveolar arcade, i. e., the linear distance between the points on the free edge of the processus alveolaris from which  $m_2h$  and  $p_1h$  were measured.
- C the chin angle, i. e., the angle formed in the sagittal plane between the projection of the basal plane of the corpus and a line through the infradentale and the pogonion.

From Harrower's measurements, moreover, was calculated:

- A the inclination of the alveolar plane ( $m_2 p_1$ ) towards the basal plane of the corpus. This angle was calculated from the right-angled triangle containing the angle A and where the hypotenuse is  $m_2 p_1$  and one of the two smaller sides is composed of the difference between  $m_2h$  and  $p_1h$  (cf. figure 2). It should be mentioned that this angle, as well as the distance  $m_2 p_1$ , are not measured in the sagittal plane but in the longitudinal direction of the corpus area.

Bilateral measurements were made only on the left side and, when this was damaged, on the right side. On account of the impossibility of determining the boundary line between the corpus and the processus alveolaris the different heights of the processus alveolaris ( $m_2h$ ,  $p_1h$ ,  $d_t h$ , and  $g_n d_f$ ) had to be measured in such a manner that actually the height of the corpus was also included.

In addition to these measurements the dimensions in the mandibular triangle (see LINDEGÅRD, 1951) were calculated in the Hylam material.

Due to the limited material the statistical analysis of the relations between the various dimensions was not carried out by calculating the correlation coefficients but in the following manner (cf. LINDEGÅRD, 1951). Of the factors to be investigated with regard to possible mutual correlation one was selected as the independent variable. Starting from the mean value of the independent variable in the entire material the latter was divided into two groups. Group I comprised lower jaws whose values for the independent variable were below the mean value; group II lower jaws with values exceeding the mean value. Within each group the mean value was then calculated for every factor whose possible correlation to the independent variable was to be investigated, i. e., every dependent variable. A difference between the mean value of the dependent variables of the two groups indicated a correlation, the degree of which depended on the quotient of the difference and its average error. According to this quotient the correlations found were represented as follows:

$\geq 3.00$	significant correlation	
2.99—2.50	probable	„
2.49—2.00	possible	„

Correlation analysis between the various dimensions within the processus alveolaris was carried out on both the Hylam and the Hokien series. In the Hylam series such analysis was also made between the components of the mandibular triangle and the dimensions within the processus alveolaris.

The material is too limited for drawing definite conclusions from the results obtained. *The aim of the study was merely to collect such preliminary data as might form a basis for continued studies of pertinent questions.*

## II. RELATIONS WITHIN THE PROCESSUS ALVEOLARIS

(see tables 2 and 3)

Of the measurements used in the study of the processus alveolaris four were chosen as independent variables, one after the other, viz.  $m_2h$ ,  $p_1h$ , the angle A, and the angle C. These measurements were all analyzed in the manner described in the foregoing with regard to their correlation to the other dimensions within the processus alveolaris. The results were as follows.

Table 2. *Hylam*. The entire material is divided into two parts according to whether the independent variable is larger or smaller than the average value. The arithmetic medium and its standard error,  $M \pm \epsilon_M$ , for the dependent variables in both groups as well as the difference and its average error,  $D \pm \epsilon_D$ , are given in mm. The quotient of the difference and its average error is also stated. In table A the independent variable is represented by  $m_2h$ , in table B by  $p_1h$ , in table C by the angle A and in table D by the angle C.

