International Journal of Orofacial Myology and Myofunctional Therapy
Official Journal of the International Association of Orofacial Myology
50th ANNIVERSARY

Volume 17 | Number 2 | pp. 12-19 1991

Research Article

Development of the nose and soft tissue profile

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Suggested Citation
Genecov, J. S., et al. (1991). Development of the nose and soft tissue profile. *International Journal of Orofacial Myology, 17(2)*, 12-19.
DOI: https://doi.org/10.52010/ijom.1991.17.2.4

Editor's Note: Permission to print the following article was obtained from Chris Burke, Editorial Assistant of ***The Angle Orthodontist****. The reprint was selected to provide the clinician with additional information when counseling patients and significant others regarding facial cosmesis. The data regarding potential growth factors will enable the clinician to predict possible factors that will impact on facial esthetics.*

Development Of The Nose And Soft Tissue Profile

By Jeffrey S. Genecov, DDS, MSD; Peter M. Sinclair, DDS, MSD; and Paul C. Dechow, PhD

As orthodontic diagnosis and treatment planning have become more sophisticated and scientific, much attention has been paid to techniques for determining the skeletal pattern, the amount and direction of facial growth, and the position of the dentition.[1-7] Far less attention has been directed towards providing information which would aid the clinician in producing a well-proportioned, balanced and harmonious soft tissue profile at the end of treatment.[8-11]

Facial esthetics have interested orthodontists for many years and although opinions as to what constitutes an attractive face have come from many sources,[3,12-14] there is still a considerable lack of information as to the longitudinal development of the nose, lips and soft tissue chin. This deficiency effectively precludes the development of any scientifically based diagnostic scheme to aid in the objective integration of soft tissue factors into an overall treatment plan.

Burstone stated that "the facial objective of the orthodontist might be considered the achievement of the optimal in facial harmony consistent with the maximum in functional occlusion within the limits of therapy."[15] Early studies suggested there was a constancy of the pattern of skeletal growth and assumed that the development of the soft tissue profile was coincident with the underlying hard tissues.[16,17] However, a considerable body of evidence now exists which suggests that different components of the soft tissue profile have differing rates and timing of growth and that all parts of the soft tissue profile do not grow in direct proportion to their skeletal bases.[18-22] Increasing amounts of soft tissue convexity with age have been demonstrated, as has considerable sexual dimorphism with regard to soft tissue thickness, as well as the timing, amount, and direction of soft tissue growth in the post-pubertal period.[23-25] Several studies have also suggested that differences develop in the size, thickness and position of the lips and chin between males and females as they approach maturity.[18,25,26]

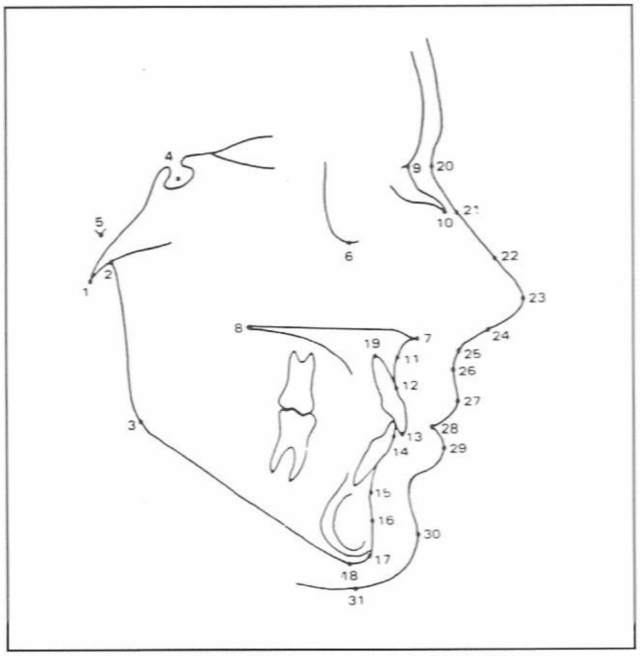


Figure 1a
Anatomical points digitized

Studies specifically devoted to nasal growth and development are infrequently found in the literature.[27] Those studies which have focused on the nose have

