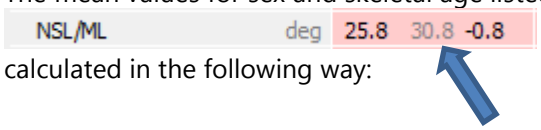
Cephalometric Morphological Analysis Parameters – Means and Variability

From the very first day as a student in the Post Graduate Orthodontic Program under Arne Björk I found it confusing that cephalometric variables for a specific individual were compared to mean values for fourteen year old Swedish boys from Björk's previous studies. When confronted with this issue Björk answered that he (almost!) agreed with me. A more correct way would be to compare the individual patient's values to those of the same sex, skeletal age and ethnic group.

Such values, however, have not been available and for present day ethical reasons it is not feasible to get this information. As a consequence I have chosen to follow a different path to develop these values, as explained in the following.

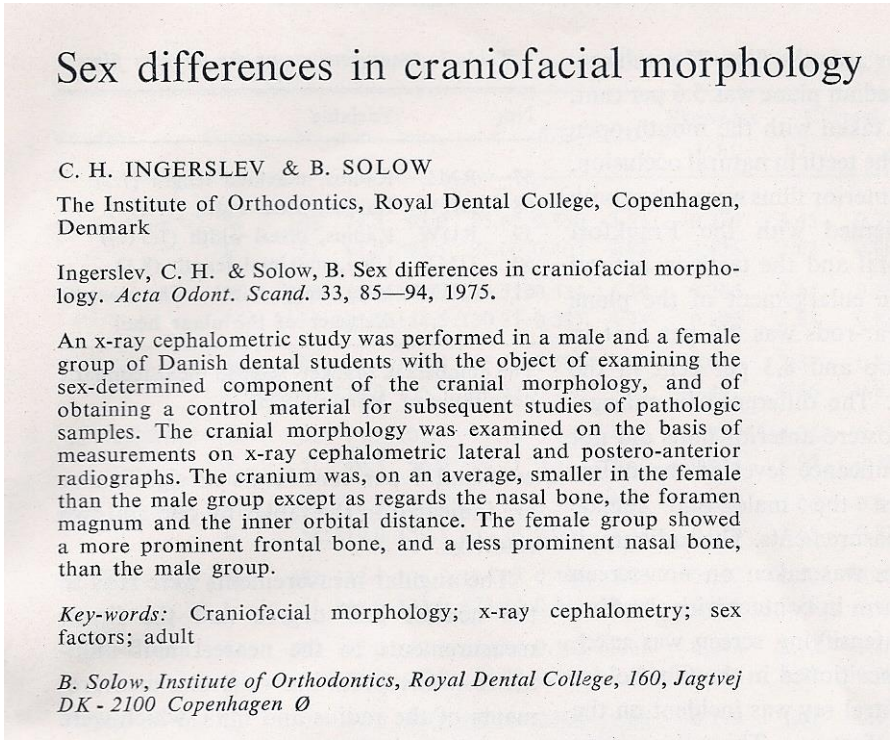
JB-J

The mean values for sex and skeletal age listed in the Morphological Analysis in Tiops4 have been



calculated in the following way:

The samples from which the values have been calculated are for adults and originated from the following publication by C. H. Ingerslev and B. Solow.



Sex differences in craniofacial morphology

C. H. INGERSLEV & B. SOLOW

The Institute of Orthodontics, Royal Dental College, Copenhagen, Denmark

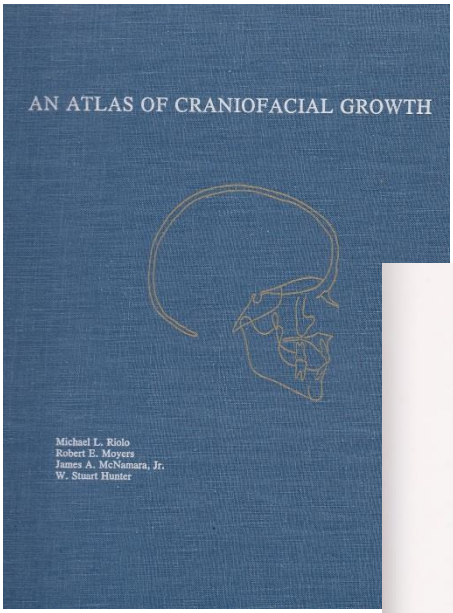
Ingerslev, C. H. & Solow, B. Sex differences in craniofacial morphology. *Acta Odont. Scand.* 33, 85—94, 1975.