	$m_2h < 28$ $M \pm \epsilon_M$	$m_2h \geq 28$ $M \pm \epsilon_M$	$D \pm \epsilon_D$	$D/\epsilon_D$
$p_1h$	$30.33 \pm 0.50$	$33.05 \pm 0.69$	$2.72 \pm 0.85$	3.20
$d_1h$	$35.56 \pm 0.76$	$38.74 \pm 0.84$	$3.18 \pm 1.14$	2.79
$g_n d_f$	$29.67 \pm 0.56$	$32.32 \pm 0.50$	$2.65 \pm 0.75$	3.53
$m_2 p_1$	$28.61 \pm 0.45$	$28.53 \pm 0.30$	$0.08 \pm 0.55$	< 1
A	$12.00 \pm 1.10$	$7.16 \pm 1.18$	$4.84 \pm 1.61$	3.01
C	$70.00 \pm 1.76$	$75.00 \pm 1.65$	$5.00 \pm 2.42$	2.07
A				
	$p_1h < 32$ $M \pm \epsilon_M$	$p_1h \geq 32$ $M \pm \epsilon_M$	$D \pm \epsilon_D$	$D/\epsilon_D$
$m_2h$	$25.55 \pm 0.49$	$28.88 \pm 0.60$	$3.33 \pm 0.77$	4.32
$d_1h$	$35.00 \pm 0.69$	$40.12 \pm 0.57$	$5.12 \pm 0.90$	5.69
$g_n d_f$	$29.45 \pm 0.49$	$32.88 \pm 0.42$	$3.43 \pm 0.64$	5.36
$m_2 p_1$	$29.00 \pm 0.29$	$28.06 \pm 0.44$	$0.94 \pm 0.53$	1.77
A	$7.75 \pm 1.15$	$11.59 \pm 1.25$	$3.84 \pm 1.69$	2.27
C	$72.71 \pm 1.74$	$72.35 \pm 1.88$	$0.36 \pm 2.56$	< 1
B				
	A < 10 $M \pm \epsilon_M$	A $\geq 10$ $M \pm \epsilon_M$	$D \pm \epsilon_D$	$D/\epsilon_D$
$m_2h$	$27.90 \pm 0.61$	$26.00 \pm 0.65$	$1.90 \pm 0.89$	2.14
$p_1h$	$30.71 \pm 0.66$	$33.06 \pm 0.38$	$2.35 \pm 0.75$	3.13
$d_1h$	$35.81 \pm 0.82$	$39.00 \pm 0.76$	$3.19 \pm 1.12$	2.85
$g_n d_f$	$30.19 \pm 0.49$	$32.13 \pm 0.57$	$1.94 \pm 0.76$	2.55
$m_2 p_1$	$28.62 \pm 0.24$	$28.50 \pm 0.53$	$0.12 \pm 0.58$	< 1
C	$74.00 \pm 1.83$	$71.06 \pm 1.71$	$2.94 \pm 2.50$	1.18
C				
	C < 73 $M \pm \epsilon_M$	C $\geq 73$ $M \pm \epsilon_M$	$D \pm \epsilon_D$	$D/\epsilon_D$
$m_2h$	$26.69 \pm 0.80$	$27.38 \pm 0.56$	$0.69 \pm 0.97$	< 1
$p_1h$	$31.94 \pm 0.83$	$31.43 \pm 0.54$	$0.51 \pm 0.99$	< 1
$d_1h$	$37.71 \pm 1.11$	$36.95 \pm 0.66$	$0.76 \pm 1.29$	< 1
$g_n d_f$	$31.00 \pm 0.75$	$31.05 \pm 0.50$	$0.05 \pm 0.90$	< 1
$m_2 p_1$	$27.81 \pm 0.44$	$29.14 \pm 0.25$	$1.33 \pm 0.51$	2.61
A	$11.25 \pm 1.45$	$8.19 \pm 1.05$	$3.06 \pm 1.79$	1.71
D				

Table 3. *Hokien*. The entire material is divided into two parts according to whether the independent variable is larger or smaller than the average value. The arithmetic medium and its standard error,  $M \pm \epsilon_M$ , for the dependent variables in both groups as well as the difference and its average error,  $D \pm \epsilon_D$ , are given in mm. The quotient of the difference and its average error is also stated. In table A the independent variable is represented by  $m_2h$ , in table B by  $p_1h$ , in table C by the angle A and in table D by the angle C.