Abstract

Cephalometric radiographs from a sample of 64 untreated persons (32 Class I and 32 Class II) were evaluated to determine the amount, direction and timing of facial soft tissue development. Twenty-five parameters were evaluated in the mixed dentition (7 to 9 years), the early permanent dentition (11 to 13 years), and early adulthood (16 to 18 years). Results showed that anteroposterior growth and subsequent increased anterior projection of the nose continued in both males and females after skeletal growth had subsided. However, females had concluded a large proportion of their soft tissue development by age 12 while in males continued growth was noted until age 17 resulting in their having greater soft tissue dimensions for many of the parameters evaluated. During the developmental period, the angular shapes and positional relationships of the nose, lips and chin remained relatively constant for both sexes and were relatively independent of the underlying hard tissues. Treatment planning implications may be drawn from the amounts and timing of the soft tissue development found in this study.

This manuscript was submitted September, 1989.

Key Words
Soft tissue development • Sexual dimorphism • Treatment planning

suggested that nasal growth proceeds at a relatively constant rate into adulthood and that the nose increases in relative prominence as maturity approaches.[23,24,28-31] Other researchers approached the problem from a different perspective, trying to determine the effect the underlying hard tissue had on the soft tissue profile of the nose. They have suggested that patients who begin adolescence with a Class II skeletal profile often continue to lack facial harmony as they mature. This lack of harmony is manifested by a greater tendency to develop disproportionate nasal size and an increased prominence of the nasal dorsum.[26,32]

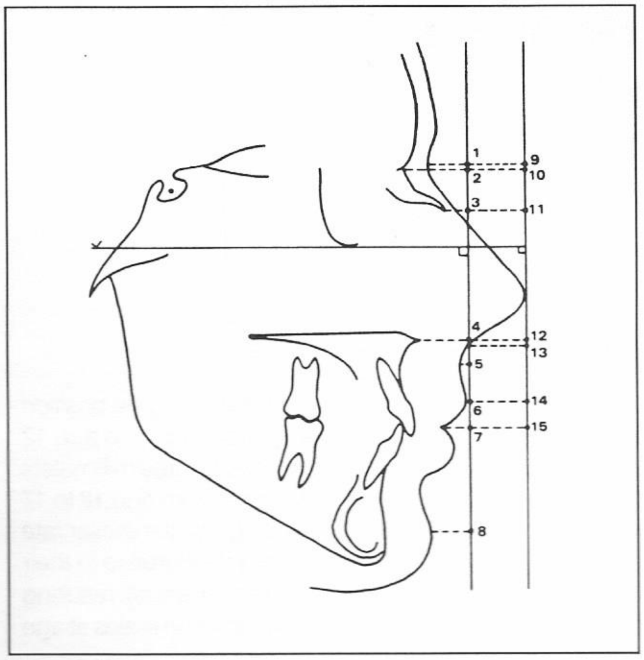


Figure 1b
Constructed points digitized

To date, however, there is a lack of quantitative data on the size, shape and relative position of the nose and lips that would enable to the clinician to make rational decisions such as whether or not to extract teeth or plan to retract maxillary incisors in order to obtain the optimum in facial esthetics and harmony. The purpose of this sutdy therefore was four-fold.

1. To determine the course of nasal development.
2. To evaluate the relative position of the nose in relation to the rest of the soft tissue profile during maturation.
3. To determine the size, shape and position of the lips during maturation.
4. To search for associations between the patterns of hard and soft tissue development.