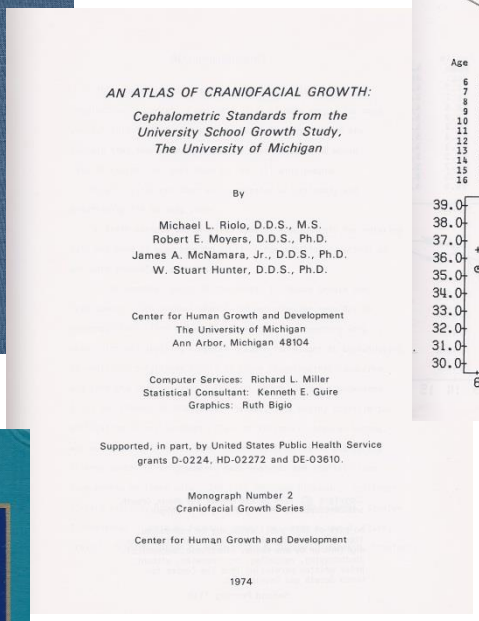
An x-ray cephalometric study was performed in a male and a female group of Danish dental students with the object of examining the sex-determined component of the cranial morphology, and of obtaining a control material for subsequent studies of pathologic samples. The cranial morphology was examined on the basis of measurements on x-ray cephalometric lateral and postero-anterior radiographs. The cranium was, on an average, smaller in the female than the male group except as regards the nasal bone, the foramen magnum and the inner orbital distance. The female group showed a more prominent frontal bone, and a less prominent nasal bone, than the male group.

Key-words: Craniofacial morphology; x-ray cephalometry; sex factors; adult

B. Solow, Institute of Orthodontics, Royal Dental College, 160, Jagtvej DK - 2100 Copenhagen Ø

There is presently no Danish age related data available, but there are several American studies that can be helpful in this respect:




AN ATLAS OF CRANIOFACIAL GROWTH:

Cephalometric Standards from the University School Growth Study, The University of Michigan

By

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Graphics: Ruth Bigio

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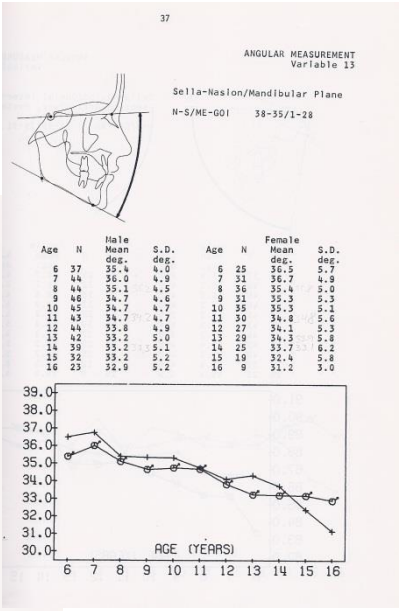
Monograph Number 2
Craniofacial Growth Series