	$m_2h < 29$ $M \pm \epsilon_M$	$m_2h \geq 29$ $M \pm \epsilon_M$	$D \pm \epsilon_D$	$D/\epsilon_D$
$p_1h$	$31.67 \pm 0.40$	$34.57 \pm 0.74$	$2.90 \pm 0.84$	3.45
$d_1h$	$38.25 \pm 1.10$	$42.14 \pm 1.34$	$3.89 \pm 1.73$	2.25
$g_n d_f$	$31.55 \pm 0.47$	$34.50 \pm 1.61$	$2.95 \pm 0.64$	4.61
$m_2p_1$	$29.90 \pm 0.49$	$31.00 \pm 0.73$	$1.10 \pm 0.88$	1.25
A	$9.30 \pm 0.83$	$7.85 \pm 1.48$	$1.45 \pm 1.69$	< 1
C	$77.90 \pm 0.69$	$77.23 \pm 1.58$	$0.67 \pm 1.73$	< 1
A				
	$p_1h < 33$ $M \pm \epsilon_M$	$p_1h \geq 33$ $M \pm \epsilon_M$	$D \pm \epsilon_D$	$D/\epsilon_D$
$m_2h$	$27.65 \pm 0.43$	$29.94 \pm 0.41$	$2.29 \pm 0.59$	3.87
$d_1h$	$38.10 \pm 1.14$	$41.47 \pm 1.04$	$3.37 \pm 1.54$	2.28
$g_n d_f$	$32.29 \pm 0.58$	$33.94 \pm 0.42$	$1.65 \pm 0.71$	2.32
$m_2p_1$	$30.13 \pm 0.36$	$30.65 \pm 0.72$	$0.52 \pm 0.81$	< 1
A	$7.12 \pm 1.07$	$9.61 \pm 0.93$	$2.49 \pm 1.42$	1.71
C	$78.25 \pm 0.96$	$75.56 \pm 1.11$	$2.69 \pm 1.47$	1.83
B				
	A < 9 $M \pm \epsilon_M$	A $\geq 9$ $M \pm \epsilon_M$	$D \pm \epsilon_D$	$D/\epsilon_D$
$m_2h$	$29.62 \pm 0.92$	$28.20 \pm 0.44$	$1.42 \pm 0.81$	1.75
$p_1h$	$31.23 \pm 0.54$	$33.95 \pm 0.59$	$2.72 \pm 0.80$	3.40
$d_1h$	$40.15 \pm 2.16$	$39.90 \pm 0.63$	$0.25 \pm 2.25$	< 1
$g_n d_f$	$31.92 \pm 0.75$	$33.45 \pm 0.47$	$1.53 \pm 0.88$	1.73
$m_2p_1$	$30.92 \pm 0.70$	$30.10 \pm 0.49$	$0.72 \pm 0.85$	< 1
C	$78.46 \pm 1.25$	$76.50 \pm 1.10$	$1.96 \pm 1.60$	1.22
C				
	C < 78 $M \pm \epsilon_M$	C $\geq 78$ $M \pm \epsilon_M$	$D \pm \epsilon_D$	$D/\epsilon_D$
$m_2h$	$28.50 \pm 0.74$	$28.94 \pm 0.42$	$0.44 \pm 0.85$	< 1
$p_1h$	$33.35 \pm 0.77$	$32.22 \pm 0.54$	$1.13 \pm 0.94$	1.19
$d_1h$	$39.15 \pm 0.70$	$38.38 \pm 0.65$	$0.77 \pm 0.95$	< 1
$g_n d_f$	$33.00 \pm 0.60$	$33.06 \pm 0.50$	$0.06 \pm 0.78$	< 1
$m_2p_1$	$30.45 \pm 0.66$	$30.20 \pm 0.47$	$0.25 \pm 0.81$	< 1
A	$10.00 \pm 1.04$	$7.31 \pm 0.97$	$2.87 \pm 1.42$	2.01
D				

Positive correlations of varying degrees exist between the different heights ( $m_2h$ ,  $p_1h$ ,  $d_t h$ , and  $g_n d_f$ ). Both series thus have significant correlations between  $m_2h$  on the one side and  $p_1h$  and  $g_n d_f$  on the other. The correlation of  $m_2h$  to  $d_t h$ , however, is probable in the Hylam series and possible in the Hokien series;  $p_1h$  has a significant correlation to  $m_2h$ ,  $d_t h$ , and  $g_n d_f$  in the Hylam series. In the Hokien series the correlation between  $p_1h$  and  $m_2h$  is significant but the correlations between  $p_1h$  on the one side and  $d_t h$  and  $g_n d_f$  on the other only possible.

Both  $m_2h$  and  $p_1h$  lack correlation to the length of the alveolar arcade ( $m_2p_1$ ).