Materials and methods

The sample used in this study consisted of 64 untreated cases from the records of the Bolton study at Case Western Reserve University in Cleveland, Ohio. This sample was comprised of 32 Class I cases (ANB: 2-4 degrees) and 32 Class II cases (ANB: >5 degrees) (16 males, 16 females in each group). In order to be included in the study, each case had to be of Caucasian origin, with no history of orthodontic treatment, allergies or airway problems. Lateral cephalometric radiographs of each case were evaluated at three time periods: (1) in the early mixed dentition when yearly orthodontic treatment might be considered (T_1, $\bar{x}$: 7 years, 6 months), so as to provide a baseline for the soft tissue profile; (2) in the early permanent dentition when full orthodontic treatment might be considered (T_2, $\bar{x}$: 12 years, 5 months), in order to evaluate the changes from T_1 and provide a baseline for comparison to adults; (3) in adulthood (T_3, $\bar{x}$: 12 years, 2 months), representing a mature soft tissue profile. Each radiograph was traced and then digitized with the assistance of a backlit digitizing table* interfaced with a minicomputer.** A custom program*** collated the data and translated the x-y coordinates of each landmark into the desired distances and angles. A total of 46 skeletal, soft tissue and constructed cephalometric points were digitized (Figures 1a and 1b) and a total of 25 cephalometric parameters were evaluated, comprising 21 linear and four angular measurements. Both S-N and Frankfort horizontal were used as reference planes with the large ear rods in use at the Bolton study necessitating the use of a machine porion (Figure 1a, point #5). The anteroposterior skeletal classification was conducted using ANB rather than the "Wits" analysis as the landmarks were more clearly identifiable and were less affected by occlusal changes during development. Ten randomly selected tracings were redigitized to evaluate measurement error which was determined to be insignificant at the $p > 0.05$ level.

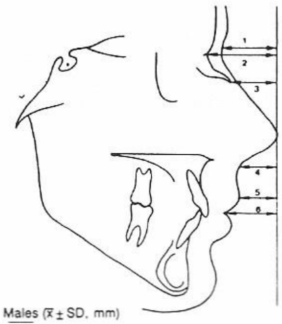
Statistical analysis was conducted on a microcomputer**** using a standard statistical analysis program.***** Means, standard deviations and ranges were calculated for each parameter at each time period for each of the four subgroups. Paired Student's *t*-test using a significance level of $p < 0.05$ were performed to assess the significance of the changes for each subgroup from T_1 to T_2 and from T_2 to T_3. A three-way analysis of variance was used to search for significant changes between time periods and between subgroups, using the specific factors of sex, Angle class, and time. Tukey's test for multiple comparisons at a significance level of $p < 0.05$ was then used to identify the source of any significant differences.

Results

Antero-posterior growth of the nose (Figure 2)

When measured relative to hard and soft tissue nasion between four and six millimeters of forward growth of the nose was found to occur from age 7 to age 12 years ($p < 0.01$). Males tended to be at the low end of this range

* *Hi-Pad Digitizing Tablet, Houston Instruments, Inc., Austin, TX 78753*
** *Analog Digital Systems, 10820 Comanche N.E., Suite F, Albuquerque, NM 87111*
*** *Data General, 4400 Computer Drive, Westboro, MA 01581*
**** *Heath-Zenith 151, Heath Company, Benton Harbor, MI 49022*
***** *SYSTAT, Systat, Inc., 2902 Central, Evanston, IL 60201*