Center for Human Growth and Development

1974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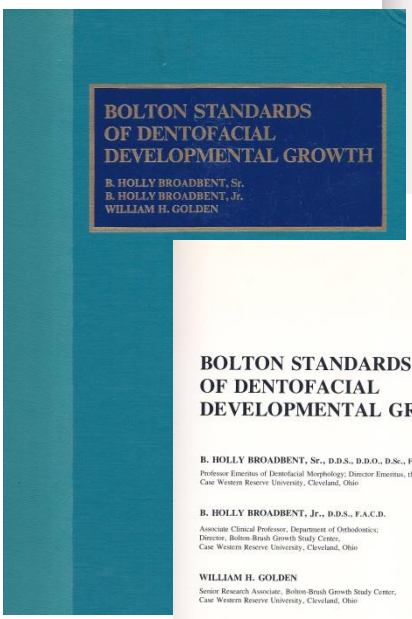
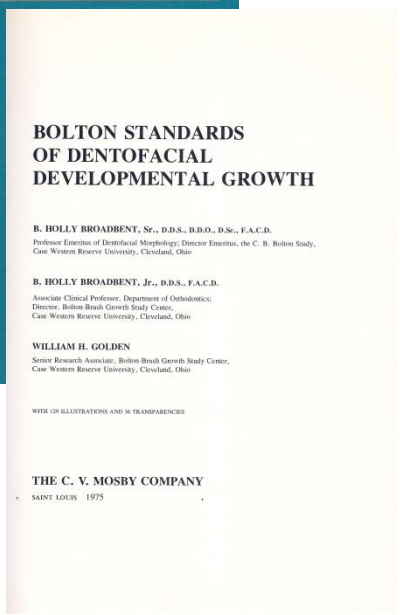
ANGULAR MEASUREMENT
Variable 13

Sella-Nasion/Mandibular Plane

N-S/ME-GOI 38-35/1-28

Age	N	Male Mean deg.	S.D. deg.	Age	N	Female Mean deg.	S.D. deg.
6	37	35.4	4.0	6	25	36.5	5.7
7	44	36.0	4.9	7	31	36.7	4.9
8	44	35.1	4.5	8	36	35.4	5.0
9	46	34.7	4.6	9	31	35.3	5.3
10	45	34.7	4.7	10	35	35.3	5.1
11	43	34.7	4.7	11	30	34.8	5.6
12	44	33.8	4.9	12	27	34.1	5.3
13	42	33.2	5.0	13	29	34.3	5.8
14	39	33.2	5.1	14	25	33.7	6.2
15	32	33.2	5.2	15	19	32.4	5.8
16	23	32.9	5.2	16	9	31.2	3.0




BOLTON STANDARDS
OF DENTOFACIAL
DEVELOPMENTAL GROWTH

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WITH 129 ILLUSTRATIONS AND 36 TRANSPARENCIES

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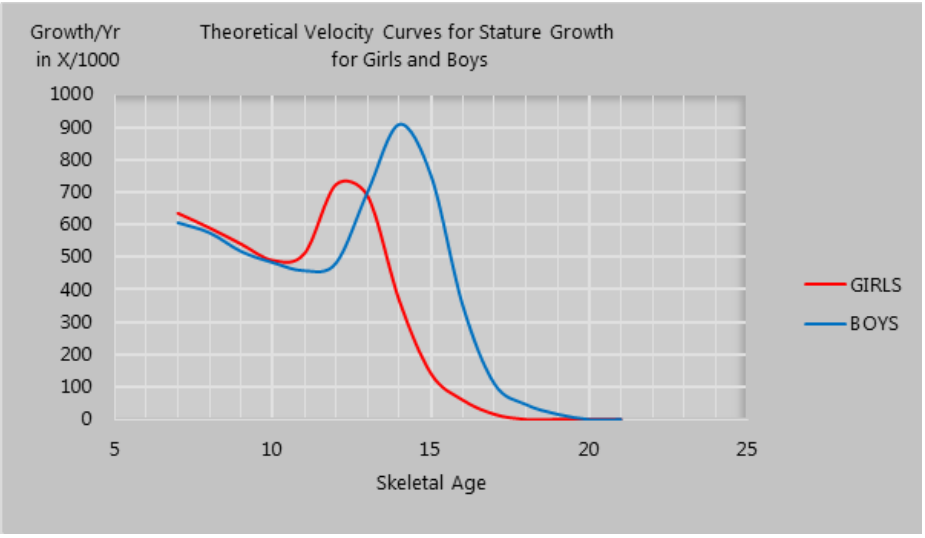
In addition there is additional material available at the following web site:

http://www.aaoflegacycollection.org/aaof_home.html

These studies all have in common that they list the cephalometric values relative to the chronological age. As a result the actual differences between the different skeletal ages to a great extent are ignored.