When the angle of inclination of the alveolar plane (A) is the independent variable and the chin angle (C) is dependent there is no correlation between them in the two series. When the latter angle, however, is the independent variable the Hokien series has a possible negative correlation to the angle A. This correlation does not occur in the Hylam material.

The chin angle (C) lacks correlation to all the linear measurements within the processus alveolaris except a probable positive correlation to  $m_2p_1$  in the Hylam series and a possible positive correlation with  $m_2h$  in the same series; no such correlations were observed in the Hokien series.

The angle of inclination of the alveolar plane (A) does not have any correlation to the length of the alveolar arcade ( $m_2p_1$ ) in the two series. The angle A, on the other hand, is correlated to the various heights within the processus alveolaris in both the Hylam and the Hokien series, but only the correlation to  $p_1h$  is significant. The correlation to  $g_n d_f$  and  $d_t h$  are probable in the Hylam material and that to  $m_2h$  possible. In the Hokien series the correlations to  $g_n d_f$  and  $m_2h$  are less pronounced; none is statistically significant. The quotient of the difference and its average error is 1.75 for  $m_2h$  and 1.73 for  $g_n d_f$ ; taken together with the results from the Hylam series they may be considered to be of some importance. There is no correlation whatsoever in the Hokien series between the angle A and  $d_t h$ . The kind of correlation between the angle A and the different heights is of particular interest. While the correlation to  $m_2h$  is negative in the two series the correlation to the other heights is positive. This fact will be discussed more in detail below.

III. RELATIONS BETWEEN THE PROCESSUS ALVEOLARIS  
AND THE MANDIBULAR TRIANGLE

(see table 4)

Preliminary studies on the connection between the processus alveolaris of the lower jaw and its basal portions on cephalometric profile radiograms have yielded results agreeing with those obtained from the osteometric study on the Hylam material reported below. It was, therefore, deemed sufficient to carry out this part of the investigation on only this one of the series.

One after the other the sides and angles of the mandibular triangle were chosen as independent variables while the measurements of the processus alveolaris were taken as dependent variables.

There are positive correlations between the two sides, Cd-Mt resp. Cd-Go, of the mandibular triangle and the heights within the processus alveolaris. Cd-Mt shows significant correlation to all the heights. Cd-Go is significantly correlated to  $m_2h$  and  $g_n d_p$ , probably correlated to  $p_1h$ , and possibly correlated to  $d_1h$ . The correlations obtained between Go-Mt and the above-mentioned heights are also positive but none is significant or even probable. There is only one possible correlation, viz. with  $d_1h$ . None of the heights possesses throughout a greater or lesser correlation to the sides of the mandibular triangle than to the others.

The sides of the mandibular triangle all lack correlation to the angle of inclination of the alveolar plane (A), the chin angle (C), and the length of the alveolar arcade ( $m_2p_1$ ).

The angles of the mandibular triangle have no correlation to the length of the alveolar arcade ( $m_2p_1$ ). Nor do they show any correlation to the heights of the processus alveolaris, except to  $m_2h$ , where the angle Go has a negative significant, the angle Mt a positive probable, and the angle Cd, finally, a positive possible correlation.

The angles of the mandibular triangle are correlated to the angle of inclination of the alveolar plane (A). Thus the angle Go has a positive significant, the angle Mt a negative significant and the angle Cd a negative probable correlation to this angle. The angles of the mandibular triangle are, moreover, correlated to the chin angle (C): the angle Go has a negative probable, the angle Mt a positive probable, and the angle Cd a positive possible correlation.

Table 4. *Hylam*. The entire material is divided into two parts according to whether the independent variable is larger or smaller than the average value. The arithmetic medium and its standard error,  $M \pm \epsilon_M$ , for the dependent variables in both groups as well as the difference and its average error,  $D \pm \epsilon_D$ , are given in mm. The quotient of the difference and its average error is also stated. In table A the independent variable is represented by Cd-Go, in table B by Go-Mt, in table C by Cd-Mt, in table D by the angle Cd, in table E by the angle Go, and in table F by the angle Mt.