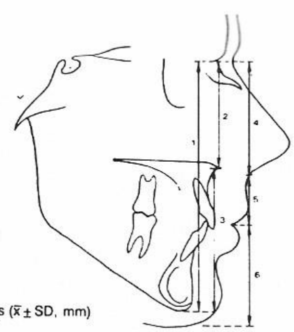


		Males ($\bar{x}$ ± SD, mm)			Females ($\bar{x}$ ± SD, mm)		
		T₁	T₂	T₃	T₁	T₂	T₃
(1) S.T. Nasion/ Nasal Tip	Class I	20·6 ± 2·9	24·8 ± 2·9***	28·8 ± 4·2***	20·2 ± 2·7	26·3 ± 3·3***	27·8 ± 3·1
	Class II	18·8 ± 2·7	22·9 ± 2·8**	28·5 ± 4·6***	21·2 ± 6·1	26·0 ± 3·0**	27·4 ± 3·9
(2) Nasion/ Nasal Tip	Class I	26·3 ± 3·1	30·6 ± 3·2***	35·9 ± 3·1***	26·4 ± 3·0	32·0 ± 3·6***	34·0 ± 2·9
	Class II	26·3 ± 2·7	30·8 ± 3·0***	35·5 ± 3·8***	25·2 ± 2·9	31·7 ± 2·8***	33·5 ± 4·2
(3) Rhinion/ Nasal Tip	Class I	16·7 ± 2·2	18·3 ± 2·8***	21·6 ± 4·2***	16·8 ± 5·5	18·9 ± 3·7	19·1 ± 2·9
	Class II	15·0 ± 2·1	17·3 ± 1.7***	21·0 ± 3·3***	15·4 ± 1·8	18·8 ± 2·8***	19·9 ± 3·1
(4) Subnasale/ Nasal Tip	Class I	10·3 ± 1·6	12·4 ± 2·1***	16·0 ± 2·0***	10·8 ± 2·0	13·6 ± 3·4***	14·6 ± 2·1***
	Class II	9·7 ± 2·0	11·7 ± 2·4***	16·3 ± 2·2***	11·2 ± 1·8	13·0 ± 5·1	5·4 ± 2·3
(5) Upper Lip/ Nasal Tip	Class I	8·2 ± 2·4	10·5 ± 4·2*	14·5 ± 3·2***	10·6 ± 3·5	10·9 ± 3·2	12·9 ± 3·7***
	Class II	7·2 ± 3·1	9·2 ± 3·3***	13·7 ± 3·7***	10·2 ± 7·1	10·7 ± 3·3	13·1 ± 2·7***
(6) Stomion/ Nasal Tip	Class I	15·6 ± 2·4	16·9 ± 4·0	21·0 ± 3·4	14·7 ± 4·2	17·7 ± 3·5**	19·0 ± 2·7
	Class II	15·5 ± 4·1	17·3 ± 3·5***	22·5 ± 3·6***	15·2 ± 3·1	17·8 ± 3·0	20·0 ± 3·8*

Figure 2
Antero-posterior nasal measurements and data (*=$p<0.05$, **=$p<0.01$, ***=$p<0.001$, from the previous time period)

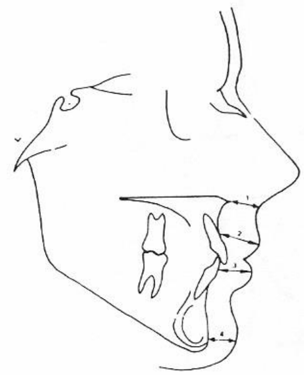
while females tended to show the greater amounts of growth. From 12 to 17 years males continued to show four to five millimeters of antero-posterior nasal growth (i.e. one millimeter/year) ($p<0.01$), while for the females a total of only one to two millimeters of growth was noted (p=n.s.). As a result, at age 17 slightly greater amounts of nasal projection were noted in males, with only the Class II males showing significantly greater ($p<0.05$) nasal projection than Class II females.

When evaluated to measurements reflecting the position of the nose relative to the upper lip, from age 7 to age 12 years all groups demontrated about two to three millimeters of increased nasal projection. However, from age 12 to 17 years, while the females continued to grow at a similar rate the males demonstrated a considerable increase in their rate of nasal projection (i.e. four to five millimeters), resulting in a tendency for increased nasal projection in males at age 17.



		Males ($\bar{x}$ ± SD, mm)			Females ($\bar{x}$ ± SD, mm)		
		T₁	T₂	T₃	T₁	T₂	T₃
(1) N/Me	Class I	102·7 ± 4·6	112·1 ± 4·1***	123·3 ± 6·1***	102·6 ± 4·5	113·3 ± 5·3***	117·6 ± 5·6**
	Class II	103·8 ± 4·5	113·0 ± 5·6***	124·8 ± 6·7***	101·4 ± 4·2	111·6 ± 6·1***	116·3 ± 4·8***
(2) N/ANS	Class I	46·1 ± 2·9	50·0 ± 2·8***	54·6 ± 3·2***	45·6 ± 2·4	51·5 ± 2·6***	53·2 ± 2·2***
	Class II	46·7 ± 2·3	51·8 ± 2·4***	56·4 ± 3·2	44·9 ± 1·9	51·1 ± 3·8***	51·9 ± 2·4
(3) ANS/Me	Class I	58·7 ± 4·5	64·1 ± 4·0***	70·3 ± 5·7***	58·8 ± 2·9	63·4 ± 4·4***	66·1 ± 5·5**
	Class II	58·9 ± 3·6	63·0 ± 5·0**	70·0 ± 6·3***	58·4 ± 3·6	62·5 ± 4·5**	65·9 ± 4·5**
(4) S.T. Nasion/ Subnasale	Class I	44·9 ± 3·0	50·6 ± 4·1***	55·7 ± 5·8*	44·3 ± 3·2	51·1 ± 3·5***	53·0 ± 2·7**
	Class II	44·0 ± 2·9	50·1 ± 4·8***	57·4 ± 3·5***	44·6 ± 3·9	52·9 ± 8·8**	53·1 ± 3·6
(5) Subnasale/ Stomion	Class I	20·8 ± 1·8	22·1 ± 2·2**	23·1 ± 2·3	20·2 ± 2·5	20·6 ± 2·9	20·9 ± 3·0
	Class II	21·6 ± 2·1	21·7 ± 2·0	22·6 ± 2·2	19·5 ± 2·1	20·2 ± 4·8	21·0 ± 2·6
(6) Stomion/ S.T. Me	Class I	46·0 ± 3·0	50·3 ± 2·7**	55·2 ± 5·7*	45·5 ± 2·8	49·8 ± 3·4***	51·9 ± 3·4**
	Class II	43·9 ± 2·9	48·5 ± 3·0***	54·4 ± 4·3	44·8 ± 3·0	48·7 ± 4·3***	51·4 ± 2·6**

