Maxillary Incisor Intrusion and Facial Growth

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A palate and first molar anchorage appliance is used to intrude upper incisors, and the effects on dental and skeletal variables are examined in 25 growing females and 25 matched controls. On average, the mandible was unaffected for the entire treated sample, but those with the largest reduction in overbite showed more increase in mandibular length than expected.

KEY WORDS: • ANCHORAGE • GROWTH • INTRUSION • MANDIBULAR ROTATION •

Clinical evidence suggests that the vertical movement of maxillary incisors can influence the direction and/or amount of mandibular growth. POULTON (1959) reports a high correlation between downward tipping of the occlusal plane defined as a line bisecting molar and incisor cusp heights (here called Oc2), and a decrease in forward pogonion movement with growth. More recently, LEVY (1979) observed increases in mandibular length greater than predicted mean behavior with the orthodontic correction of severe overbite in growing Class II, division 2 malocclusion patients.

Class II elastics, cervical traction, and functional appliances all tend to tip the maxilla, including the occlusal plane and maxillary incisors, downward and backward. This is accompanied by an apparent inhibition of the forward movement of the chin (JAKOBSSON 1967, ADAMS ET AL. 1972, WIESLANDER 1974, EDWARDS 1983, MILLS 1983, GIANELLI AND BERSTEIN 1984).

Do the maxillary incisors only follow the mandible in facial growth, as SCHUDY (1968) suggests? Or, can their position exert a determining influence on the position of the chin?

This report describes a clinically useful maxillary incisor intrusion procedure, and evaluates the effects of the resulting maxillary incisor intrusion on the growing face.

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— Methods and Materials —

The treatment group consisted of 25 treated females with an average initial age of 11 years and 7 months. These growing patients were selected from an orthodontically untreated group solely on the basis of the amount of maxillary anterior gingival tissue that showed on smiling.

The control group of 25 females was matched as closely as possible in age, cephalograph interval, S–N–B, and growth on S–N. They also averaged 11 years 7 months of age at the time of the initial cephalograph, with a mean difference of 1.5 months between matched pairs.

After matching for initial age, cephalograph interval, and S–N–B, five control patients showing very poor matching for S–N/Go–Gn values and/or no growth on S–N during the test interval, were deleted for this design and replaced with patients who matched more closely for these two variables. These replacements matched almost as closely for initial age, S–N–B, and interval between cephalographs. The composition of the study groups is described further in Tables 1 and 2.

No patient in the control group had ever had maxillary incisor intrusion,

Table 1

Skeletal variables for 25 consecutively treated Females and for 25 matched Controls (mean ± standard deviation)

		Initial Values			Differences		
		Treated group	Control group	Pair Diff.	Treated group	Control group	p
Age	mo	139.1±14.8	138.6±14.4	1.5±1.6	11.8±3.4	11.5±3.9	
S-N/Go-Gn	°	36.6±4.4	35.1±3.9	5.7±3.0	0.2±1.0	0.5±1.3	
S-N/PP	°	8.4±4.0	8.7±3.7	4.5±3.1	0.7±0.9	0.2±1.2	
S-N/FP	°	65.0±2.5	63.8±2.5	3.0±1.8	0.4±0.8	0.7±0.8	
Oc2/S-N	°	17.1±3.1	16.4±3.9	4.4±3.4	−4.4±2.4	0.3±3.2	***
Oc2/Go-Gn	°	16.6±4.7	16.1±3.4	5.0±3.3	2.1+2.2	0.3+2.1	*
S-N-A	°	80.6±3.0	80.6±2.9	3.0±2.2	−1.5±1.4	−0.6±1.3	*
S-N-B	°	75.4±2.3	76.1±2.5	2.1±1.8	0.0±0.7	−0.2±0.9	
Y→Prp	mm	84.5±2.7	83.3±3.4	3.2±2.5	0.1±0.8	0.7±0.7	*
Y→A	mm	84.4±2.6	82.8±3.2	3.4±2.6	−0.3±1.4	0.6±1.3	*
Y→B	mm	93.7±5.4	91.5±4.3	5.0±3.6	0.9±1.3	1.1±1.1	
Ar→PM	mm	98.5±4.3	97.1±3.4	4.5±3.5	2.1±1.4	2.0±1.5	
Ar→Pog	mm	102.5±4.2	101.2±3.3	4.7±3.1	2.4±1.3	2.2±1.5	
Y→Ar	mm	0.8±3.4	−0.1±3.3	4.1±3.0	−0.5±0.7	−0.5±0.8	
Y→PM	mm	97.0±6.1	94.8±4.5	5.7±4.2	1.3±1.5	1.4±1.5	
Y→Pog	mm	99.9±6.2	97.8±4.5	6.0±4.1	1.6±1.2	1.5±1.3	
Y→Ramus	mm	15.9±4.1	14.7±4.4	5.1±3.4	0.0±1.3	0.0±0.8	
W→Prp	mm	42.2±3.2	41.0±4.0	4.6±3.4	0.9±0.8	1.1±0.9	
X→Prp	mm	−2.4±7.0	−4.4±5.5	7.0±4.5	−1.0±0.9	−1.0±1.1	
X→PM	mm	52.6±4.9	52.0±4.7	6.4±3.5	1.8±1.8		
N→Gn	mm	115.8±4.9	112.0±4.5	6.7±4.2	2.4±1.6	2.5±1.6	
AFH	mm	65.3±4.8	64.5±5.1	1.9±3.2	1.8±1.8	1.9±1.6	
PFH	mm	65.3±4.8	64.4±5.1	6.6±3.2	1.7±1.2	1.8±1.5	
S→Go	mm	71.4±3.7	69.4±4.1	5.3±3.2	1.5±1.5	1.7±1.6	
S→N	mm	71.9±2.9	71.1±3.0	2.9±2.4	0.7±0.4	0.6±0.6	