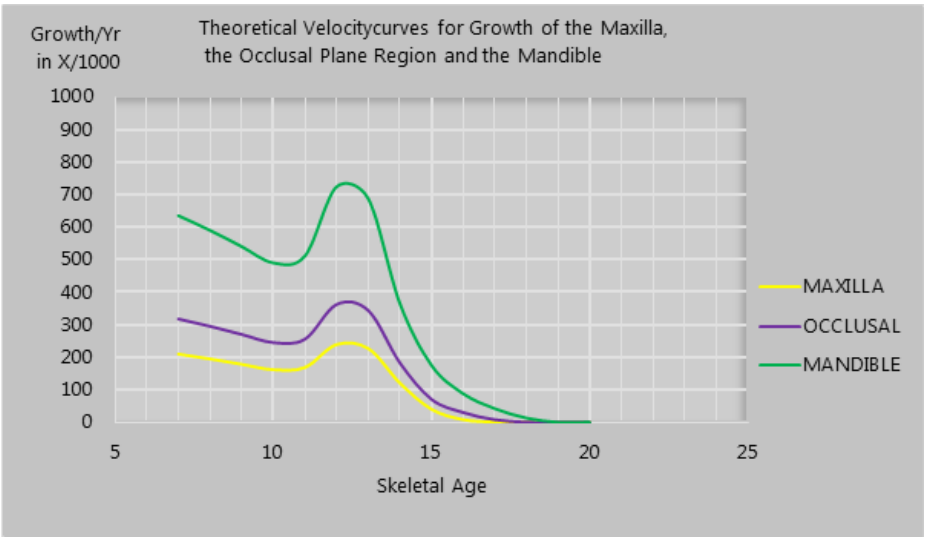
To get around this problem we have constructed the following theoretical growth curves for stature in girls and boys:

GROWTH CURVES		
Age	GIRLS	BOYS
7	635	606
8	590	575
9	540	517
10	490	483
11	511	458
12	724	482
13	687	702
14	365	909
15	141	751
16	60	352
17	16	110
18	0	46
19	0	16
20	0	0
21	0	0

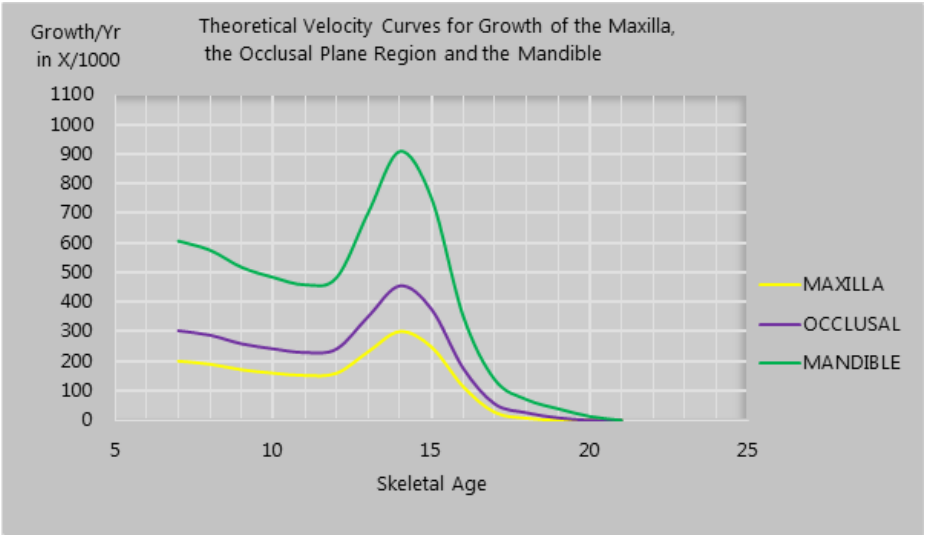


Likewise problem we have constructed the following theoretical growth curves for the maxilla, the mandible and the occlusal plane area in girls and boys:

GROWTH CURVES GIRLS			
Age	MAXILLA	OCCLUSAL	MANDIBLE
7	210	318	635
8	195	295	590
9	178	270	540
10	162	245	490
11	169	256	511
12	239	362	724
13	227	344	687
14	120	183	365
15	40	71	175
16	8	30	88
17	1	8	42
18	0	0	13
19	0	0	0
20	0	0	0

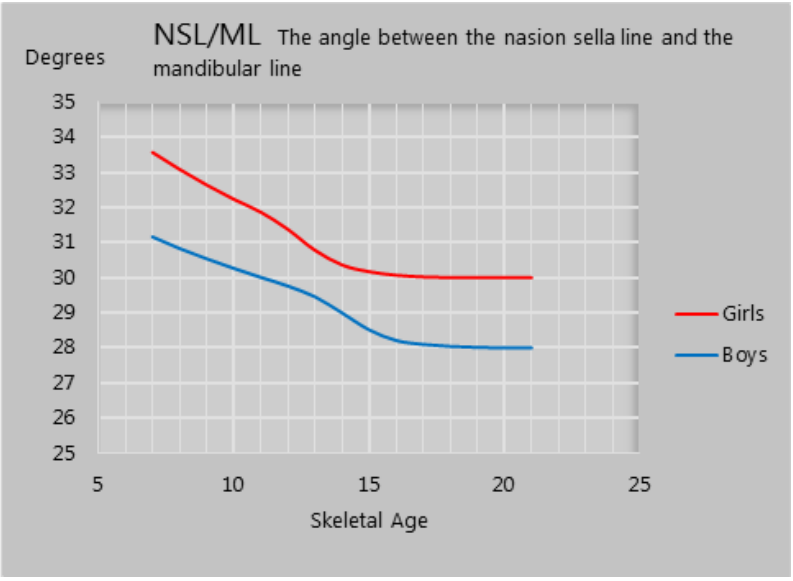


GROWTH CURVES BOYS			
Age	MAXILLA	OCCLUSAL	MANDIBLE
7	200	303	606
8	190	288	575
9	171	259	517
10	159	242	483
11	151	229	458
12	159	241	482
13	232	351	702
14	300	455	909
15	248	376	751
16	114	176	353
17	27	55	137
18	7	26	70
19	0	8	39
20	0	0	13
21	0	0	0



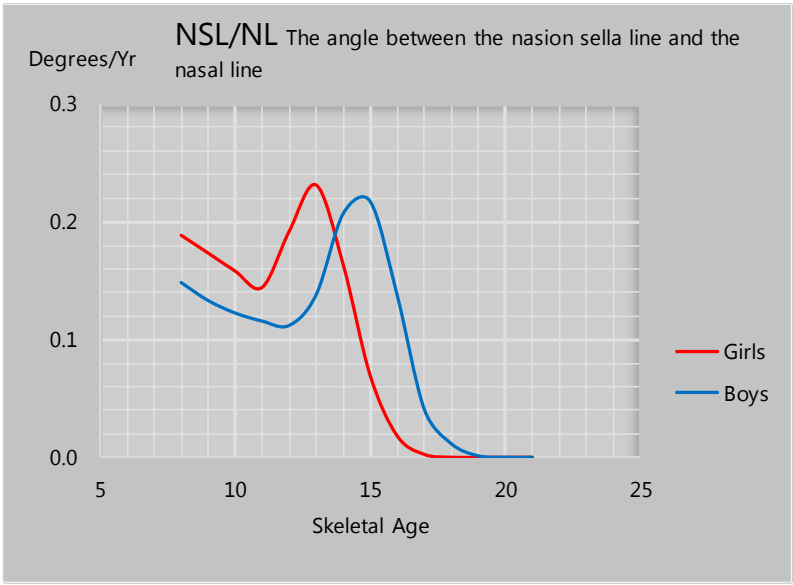
By means of regression lines and calculation of the integral, as illustrated in the shown Excel spreadsheet, we have determined the following values for the variable NSL/ML relative to skeletal age for girls and boys:

Means		
Age	Girls	Boys
7	33.6	31.2
8	33.1	30.8
9	32.6	30.5
10	32.2	30.3
11	31.9	30.0
12	31.4	29.8
13	30.8	29.5
14	30.4	29.0
15	30.2	28.5
16	30.1	28.2
17	30.0	28.1
18	30.0	28.0
19	30.0	28.0
20	30.0	28.0
21	30.0	28.0
SD	6.0	6.0



The velocity curve the for same variable is shown below:

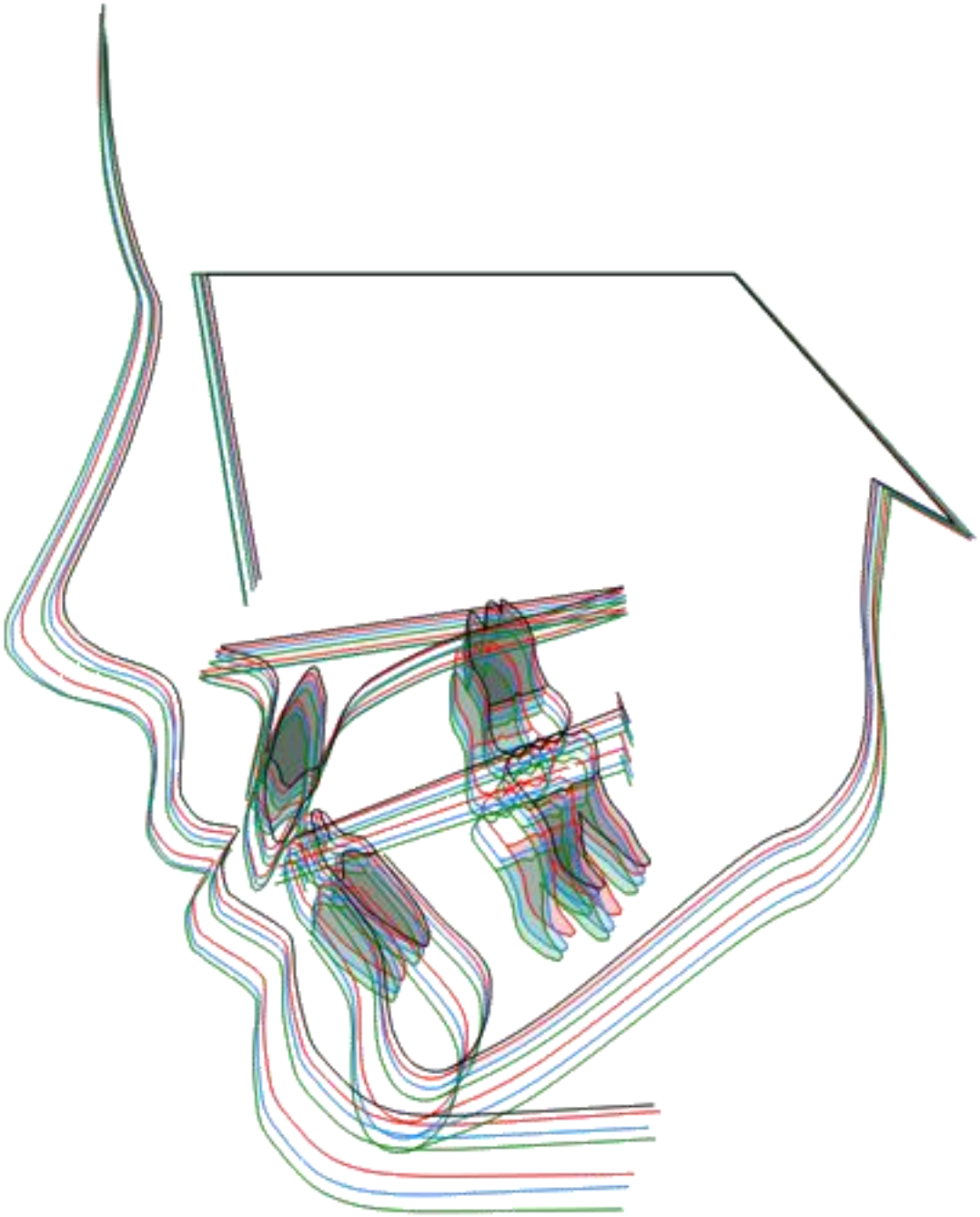
Means		
Age	Girls	Boys
7	-	-
8	0.19	0.15
9	0.17	0.13
10	0.16	0.12
11	0.14	0.12
12	0.19	0.11
13	0.23	0.14
14	0.16	0.21
15	0.07	0.22
16	0.02	0.14
17	0.00	0.04
18	0.00	0.01
19	0.00	0.00
20	0.00	0.00
21	0.00	0.00