	Cd — Go < 61 M ± ε <sub>M</sub>	Cd — Go ≥ 61 M ± ε <sub>M</sub>	D ± ε <sub>D</sub>	D/ε <sub>D</sub>
m <sub>2</sub> h	25.32 ± 0.51	29.00 ± 0.50	3.68 ± 0.87	4.23
p <sub>1</sub> h	30.58 ± 0.51	33.00 ± 0.74	2.42 ± 0.89	2.72
d <sub>1</sub> h	35.84 ± 0.81	38.61 ± 0.84	2.77 ± 1.17	2.37
g <sub>n</sub> d <sub>f</sub>	29.79 ± 0.55	32.33 ± 0.51	2.54 ± 0.75	3.39
m <sub>2</sub> p <sub>1</sub>	28.84 ± 0.30	28.28 ± 0.44	0.56 ± 0.53	1.06
A	10.42 ± 0.97	8.06 ± 1.51	2.36 ± 1.80	1.31
C	71.05 ± 1.97	74.00 ± 1.54	2.95 ± 2.51	1.18
A				
	Go — Mt < 76 M ± ε <sub>M</sub>	Go — Mt ≥ 76 M ± ε <sub>M</sub>	D ± ε <sub>D</sub>	D/ε <sub>D</sub>
m <sub>2</sub> h	26.22 ± 0.57	27.89 ± 0.69	1.67 ± 0.89	1.88
p <sub>1</sub> h	30.72 ± 0.57	32.50 ± 0.69	1.78 ± 0.90	1.98
d <sub>1</sub> h	35.72 ± 0.69	38.70 ± 0.78	2.98 ± 1.20	2.48
g <sub>n</sub> d	30.22 ± 0.61	31.79 ± 0.56	1.57 ± 0.82	1.92
m <sub>2</sub> p <sub>1</sub>	28.56 ± 0.32	28.58 ± 0.42	0.02 ± 0.53	< 1
A	9.28 ± 1.14	9.74 ± 1.38	0.46 ± 1.79	< 1
C	72.28 ± 1.96	72.80 ± 1.66	0.52 ± 2.57	< 1
B				
	Cd — Mt < 120 M ± ε <sub>M</sub>	Cd — Mt ≥ 120 M ± ε <sub>M</sub>	D ± ε <sub>D</sub>	D/ε <sub>D</sub>
m <sub>2</sub> h	25.71 ± 0.45	28.87 ± 0.70	3.16 ± 0.83	3.81
p <sub>1</sub> h	30.19 ± 0.48	33.62 ± 0.69	3.43 ± 0.84	4.08
d <sub>1</sub> h	35.59 ± 0.72	39.62 ± 0.77	4.03 ± 1.05	3.84
g <sub>n</sub> d <sub>f</sub>	29.86 ± 0.51	32.56 ± 0.54	2.70 ± 0.74	3.65
m <sub>2</sub> p <sub>1</sub>	28.71 ± 0.30	28.38 ± 0.48	0.33 ± 0.57	< 1
A	9.29 ± 1.13	9.81 ± 1.44	0.52 ± 1.84	< 1
C	73.23 ± 1.78	71.62 ± 1.77	1.61 ± 2.51	< 1
C				
	Cd < 32 M ± ε <sub>M</sub>	Cd ≥ 32 M ± ε <sub>M</sub>	D ± ε <sub>D</sub>	D/ε <sub>D</sub>
m <sub>2</sub> h	26.25 ± 0.64	28.06 ± 0.62	1.81 ± 0.89	2.03
p <sub>1</sub> h	31.90 ± 0.63	31.39 ± 0.69	0.51 ± 0.96	< 1
d <sub>1</sub> h	37.50 ± 0.95	37.06 ± 0.76	0.44 ± 1.22	< 1
g <sub>n</sub> d <sub>f</sub>	31.10 ± 0.63	30.94 ± 0.57	0.16 ± 0.85	< 1
m <sub>2</sub> p <sub>1</sub>	28.30 ± 0.41	28.88 ± 0.37	0.58 ± 0.56	1.04
A	11.65 ± 1.20	7.00 ± 1.07	4.65 ± 1.61	2.89
C	70.20 ± 1.84	75.17 ± 1.54	4.97 ± 2.40	2.07
D				