Figure 3
Vertical facial measurements and data (*=$p<0.05$, **=$p<0.01$, ***=$p<0.001$, from the previous time period)



		Males ($\bar{x}$ ± SD, mm)			Females ($\bar{x}$ ± SD, mm)		
		T_1	T_2	T_3	T_1	T_2	T_3
(1) ANS/SLS	Class I	13.0 ± 1.2	15.2 ± 1.3***	17.1 ± 1.9***	11.9 ± 1.8	14.7 ± 1.3***	15.0 ± 1.6
	Class II	12.7 ± 1.5	15.0 ± 1.9***	16.6 ± 2.3**	11.5 ± 2.0	13.3 ± 1.6***	13.8 ± 0.9
(2) SD/UL	Class I	15.5 ± 1.4	17.7 ± 2.8**	19.9 ± 2.7**	13.9 ± 2.2	16.5 ± 2.1***	16.9 ± 2.1
	Class II	15.9 ± 1.3	17.8 ± 1.5**	21.0 ± 2.6***	14.1 ± 2.1	16.6 ± 2.9***	17.2 ± 2.7
(3) LI/LL	Class I	14.4 ± 1.3	15.4 ± 1.6*	17.0 ± 2.1***	12.3 ± 1.8	15.5 ± 1.5***	16.2 ± 1.6
	Class II	14.5 ± 1.8	16.2 ± 1.7**	17.7 ± 1.9*	13.2 ± 2.0	15.7 ± 2.2	15.8 ± 1.1
(4) Pg/Pgs	Class I	11.1 ± 2.0	11.8 ± 1.7	13.4 ± 1.4***	11.5 ± 1.6	13.0 ± 1.4**	13.5 ± 1.3
	Class II	10.4 ± 1.5	12.0 ± 1.8***	13.0 ± 1.3**	11.9 ± 2.4	12.9 ± 2.9*	13.2 ± 2.1

Figure 4
Soft tissue thickness measurements and data (*=$p<0.05$, **=$p<0.01$, ***=$p<0.001$, from the previous time period)

Vertical facial development (Figure 3)

At age 7, males and females had similar total hard tissue total facial heights (N-Me) in the range of 101-103 millimeters. By age 17, the males had outgrown the females by seven millimeters resulting in a greater ($p<0.05$) male total facial height at 124 millimeters compared to the 117 millimeters total facial height seen in females. However, from T_1 to T_2 both sexes had similar amount of growth (males +9.3 millimeters, females+10.5 millimeters) while from T_2 to T_3 the males continued to grow rapidly (+11.5 millimeters) even as the females' growth slowed down (+4.5 millimeters). Similar growth patterns were seen in the midface (N-ANS) and the lower face (ANS - Me). Two thirds of the growth seen in total facial height occurred in the lower face which was also responsible for the majority of the greater male facial height seen at T_3.