Please note that if the Adult values for other ethnic groups are known, the constructed Excel spreadsheets for the individual variables can be used to calculate sex and age specific mean values for the respective groups by placing the values in the fields marked with <-----

It should be mentioned that some of these ideas may seem purely speculative.

I have, however, tested my calculations on a sample of 10,000 German patients that I have collected over a period of time. Part of this material is presented in graphical form in the following illustration as seen below. The calculations are here represented by a yearly average tracing of ca. 6,000 females between age 9 and 15. The superimpositions are made on the anterior cranial base and arranged according to their skeletal age. Note the growth spurt that is clearly visible in this illustration.



Download Excel spreadsheet

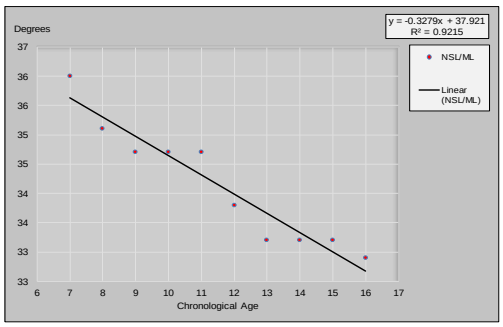
BOYS MANDIBULAR REGION

Age	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Sum		Sum	Estimated	Age
6	63	62	62	61	61	60	60	60	60	61	610		**Yr + 1**	**x̄ Values**	
7	61	61	61	61	61	61	60	60	59	58	603		0	**31.2**	**7**
8	57	56	55	55	54	54	53	53	52	52	541		603	**30.8**	**8**
9	51	51	51	50	50	50	49	49	49	48	498		1144	**30.5**	**9**
10	48	48	48	47	47	47	47	46	46	46	470		1642	**30.3**	**10**
11	46	45	45	45	45	45	45	46	46	47	455		2112	**30.0**	**11**
12	48	49	50	52	54	56	58	61	64	69	561		2567	**29.8**	**12**
13	73	76	79	82	84	86	88	90	91	92	841		3128	**29.5**	**13**
14	93	93	93	92	91	89	87	85	82	78	883	S 6-15	3969	**29.0**	**14**
15	74	70	66	62	58	54	50	46	42	37	559	5411	4852	**28.5**	**15**
16	32	28	24	21	19	18	17	16	15	14	204		5411	**28.2**	**16**
17	13	12	11	11	10	10	9	9	8	8	101		5615	**28.1**	**17**
18	7	7	6	6	6	5	5	5	4	4	55		5716	**28.0**	**18**
19	4	3	3	3	3	2	2	2	2	1	25		5771	**28.0**	**19**
20	1	1	1	1	0	0	0	0	0	0	4	S 16-21	5796	**28.0**	**20**
21	0	0	0	0	0	0	0	0	0	0	0	389	5800	**28.0**	**21**
Boys											5800	5800			

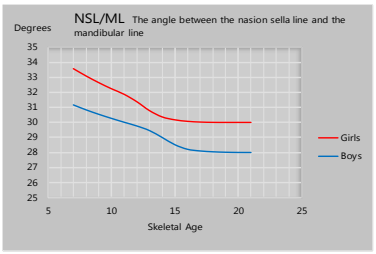
Variable:	NSL/ML	
Age	x̄	σ
7	**36.0**	6.0
8	**35.1**	6.0
9	**34.7**	6.0
10	**34.7**	6.0
11	**34.7**	6.0
12	**33.8**	6.0
13	**33.2**	6.0
14	**33.2**	6.0
15	**33.2**	6.0
16	**32.9**	6.0
Source:	Riola	6.0
7 Yr	35.6	
16 Yr	32.7	
Adult	32.5	
7-16 Yr	3.0	
7-20 Yr	3.2	