	$Go < 122$	$Go \geq 122$	$D \pm \epsilon_D$	$D/\epsilon_D$
	$M \pm \epsilon_M$	$M \pm \epsilon_M$		
$m_2h$	$28.61 \pm 0.56$	$25.63 \pm 0.58$	$2.98 \pm 0.80$	3.73
$p_1h$	$31.84 \pm 0.68$	$31.47 \pm 0.67$	$0.37 \pm 0.95$	< 1
$d_1h$	$37.47 \pm 0.75$	$37.15 \pm 0.98$	$0.32 \pm 1.23$	< 1
$g_n d_f$	$31.22 \pm 0.54$	$30.84 \pm 0.66$	$0.38 \pm 0.86$	< 1
$m_2 p_1$	$28.56 \pm 0.31$	$28.58 \pm 0.43$	$0.02 \pm 0.54$	< 1
A	$6.89 \pm 0.99$	$12.00 \pm 1.23$	$5.11 \pm 1.58$	3.23
C	$75.53 \pm 1.57$	$69.58 \pm 1.75$	$5.95 \pm 2.36$	2.52
E				
	$Mt < 26$	$Mt \geq 26$	$D \pm \epsilon_D$	$D/\epsilon_D$
	$M \pm \epsilon_M$	$M \pm \epsilon_M$		
$m_2h$	$26.05 \pm 0.56$	$28.36 \pm 0.65$	$2.31 \pm 0.86$	2.69
$p_1h$	$31.77 \pm 0.61$	$31.67 \pm 0.80$	$0.10 \pm 1.00$	< 1
$d_1h$	$37.45 \pm 1.10$	$37.06 \pm 0.84$	$0.39 \pm 1.39$	< 1
$g_n d_f$	$31.09 \pm 0.59$	$30.93 \pm 0.61$	$0.16 \pm 0.85$	< 1
$m_2 p_1$	$28.73 \pm 0.39$	$28.33 \pm 0.33$	$0.40 \pm 0.51$	< 1
A	$11.82 \pm 1.11$	$6.07 \pm 1.02$	$5.75 \pm 1.51$	3.81
C	$69.91 \pm 1.54$	$76.19 \pm 1.82$	$6.28 \pm 2.38$	2.64
F				

## IV. DISCUSSION

The author has shown in his previously quoted publication that the shape of the facial triangle has only a slight, if any, connection with the shape of the mandibular triangle (see figs. 1 A and 1 B). Since the facial and mandibular triangles are an expression of the basal parts of the upper and lower facial skeleton, respectively, it is justifiable to assume the existence of factors which, during the formation of the facial skeleton, serve to level out possible disproportions between the basal parts of the upper and lower face so that the dental arcades occlude in a normal manner. The processus alveolaris may be assumed to constitute such a levelling factor.

The larger the jaw angle of a lower jaw the more forward-downward the course of the basal plane of the corpus mandibulae in relation to the rest of the face, expressed by the angle between this plane and the frankfort horizontal (JOHNSON 1950). This position of the corpus mandibulae would produce an open bite in the frontal part insofar as no levelling factors of the above-mentioned type were present. The positive correlation demonstrated between the jaw angle ( $Go$ ) and the angle of inclination of the alveolar plane towards the basal plane of the corpus (A) supports the

theory that the processus alveolaris actually is the levelling factor in question. Thus, an increase in height of the processus alveolaris prevents an open bite. Such an increase in height of the processus alveolaris, however, does not take place along the entire corpus area. The investigation showed that only the heights  $p_1h$ ,  $d_1h$ , and  $g_n d_f$  have a positive correlation to the angle A. The most distally situated height,  $m_2h$ , had instead a negative correlation to the angle A which indicates that the more marked the forward-downward inclination of the corpus the lesser the height  $m_2h$ .

Since  $m_2h$  has a negative and  $p_1h$  a positive correlation to the angle A there is likely a height measurement between those two (here denominated  $xh$ ), which lacks correlation to the angle A. As  $p_1h$  has a qualitatively stronger correlation to the angle A than  $m_2h$  has  $xh$  should, due to its assumed characteristic, be situated closer to  $m_2h$  than to  $p_1h$ , i. e., it should lie at the position of the first molar.