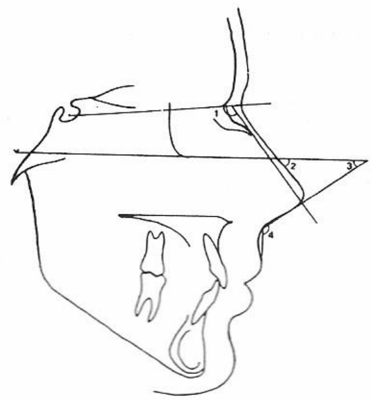
When evaluating the comparable soft tissue parameters a much more diverse set of results was seen. For both sexes, from T_1 to T_2, the soft tissue nasion to subnasale distance demonstrated increases in the five to seven millimeter range which were similar to those seen in the hard tissue N-ANS distance. However, from T_2 to T_3 the males continued to demonstrate similar increases in growth in their soft tissue (+six millimeters) while the females only grew very slightly (+one millimeter). As a result, the males soft tissue midface was three to four millimeters longer than that of the females at T_3 (57 millimeters vs 53 millimeters). Similarly the stomion to soft tissue menton distance in males was considerably larger at T_3 (55 millimeters vs 51 millimeters) as a result primarily of greater T_2 to T_3 growth. In contrast were the changes seen in upper lip length (Sn - Sto). Here only a two millimeter overal T_1-T_3 increase was seen in males (21 to 23 millimeters) and only a one millimeter increase (20 to 21 millimeters) in females, with most of the change occurring primarily from T_1 to T_2.

Tissue thickness (Figure 4)

At age 7 there was a tendancy for the soft tissue thickness in the upper lip area (ANS) SLS and Supradentale/UL) to be one to two millimeters thinner in females than in males. By age 17, this trend had become very clear with females demonstrating an upper lip thickness two to three millimeters less than that of the males. As in other areas, the males and females demonstrated similar growth rates from age 7 to 12 years (males + 2.1 millimeters, females + 2.4 millimeters), but while males continued to grow from 12 to 17 years (+2.2 millimeters), females showed only small changes (+0.5 millimeters).

The lower lip in females started off at age 7 being 1.6 millimeters thinner than the males (12.8 vs 14.4 millimeters) and ended up at age 17 with a similar deficiency (16.0 vs 17.4 millimeters). However, the majority of the females' increase of 3.2 millimeters in lower lip thickness occurred from 7 to 12 years while in the males a similar increase (3.0 millimeters) was almost evenly distributed over the two time periods.

In contrast, soft tissue chin thickness in females at T_1 was greater than in males (11.7 vs 10.8 millimeters) but only demonstrated a 1.6 millimeter increase up to age 17, while the males demonstrated 2.4 millimeters of increase in tissue thickness over this period. As a result both sexes had similar (i.e. 13.3 millimeters) soft tissue chin thicknesses at age 17 years.



		Males ($\bar{x} \pm$ SD, degrees)			Females ($\bar{x} \pm$ SD, degrees		
		T_1	T_2	T_3	T_1	T_2	T_3
(1) Nasal Bone /SN	Class I	107·2 ± 5·4	113·5 ± 5·3***	118·6 ± 6·5**	106·6 ± 5·9	110·2 ± 12·3	113·9 ± 6·2
	Class II	103·9 ± 5·5	107·1 ± 4.9***	113·1 ± 6·1***	102·4 ± 12·9	105·4 ± 16·7	109·2 ± 10·6
(2) Nasal Dorsum /FH	Class I	50·9 ± 4·6	50·3 ± 3·9	47·4 ± 12·7	50·6 ± 5·6	48·3 ± 8·5	48·9 ± 3·7
	Class II	52·1 ± 5·7	51·8 ± 5·6	51·6 ± 5·6	52·5 ± 5·5	49·5 ± 4·3	49·8 ± 6·6
(3) Columella /FH	Class I	25·0 ± 4·9	26·3 ± 5·5	28·1 ± 5·3	25·4 ± 5·8	26·1 ± 6·4	28·7 ± 3·9
	Class II	26·1 ± 7·1	28·3 ± 5·0	29·4 ± 6·5	25·3 ± 1·8	27·1 ± 6·2	30·0 ± 5·6
(4) Nasiolabial Angle	Class I	113·7 ± 12·4	112·9 ± 15·0	109·8 ± 13·3	111·4 ± 14·0	109·5 ± 12·3	108·3 ± 11·8
	Class II	111·0 ± 13·0	110·9 ± 14·6	107·2 ± 15·1	113·4 ± 8·4	109·1 ± 9·6	109·2 ± 10·6

Figure 5
Angular nasal change measurements and data (*=$p<0.05$, **=$p<0.01$, ***=$p<0.001$, from the previous time period)

Angular nasal changes (Figure 5)

The nasal bone tended to demonstrate an increase in its anterior projection from age 7 to 17 years as measured to the S-N line (measurement #1). In males a 10 degree increase ($p<0.001$) was noted, while in females the increase was seven degrees (p=n.s.) while the columella (measurement =3) became more vertical by three to five degrees (p=n.s.) in both sexes from age 7 to 17 when years when measured to Frankfort.