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

either before or during the test interval. The control group included sixteen patients with no orthodontic treatment, eight with face-bows only, and one with a biteplate.

The intrusion mechanics used in the treatment group included a .016×.022 stainless-steel archwire engaging the maxillary first molar tubes and torque-slot brackets on the maxillary incisors. Bracket slot torque angulation was 25° on the central incisor brackets and 20° on the lateral incisor brackets. Intrusive force on the incisors was produced by a tip-back bend at the mesial of the molars.

The intrusion force, measured between the central incisors with a 4oz capacity Dontrix gauge, was 2±0.5oz. This force was checked at six-week intervals and adjusted when necessary.

No bicuspids or second molars were banded during the treatment period, but if some vertical control or intrusion was needed on the erupting cuspids, they were banded and incorporated into the intrusion arch with no increase in the overall intrusive force on the archwire.

The archwire was always bent sharply behind the .018×.025 pressed molar tubes.

Table 2

Dental variables for 25 consecutively treated Females and for 25 matched Controls (mean ± standard deviation)

		Initial Values			Differences		
		Treated group	Control group	Pair Diff.	Treated group	Control group	p
Age	mo	139.1±14.8	138.6±14.4	1.5±1.6	11.8±3.4	11.5±3.9	
S-N/sI	°	95.3±8.5	104.8±8.0	11.0±8.6	15.5±9.8	−0.5±3.7	***
sI/iI	°	137.1±12.1	126.9±12.1	14.3±12.5	−15.7±12.9	−0.2±5.5	***
Go-Gn/iI	°	90.9±4.0	92.3±7.2	6.9±4.9	0.0±5.0	1.3±4.8	
Y→sI	mm	95.9±5.5	96.0±4.5	4.9±4.0	−0.5±2.0	0.6±1.0	*
Y→iI	mm	89.2±5.0	88.2±4.8	4.7±3.3	1.2±2.0	1.4±1.6	
Y→sM	mm	66.3±4.2	64.1±3.6	4.5±2.8	2.0±1.8	1.3±1.7	
Y→iM	mm	68.1±5.0	65.5±4.2	5.0±3.6	2.2±1.8	1.6±1.2	
sI→A-Pog	mm	5.1±2.8	7.4±3.3	3.4±2.2	0.4±2.2	−0.4±1.2	.085
iI→A-Pog	mm	0.2±2.2	0.6±2.5	2.6±2.0	0.7±1.8	0.3±1.1	
Overbite	mm	4.8±1.8	3.7±2.0	2.5±1.9	−2.9±1.4	−0.1±0.6	***
Z dist.	mm	0.5±0.9	1.2±1.3	1.4±1.2	-.5±1.1	−0.2±0.7	**
Overjet	mm	5.2±1.3	7.0±2.7	2.5±2.3	−0.5±1.4	−0.7±0.9	
PP→sI	mm	29.0±2.2	26.5±2.4	3.0±2.4	−2.9±1.3	0.8±2.0	***
PP→sIC	mm	11.7±2.4	10.4±1.8	2.5±2.1	−1.6±1.6	0.4±0.7	***
X→sI	mm	29.0±7.4	28.2±6.0	7.9±4.8	−2.3±1.6	1.4±1.5	***
X→iI	mm	26.0±6.0	26.7±5.1	6.6±3.9	0.6±1.3	1.2±1.4	.064
iI→PM	mm	27.8±2.8	26.4±2.5	3.2±2.0	1.3±1.0	0.8±0.7	
iI→Go-Gn	mm	39.5±2.2	37.7±2.8	3.6±2.0	1.1±0.8	0.7±0.7	
PP→sM	mm	19.1±2.8	17.9±1.6	2.6±2.5	0.8±0.7	0.4±1.0	
X→sM	mm	32.9±4.7	33.7±4.3	5.0±3.4	0.8±1.9	0.8±1.4	
X→iM	mm	39.3±4.5	39.4±4.4	5.5±3.5	0.6±1.5	1.2±1.4	
iM→PM	mm	31.9±2.8	32.0±2.4	3.1±2.0	−0.3±1.2	0.2±0.9	
iM→Go-Gn	mm	26.3±1.7	24.5±3.4	3.0±2.5	0.7±1.7	0.5±0.9	