Ethnic Group:	
Danish	
Adult	**28.0**
7 Yr	31.2

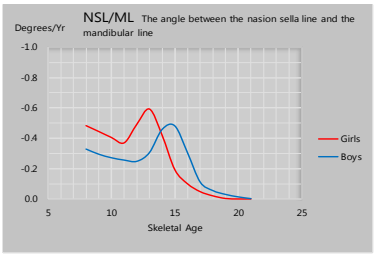
CHRONOLOGICAL SKELETAL YR



Means		
Age	Girls	Boys
7	33.6	31.2
8	33.1	30.8
9	32.6	30.5
10	32.2	30.3
11	31.9	30.0
12	31.4	29.8
13	30.8	29.5
14	30.4	29.0
15	30.2	28.5
16	30.1	28.2
17	30.0	28.1
18	30.0	28.0
19	30.0	28.0
20	30.0	28.0
21	30.0	28.0
SD	6.0	6.0



Means		
Age	Girls	Boys
7	-	-
8	-0.48	-0.33
9	-0.44	-0.30
10	-0.41	-0.27
11	-0.37	-0.26
12	-0.49	-0.25
13	-0.59	-0.31
14	-0.42	-0.46
15	-0.19	-0.48
16	-0.10	-0.30
17	-0.05	-0.11
18	-0.02	-0.06
19	0.00	-0.03
20	0.00	-0.01
21	0.00	0.00



GIRLS MANDIBULAR REGION

Age	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Sum		Sum	Estimated	Age
6	64	64	64	65	65	65	65	64	64	64	644		**Yr + 1**	**x̄ Values**	
7	63	63	63	62	62	61	61	60	60	59	614		0	**33.6**	**7**
8	59	58	58	57	57	56	56	55	55	54	565		614	**33.1**	**8**
9	54	53	53	52	52	51	51	50	50	49	515		1179	**32.6**	**9**
10	49	48	48	47	47	46	46	45	46	48	470		1694	**32.2**	**10**
11	50	53	56	59	62	65	67	69	71	73	625		2164	**31.9**	**11**
12	74	75	76	77	77	77	76	75	74	72	753		2789	**31.4**	**12**
13	70	67	63	59	54	50	47	44	41	38	533	S 6-15	3542	**30.8**	**13**
14	35	32	29	26	23	22	21	20	19	18	245	4320	4075	**30.4**	**14**
15	17	16	15	14	13	12	11	10	10	9	127		4320	**30.2**	**15**
16	8	8	7	7	6	6	5	5	5	4	61		4447	**30.1**	**16**
17	4	4	3	3	3	2	2	2	2	1	26		4508	**30.0**	**17**
18	1	1	1	1	0	0	0	0	0	0	4		4534	**30.0**	**18**
19	0	0	0	0	0	0	0	0	0	0	0		4538	**30.0**	**19**
20	0	0	0	0	0	0	0	0	0	0	0	S 16-21	4538	**30.0**	**20**
21	0	0	0	0	0	0	0	0	0	0	0	218	4538	**30.0**	**21**
											4538	4538			

Variable	NSL/ML	
	x̄	σ
7	**36.7**	6.0
8	**35.4**	6.0
9	**35.3**	6.0
10	**35.3**	6.0
11	**34.8**	6.0
12	**34.1**	6.0
13	**34.3**	6.0
14	**33.7**	6.0
15	**32.4**	6.0
Source:	Riola	6.0
7 Yr	36.4	
15Yr	33.0	
Adult	32.8	
7-15 Yr	3.4	
7-20 Yr	3.6	

Ethnic Group:	
Danish	
Adult	**30.0**
7 Yr	33.6

CHRONOLOGICAL SKELETAL YR