The nasolabial angle showed a tendency to decrease about three to four degrees in both sexes (p=n.s.) from age 7 to 17 with no differences being noted between the Class I and Class II samples.

Facial profile to subnasal vertical line (Figure 6)

All five parameters evaluated in this area demonstrated no significant changes during maturation, with no significant differences being seen between the different sexes, or between different skeletal and dental classifications.

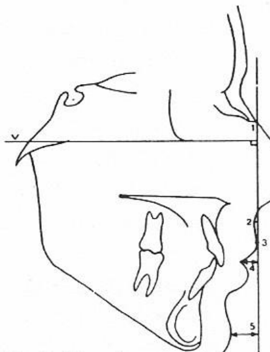
Discussion

The overall impression gained from the data collected in this study was for both sexes and Angle classes to show quite similar amounts of soft tissue growth from age seven to age 12 years, but for a considerable dichotomy to occur between the sexes from age 12 to age 17 years.

This is clearly evident when examining the absolute amount of antero-posterior growth of the nose and its resultant projection relative to the rest of the profile. In several of the parameters evaluated (Figure 2) the females demonstrated equal, if not slightly greater, amounts of nasal projection at age 7 and experienced slightly more growth up to age 12 than the males (+five to six millimeters, vs + three to four millimeters) at which age they showed a consistent trend for greater nasal projection. By age 17, while the females' nasal projection had remained virtually constant since age 12, the males had demonstrated continued, and in many cases increased nasal growth (+ four to five millimeters), resulting in a slightly greater degree of nasal prominence in males at age 17 in many of the parameters evaluated.

These soft tissue findings are thus in general agreement with previously published theories of skeletal growth patterns which have suggested that there is a strong tendency for growth in males to continue for several years beyond that seen in females.[18,20-22,26] Where they differ is in suggesting that soft tissue development, particularly in males does tend to lag behind skeletal development and that this finding should be taken into account in the orthodontic treatment planning process. For instance, a clinician evaluating a Class II female at age 12 years could thus reasonably expect that on average only minimal increases in nasal projection will occur over the next two years. However, in a male of similar age any procedure that resulted in upper lip retraction might, in combination with the several millimeters of expected anterior nasal growth, produce a less than optimal final relationship between the lips and nose.

In contrast to the complex sexually dimorphic changes in nasal tip antero-posterior projection, the parameters reflecting the nasal complex's angular characteristics remained virtually unchanged over the 10 year period evaluated in this study (Figure 5). These findings are in agreement with the reports of Sorrell[33] and Farkas,



		Males ($\bar{x} \pm$ SD, mm)			Females ($\bar{x} \pm$ SD, mm)		
		T_1	T_2	T_3	T_1	T_2	T_3
(1) Rhinion/ SNV	Class I	5·8±2·7	4·9±4·3	4·8±4·9	4·3±3·9	4·7±5·7	3·7±3·5
	Class II	4·7±3·0	4·9±2·8	4·4±3·5	4·2±2·4	5·0±3·7	4·0±3·8
(2) SLS/SNV	Class I	0·0±0·2	0·5±0·6	1·1±1·6	0·3±0·9	0·2±0·7	0·5±1·3
	Class III	0·2±0·6	0·0±0·3	0·6±1·4	0·1±0·5	0·2±0·6	0·2±0·7
(3) UL/SNV	Class I	1·2±1·4	1·6±2·7	1·0±1·8	1·6±1·8	1·9±2·0	1·3±2·0
	Class II	1·7±1·8	2·3±2·0	2·2±2·3	1·7±1·6	1·8±1·6	1·4±1·9
(4) Stomion/ SNV	Class I	4·4±2·5	3·8±3·0	5·3±5·0	4·5±3·6	3·2±2·6	3·5±2·8
	Class II	5·3±2·7	4·6±2·5	5·5±3·3	3·6±2·8	3·9±2·6	3·8±2·3
(5) Pogonion/ SNV	Class I	8·0±3·2	8·3±5·0	7·8±5·0	5·7±3·2	4·4±3·9	4·5±4·0
	Class II	8·6±4·4	8·4±4·6	8·7±4·7	6·8±4·9	6·0±4·0	6·2±4·9