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

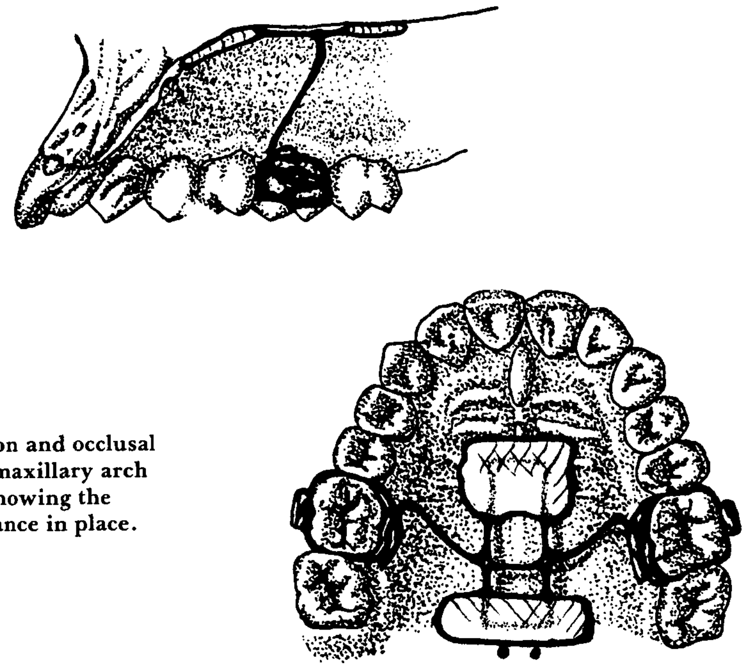

Fig. 1
Sagittal section and occlusal views of the maxillary arch and palate, showing the palatal appliance in place.

Bracket torque was excessive for some patients, making it necessary to apply compensating labial root torque adjustments to the wire to reduce the torqueing effect and maintain the roots within the alveolar process (TEN HOEVE AND MULIE 1976).

Before placing the archwire, the palatal appliance was constructed so that it could be cemented into position with the molar bands (Fig.1). This appliance was constructed on a .036 stainless steel transpalatal wire joining the maxillary first molars.

Two parallel .030 stainless steel wires, adapted to the contour of the palate, were soldered to the transpalatal wire to support two clear acrylic pads. The more distal pad, which was approximately 8mm wide, covered the posterior aspect of the hard palate and ended just anterior to the fovea palatini. The mesial acrylic pad covered a more anterior part of the hard palate, extending approximately 8mm. It never extended as far as the rugae.

The two pads were always positioned so that the distal one was completely posterior to the lingual roots of the maxillary first molars, and the mesial one covered the anterior palatal vault where it began its incisal descent. Anchorage was thus established against the tipping force placed on the molars by the intrusive bend in the archwire.