The following theory is based on the foregoing conditions. A particular upper facial skeleton is combined with a lower jaw, which is connected to the cranium by means of the two jaw joints. The first molar is the first definitive tooth in the lower jaw. The inclination of the corpus is determined inter alia by the numerical value of  $xh$ . The position of the mandible (corresponding to central occlusion) in relation to the upper face is thereby fixed. Provided that the maxilla is of greater significance for the position of the occlusal plane — and thus also of the two alveolar planes — in relation to the frankfort plane, the formation of the processus alveolaris mandibulae can be assumed to occur in the following manner. The processus alveolaris mandibulae increases in height in different parts until the teeth of the mandible meet those of the maxilla. This means that the increase in height of the alveolar process mesial of  $xh$  must be accelerated but the increase in height distal of  $xh$  be retarded. This is actually the case as shown by the correlations between the angle A and the different heights of the alveolar process.

The angle A is thus a factor that is correlated and probably subordinated to both the jaw angle  $Go$  and possibly the relative height in the upper facial skeleton as expressed by the angle  $Ba$  (see figure 1 A) or by the length-height index of the upper facial skeleton (see HJORTSJÖ, 1947).

The angle  $Go$  has a strong negative correlation to the general size of the mandible. Thus, for example, the larger the angle  $Go$  the smaller the expected heights within the processus alveolaris. From the foregoing it is evident, however, that a large value of the angle  $Go$  means a large value of the angle A and that this relation is also decisive for the height of the

processus alveolaris. The height, which is assumed to lack correlation to the angle A, should then be negatively correlated to  $G_0$ , as it is not influenced by the angle A. Since the distally situated heights — here represented by  $m_2h$  — strive to assume lesser values through their simultaneous negative correlation with the angles  $G_0$  and A when these two angles (which are positively correlated) increase,  $m_2h$  will show an accentuated decrease (through a synergistic effect), appearing in a significant negative correlation to the angle  $G_0$ . It is different for the heights situated mesial of  $xh$ . When the angle  $G_0$  increases, thereby (due to its correlation to the general size of the mandible) striving to reduce gradually the values of the last-mentioned height measurements, the latter are at the same time subjected to a tendency to increase through their positive correlations to the angle A (which is assumed to increase simultaneously). The tendencies to change the heights, caused by the simultaneous alteration of the angles  $G_0$  and A, are thus antagonistic. This is corroborated by the fact that the heights situated mesial of  $xh$  ( $p_1h$ ,  $d_1h$ , and  $g_n d_1$ ) have no correlation whatsoever to the angle  $G_0$ .

The formation of the processus alveolaris, expressed by the angle A has thus been demonstrated to possess good correlation to the shape of the mandibular triangle, expressed by its angles. The different heights in the processus alveolaris have also been shown to be positively correlated to the size of the mandibular triangle, expressed by the sides of the latter. Within the mandibular triangle there is a good correlation between the shape of the mandible (i. e., its angles) and its size (i. d., its sides). A correlation between the size of the mandibular triangle (expressed by its sides) and the form of the processus alveolaris (expressed by the angle A) might therefore be expected. No such correlation, however, can be established in the present material. This fact lends further support to the supposition that a *certain* mandible *can* have practically any position in relation to the rest of the face, even though the corpus would have a tendency to become more inclined forward-downwards the smaller the size of the mandibular triangle.

The assumed significance of the first mandibular molar for the formation of the processus alveolaris of the mandible seems to justify further studies on a larger material.

The very marked retardation of the growth in heights of the alveolar process situated distal of  $xh$ , which occurs at the same time as the jaw angle ( $G_0$ ) assumes a larger value, is probably important enough to warrant further studies. Suffice it to say here that during the phylogenesis

the jaw angle undergoes an enlargement. It can therefore be expected a priori that the occurrence of the retention of the distal molar in the lower jaw will increase simultaneously with this change in the size of the mandible.

On the basis of the knowledge gained from the present investigation two extreme variants with numerous intermediate forms can be set forth in a certain series of mandibles with regard to the typology, where, however, the transition from one form to another always occurs regularly:

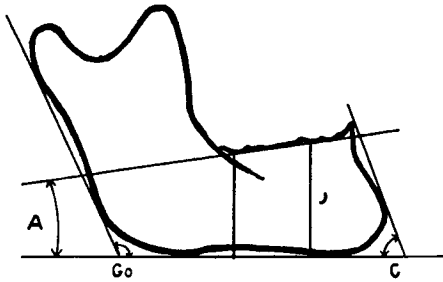


Fig. 2 A. An extreme variant of a mandible of powerful build with a small jaw angle, large chin angle, and small angle between the alveolar plane and the basal plane of the corpus.