Figure 6
Subnasale vertical line measurements and data (*=$p<0.05$, **=$p<0.01$, ***=$p<0.001$, from the previous time period)

et al.;[34] and would suggest to the clinician that despite the differences in nasal growth, the overall contours of the nose, and in particular the clinically significant naso-labial angle, are not likely to change by more than three to four degrees as a child matures. The only exception to these findings was in the angulation of the nasal bone which showed a strong tendency to become more horizontally inclined with time. This tendency has been reported previously with the T_3 projection being up to 10 degrees more horizontal than at T_1.[28,32] It has been suggested that greater elevation and projection of the nasal bone is seen in Class II cases resulting in a dorsal nasal hump occurring more frequently in Class II cases.[24,28]

The data from this study agrees with these findings showing both a more anterior position of the nasal dorsum and a more anteriorly angulated nasal bone in the Class II cases.

The tendency for females to have smaller soft tissue dimensions than males was clearly demonstrated in the relative thickness of the soft tissue of the lips and chin (Figure 4). Females demonstrated thinner lips at age seven and while growing similar amounts to males up to age 12, the final lip thicknesses in females were often less by two millimeters or more at age 17 due to almost no increase occurring in females from age 12 to 17 years. This data tends to confirm the findings of Subtelny,[18] Mauchamp and Sassouni,[25] as well as Riolo, et al.[26] Thus, a clinician retracting upper incisors in 12 year female might expect little compensatory lip growth, while in a male a less detrimental facial effect might be expected if the normal two millimeter increase in upper lip thickness occurred from age 12 to age 17 years.

When evaluated relative to the subnasale vertical reference line, the components of the soft tissue profile below the nose (e.g.: superior labial sulcus, upper lip, and soft tissue chin) showed remarkably little change over the seven to 17 years age period (Figure 6). This data seems to confirm the overall impression gained that the components of soft tissue profile mature relatively similarly, although the timing and amount of change is very different in males and females.[34] The data from the subnasale vertical reference line would tend to suggest to the clinician that the relative positions of the upper lip and soft tissue chin are likely to remain constant with maturation of the child and that this should be taken into account in treatment planning. The absolute values seen at age 17 of the Class I and Class II cases were very similar to those seen in Spradley's study[35] of ideal faces with the exception of the more retrusive soft tissue chin seen in the Class II cases in this study.

As this study was concluded at age 17 the potential for future soft tissue development should not be ruled out. However, as Sarnas and Solow have demonstrated, any future changes are likely to be small, averaging less than 0.5 millimeters or 0.5 degrees.[36]

Conclusions

On the basis of cephalometric records from a sample of 64 untreated persons examined in the mixed dentition, early permanent dentition and early adulthood, the following conclusions were reached:

1. Antero-posterior growth and increased anterior projection of the nose continued in both males and females after skeletal growth had subsided.

2. Females had concluded a large proportion of their soft tissue development by age 12 while in males growth continued until age 17 resulting in greater soft tissue dimensions in many parameters.
3. The angular shapes and positional relationships of the nose, lips and chin remained relatively constant throughout the developmental period for both sexes.
4. No relationships were found between the amount of nasal development and skeletal class or sex of the subjects. The growth observed was relatively independent of the underlying skeletal hard tissue.
5. The sexual dimorphism in the amount and timing of soft tissue development may have treatment planning implications.

Acknowledgments

The authors would like to express their gratitude to Dr. B. Holly Broadbent of the Bolton Study for allowing them access to the patient records; to Dr. Jim Economides, Paul Economides and Dr. Martin Wagner for their assistance in the statistical and computer portion of this project; to Dr. Wick Alexander and Dr. Joe Jacobs for their advice and guidance; and to Mrs. Martha Black for typing this manuscript.

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