The posterior pad caused irritation to the palatal mucosa in about 30% of the cases after 5 to 7 months. If that occurred, either the posterior of the pad was reduced about 3mm, or the appliance was discontinued. Occasionally, after a few weeks without the appliance, a new one was inserted. The anterior intrusive force was continued in these cases, even without the palatal appliance.

The appliance was cemented so that both acrylic pads rested firmly on palatal tissue, without rocking or blanching. If rocking occurred under firm pressure with a blunt instrument, the appliance was considered destined to fail, and it was either recemented or remade.

The cephalometric landmarks, techniques, and analysis were those reported earlier (DeVincenzo et al. 1987), with some exceptions and additions.

Ar — Articulare
sI — superior Incisor
iI — inferior Incisor
sM — Mesial convexity of the superior first molar
iM — Mesial convexity of the inferior first molar
Oc2 — Occlusal plane bisecting upper and lower molar and incisor tips
PFH — Posterior Facial Height, measured on a perpendicular erected from gonion to S–N.
PM — Protuberance Menti
Prp — Palatal reference point, intersection of N–A with the palatal plane
W — A "horizontal" axis through sella, parallel to the palatal plane
X — A "horizontal" axis through sella, parallel to the initial mandibular plane (Go–Gn)
Y — A "vertical" axis through sella, perpendicular to the initial mandibular plane and to X

The following three variables have been added:

PP–sI, the perpendicular distance from the palatal plane to the tip of the superior incisor,
PP–sIC, the perpendicular distance from the palatal plane to the centroid of the superior incisor, and
Oc2/S–N, the angular measure between S–N and the occlusal plane as defined by Poulton (1959).

Summary statistics

Means, standard deviations, skewness, and kurtosis are calculated on initial values for treated and control samples for all variables. The mean of the absolute values of the differences between pairs is calculated to assess the closeness of matching.

The same summary statistics are calculated for differences over the test interval. Because the sample selection in matching controls applied blocking to four influential variables (sex, initial age, S–N–B, and treatment period), a two-sample dependent test is applied to all variables. The Lilliefors two-tailed test for normality, which is a modification of the Kolmogorov-Smirnov test that does not demand knowledge of the population distribution parameters, is applied to both samples of differences.

Because the samples were smaller than 30 and the assumption of normality could not be proven for any paired sample in this study, the Wilcoxon signed ranks test was used rather than the paired t-test.

If the treated sample were divided on the basis of selected extreme initial values for some variables, would a significant difference in mandibular length and/or rotation be found? The group of patients with the ten highest initial values for the variables Oc2/S–N, sI/iI and overbite, and the group with the ten lowest initial values, were compared for changes in mandibular length (Ar–PM, Y–PM) and rotation (S–N/Go–Gn, S–N–B) during treatment. The results are presented in Table 3.

If the treated sample were divided on the basis of selected extreme values for change in some variables during treatment, would significant differences in mandibular length and rotation be found? The group with the highest values for changes in the variables X–sI, sI/iI and overbite, and the group with the lowest values, were compared for changes in mandibular length and rotation, and the results are presented in Table 4.

Because the sample sizes in Tables 3 and 4 were so small that normality could not be proven, the null hypotheses were evaluated with both the Student's t-test and the Mann-Whitney U-test.

— Results —

Tables 1 and 2 present the mean initial values for both the treatment and matched control groups, the mean initial differences between matched pairs, the mean differences after the treatment period, and the level of significance.

P values greater than 0.05 are regarded as evidence that means are not significantly different. Where p values closely approach the lower range that could be considered significant, even though failing the null hypothesis, the actual values of p are shown.

There is a significant reduction in the occlusal plane angle in the treated group (mean Oc2/S–N decreased 4.4°), with pronounced palatal root tipping in the maxillary incisors (mean S–N/sI angle increased 15.6°), and a decrease in the interincisor angle (mean sI/iI angle decreased 15.7°).

Mean net elevation of the maxillary incisors, as measured by either the decrease in overbite or by the difference in the change in X–sI between treatment and control groups, is more than 3mm.