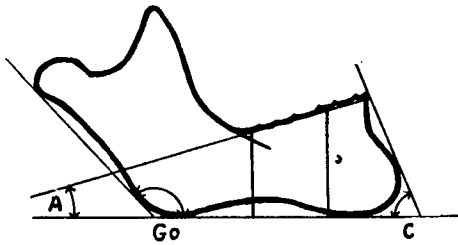


Fig. 2 B. An extreme variant of a mandible of slender build with a large jaw angle, small chin angle, and large angle between the alveolar plane and the basal plane of the corpus.

The first extreme variant (see figure 2 A) is characterized by a powerful build, a comparatively small jaw angle, a rather horizontal position of the corpus in relation to the upper face (expressed by the angle between the Frankfort plane and the basal plane of the corpus), a small angle A and a comparatively large chin angle (C).

The second extreme variant (see figure 2 B) is characterized by a slender build, a comparatively large jaw angle, a fairly oblique corpus (cf. above), a large angle A, and a small angle C.

## V. SUMMARY

An analysis of the correlations between various dimensions of two series of male Chinese mandibles, each series comprising 38 cases, has been carried out.

On the basis of the results obtained and previous knowledge of the anatomical variation of the mandible, two extreme variants with regular intermediate forms are distinguished with regard to the typology. See figures 2 A and B.

Theories on the significance of the first mandibular molar in the formation of the processus alveolaris of the mandible are advanced, as well as on the connection between the occurrence of retarded molars in the lower jaw and the size of the mandible, and the position of the mandible in relation to the upper face, respectively.

## ZUSAMMENFASSUNG

Der Verfasser analysiert die Korrelationen zwischen der verschiedenen Dimensionen zwei Serien von männlichen chinesischen Unterkiefern.

Auf Grund der Resultaten und der Kenntnis von Variationanatomie des Unterkiefers zwei extreme Varianten sind unterschieden in bezug auf die Typologie, mit regelmässig in einander übergehenden Zwischenformen, s. Fig. 2 A und B.

Die Bedeutung des ersten Molar des Unterkiefers für die Formation des Processus Alveolaris des Unterkiefers ist diskutiert, sowie der Zusammenhang zwischen dem Vorkommen zurückgehaltener Molaren des Unterkiefers und die Grösse des Unterkiefers resp. die Lage des Unterkiefers im Verhältnis zum Obergesicht.

## RÉSUMÉ

L'auteur analyse les corrélations entre les dimensions différentes en deux séries de crânes chinois masculins, chacune comprenant 38 cas.

Les résultats obtenus et notre connaissance de l'anatomie de variation de la machoire inférieure ont permis la distinction de deux variantes extrêmes suivant la typologie et des formes intermédiaires qui se succèdent avec régularité, voir fig. 2 A et B.

L'importance du premier molar de la machoire inférieure pour la formation du processus alveolaris est indiquée, ainsi que la relation entre

l'occurrence de molars retardés dans la mâchoire inférieure et la dimension de la mâchoire inférieure resp. la position de la mâchoire inférieure relativement à la partie supérieure de la face.

#### SAMMANFATTNING

På tvenne serier manliga kinesiska underkäkar, vardera serien omfattande 38 fall, har förf. utfört analys av korrelationsförhållanden mellan olika dimensioner.

På grundval av de erhållna resultaten, i förening med tidigare kunskap om underkäkens variationsanatomi, särskiljes med hänsyn till typologien tvenne extremvarianter och lagbundet i varandra övergående mellanformer. Se fig. 2 A och B.

Vidare framlägges synpunkter på första underkäksmolarens betydelse för utformningen av underkäkens alveolarutskott samt på sambandet mellan förekomsten av retinerade underkäksmolarer och storleken av underkåken, resp. ställning av underkåken i förhållande till övre ansiktet.

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