Table 3

Comparison of changes in Mandibular Length and Rotation
in two subgroups with extreme Initial values for three other variables
(mean ± standard deviation) ($p>0.05$ for all differences)

Mandibular measure	High group Change	Low group Change
Subgroups selected for extreme values of Oc2/S N	*High group* 20.7±2.0°	*Low group* 14.9±1.7°
Ar→PM	1.9±1.0mm	2.7±1.4mm
Y→PM	1.5±1.4mm	1.8±1.0mm
S–N/Go–Gn	−0.2±0.8°	0.4±1.4°
S–N–B	0.2±0.6°	0.1±0.6°
Subgroups selected for extreme values of sI/iI	*High group* 148.6±7.0°	*Low group* 126.0±6.7°
Ar→PM	2.3±1.6mm	2.0±1.6mm
Y→PM	1.2±1.8mm	1.4±1.5mm
S–N/Go–Gn	0.4±1.4°	0.2±0.6°
S–N–B	−0.1±1.0°	−0.2±0.6°
Subgroups selected for extreme values of Overbite	*High group* 6.6±0.9*mm*	*Low group* 3.1±1.1*mm*
Ar→PM	2.4±1.7mm	1.9±1.2mm
Y→PM	1.2±1.7mm	1.4±1.3mm
S–N/Go–Gn	0.2±1.2°	−0.1±0.6°
S–N–B	0.0±0.8°	0.0±0.8°

There was neither significant forward mandibular rotation (S–N/Go–Gn, S–N–B, Y–Ar, Y–Ramus, X–PM), nor any increase in mandibular length (Ar–PM, Ar–Pog, Y–B, Y–PM, Y–Pog), based on comparisons of the entire treatment sample with their matched controls.

This approach to intrusion did have some effects on the maxilla and on the maxillary incisor teeth. The incisors moved distally approximately 1mm (Y–sI change −1.1mm), and the remodeling caused by the torquing movement significantly affected point A (mean Y–A change −0.9mm; S–N–A −0.9°). The normal forward movement of the anterior palate was also affected (Y to Prp change −0.6mm). The maxillary molars did not move distally (Y to S–M). There were no significant effects on the mandibular dentition.

Tables 3 and 4 show give the results of the examination of two subsamples selected for extreme values. Only the subgroup that experienced the largest amount of overbite reduction showed a significant change in mandibular length.

— Discussion —

Various modifications to the intrusive anchorage appliance described here were tried prior to this study.

One that was expected to be especially useful was incorporating the second molars into the transpalatal assembly,

Table 4

Comparison of changes in Mandibular Length and Rotation in two subgroups with extreme values for the changes in three other variables (mean ± standard deviation)

Mandibular measure	High group Change	Low group Change	
	Subgroups selected for extreme values of X→sI change		
	High group −4.0±0.9*mm*	*Low group* −0.8±0.5°	
Ar→PM	1.8±1.2mm	2.5±1.5mm	
Y→PM	1.0±1.9mm	1.6±1.1mm	
S–N/Go–Gn	0.2±0.7°	0.4±1.3°	
S–N–B	−0.1±0.9°	0.1±0.6°	
	Subgroups selected for extreme values of sI/iI change		
	High group −29.4±7.3°	*Low group* −4.2±4.6°	
Ar→PM	2.1±1.2mm	2.2±1.6mm	
Y→PM	1.2±1.7mm	1.7±1.4mm	
S–N/Go–Gn	0.1±0.6°	−0.2±1.2°	
S–N–B	−0.1±0.7°	0.2±0.8°	
	Subgroups selected for extreme values of Overbite change		
	High group −4.2±0.9*mm*	*Low group* −1.6±0.8*mm*	
Ar→PM	2.9±1.5mm	1.3±0.8mm	p<0.01
Y→PM	2.1±1.2mm	0.7±0.6mm	p<0.05
S–N/Go–Gn	0.3±1.2°	−−0.1±0.6°	
S–N–B	0.1±0.5°	0.0±0.7°	

along with the dual acrylic pads already described. This had the effect of moving the center of rotation of the intrusive anchorage unit distally, between the two molars, probably very close to the mesiobuccal cusp of the second molar.

With the 4-molar anchorage, a slightly greater intrusion force of 2.75±0.25oz was used. The first molars extruded, but the second molars did not appear to have intruded. It was not uncommon to find an increase of 1° to 1.5° in S–N/Go–Gn. The palatal tissue was also irritated more rapidly.

These trial modifications and others demonstrated that the maximum effective intrusive force that this appliance can support is approximately 2.25oz.

Use of the .036 transpalatal wire alone without the acrylic pads prevented any change in intermolar distance, but the severity of the molar tip-back that often occurred after just a few months of incisor intrusion force prevented the continued use of these molars as intrusive anchorage units.

Using both the first and second molars with the transpalatal wire without the acrylic pads frequently resulted in obvious extrusion of the first molars, with accompanying increased mobility. On some occasions, gingival stripping developed on the mesiobuccal roots, along with prolonged excessive mobility.

Experience to date strongly indicates that including the second molars in any such incisor intrusion mechanism, in an effort either to increase the anchorage or to eliminate the need for the acrylic pads, is contraindicated.

Incorporating one or more bicuspids into the appliance also presented some difficulties. The most anterior bicuspid in the assemblage frequently extruded, exhibited increased mobility, and in adults occasionally developed gingival stripping. In addition, the subsequent leveling of the occlusal plane was more difficult and often accompanied by some maxillary incisor extrusion.

The posterior acrylic pad frequently pressed into the palatal mucosa; but, if it did not extend onto the soft palate or too far buccally onto the alveolar process, it seldom caused acute problems.

On some patients, a 2oz intrusion force could not be maintained without causing the anterior acrylic pad to drop away from its underlying supporting tissue. When this occurred, the intrusion force was reduced by ½ ounce.

Eliminating the anterior acrylic pad reduced the intrusive anchorage, resulting in more molar tip-back. This caused more acute tissue trauma in the vicinity of the posterior pad, requiring premature removal.

To maintain a significant force between visits, .016×.022 wire seemed to give more consistent results than .016×.016. The latter may be a bit small either to maintain 2oz of intrusion or to withstand some of the extraneous forces that patients can apply. It was important to untie the arch to check the actual intrusive force at least every six weeks, as it had often dissipated ⅓ or ½ of its original force level in that time.

The 2oz intrusive force applied to the four maxillary incisors was about half the amount recommended by Burstone in his classic article on intrusion (1977), and it is possible that more rapid intrusion might have been attained with greater force.

Another departure from Burstone's recommendations is the absence of a sectional rectangular arch on the incisors. As intrusion progressed, it became necessary to remove the archwire and place a reverse arc in the labial portion to counteract the more rapid intrusion of the lateral incisors.

Root resorption did occur in some patients, and the central incisor roots were always the most severely affected. Root resorption seemed to occur when the roots were in close proximity to the palatal cortical plate as viewed on the lateral cephalographs, as suggested by TEN HOEVE AND MULIE (1976). Root resorption was not found to correlate closely with the total amount of incisor centroid intrusion obtained. This would be in agreement with DELLINGER (1967), who reported that resorption was independent of tooth movement.

Although significant incisor centroid intrusion did occur (mean PP–sIC change was −2.0mm), it was not as great as it might have been if more labial root torque had been placed in the archwire. The primary intent in these cases was to eliminate any potential maxillary incisor interference that might cause backward mandibular rotation, rather than to acomplish as much incisor intrusion as possible.

As is so often the case in clinical orthodontic research, there were some deficiencies in the matched control group. It was not a pure untreated sample, but included eight patients with cervical or occipital forces and bands on the maxillary molars, and one with a biteplate. Only 64% (16) of them had no treatment whatsoever.

In the total sample of growing females, intrusion of the maxillary incisors with accompanying decrease in overjet and upward tipping of the occlusal plane resulted in neither increased mandibular length nor in forward rotation.

However, the subgroup of patients averaging more than 4mm decrease in overbite did exhibit about 1.5mm more increase in mandibular length than the subgroup averaging a 1.6mm decrease in overbite. These results must be viewed with some caution, because with this many independent t-tests, random error should produce at least one test with a p value of 0.05. That the two tests showing significance are physically correlated, however, does increase confidence in the significance of both findings.

LEVY (1979) reported previously that mandibular length increased more than expected in a treated growing population in which initial excessive interincisor angle (mean = 152°) and overbite (mean = 6.4mm) were present. In the subgroups of treated patients in this study who showed extreme initial values for these two variables, no increase in mandibular length was found (Table 3).

The difference in results between these two studies probably could not be explained on the basis of group differences, since the subgroup in this report was comparable in initial interincisor angle (mean 148.6°) and in overbite (mean 6.6mm) to those reported by Levy,

However, the data presented in Table 4 does support the hypothesis that major overbite correction can lead to greater increases in mandibular length. Reduction of overbite was a treatment objective for the sample reported by Levy, and this was undoubtedly accomplished in part by leveling the lower arch with relative intrusion of the lower incisors and probably some backward mandibular rotation. In our sample, the only treatment objective was the intrusion of maxillary incisors. No orthodontic treatment was applied to the mandibular arch, and thus a patient could have had significant maxillary incisor intrusion and still experienced continued eruption of the mandibular incisors.

An analysis of mandibular incisor extrusion within the subgroups did not show any significant differences, so this possibility is excluded. That this might be the case is suggested by the decrease of the values for X–iI for the treatment group (mean change compared to controls was −0.6mm), with a mean increase in iI to Go–Gn of 1.1mm.

The initial mean overbite in the subgroup that showed an increase in mandibular length was 5.4mm. This was reduced by 4.2mm with the maxillary incisor intrusion, to a net 1.2mm average overbite. In the subgroup with the least amount of overbite reduction (1.6mm), the mean initial overbite measured 3.8mm.

This data also supports the hypothesis that in the growing patient with severe initial overbite and subsequent overbite reduction, some mandibular increase can be expected.

The increase in the distance from articulare to the anterior border of the mandible could have been the result of either additional mandibular growth (Levy 1979) or anterior positioning of the condyles in their fossae (Thompson 1986a,b).

The group whose mean mandibular length increased more had somewhat longer mandibles initially (12.1mm) than the the group with less mean mandibular increase (10.0mm), which does not support the concept that those with smaller increases have already experienced more growth before treatment began.

Pronounced intrusion and torque to the maxillary incisors does seem to retard the forward development of the anterior maxilla as measured by S–N–A, Y–Prp, and Y–A. Since point A is sensitive to the location of the maxillary incisor roots, and since more than 15° of palatal root torque was obtained, this result was not surprising for measures involving point A (S–N–A, Y–A). Y–Prp for treated cases averaged 0.6mm less than in matched controls, even though these intrusive/torquing forces caused no detectable change in the vertical dimension of the anterior nasal spine (S–N/PP, X–Prp, W–Prp).

The obvious stability of the maxillary molars coupled with the palatal appliance as intrusive anchorage units is encouraging. These molars neither moved distally during treatment (Y–sM) nor extruded (X–sM, PP–sM). This is consistent with the observation that the mandibular plane angle did not increase during treatment (S–N/Go–Gn, X–iM).

Since no extraoral traction such as occipital, vertical-pull, or J-hook headgear is used with this mechanism, accomplishing significant maxillary incisor intrusion is not dependent on patient cooperation.

Schudy (1968) reported that in a population of growing subjects without any orthodontic treatment, the downward growth of the maxillary molars from the palatal plane exceeded the downward growth of the maxillary incisors by a ratio of 2:1. Supporting this was his observation that the occlusal plane descended more in the posterior area.

The findings in the controls in our study indicate the opposite, with twice the downward eruption of the maxillary incisors (mean PP–sI change 0.8mm) as in the maxillary molars (mean PP–sM change 0.4mm). Measuring from the incisor centroid to eliminate that portion of apparent extrusion attributable to incisor tipping, our findings for maxillary incisor extrusion still equalled the downward growth of the maxillary molars (mean PP–sIC change 0.4mm).

Although the entire sample of growing females in this investigation showed no consistent relationship between either intrusion or palatal root torque of the maxillary incisors and any change in mandibular length or rotation, it cannot be assumed that similar negative results would be obtained with this intrusion mechanism in conjunction with Class II mechanics in full-banded therapy or functional appliances.

Because Class II mechanics and functional appliances both tend to cause the maxillary anterior teeth to move downward and backward (DeVincenzo et al. 1987), could an intrusive change in these incisors prevent this from happening? What magnitude and duration of force would be required? Would such an intrusive force affect the ultimate length and angulation of the mandibles in these patients?

— Conclusions —

A fixed palatal anchorage appliance is described that produced significant intrusion of the maxillary incisors when used to apply approximately 2oz of intrusion force. There was neither distal tipping nor extrusion of the maxillary molars to which the anchorage appliance was attached.

Although there was a 4° decrease in the occlusal plane angle, 15° of palatal root torque, 3mm of maxillary incisor intrusion, and a 3mm decrease in overbite, average values for the entire sample showed neither forward mandibular rotation nor an increase in mandibular length.

However, the subgroup experiencing the greatest reduction in overbite during the treatment period did show a statistically significant increase in mandibular length. This increase was 0.9mm more than expected in comparison to one control group and 1.6mm more than another.

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