# Dentoalveolar response after protraction mask and expansion in males and females in the mixed dentition

Marc Saadia * / Edgar Torres **

*The purpose of this study was to determine the dentoalveolar response of class III patients in the mixed and late mixed dentition phases fitted with a protraction mask and expansion. The before and after cephalometric records of 74 patients divided by sex were analyzed at ages 6 to 9 and 9 to 12 years to assess the dentoalveolar changes. Data was correlated by means of paired t tests and Scheffe´s multiple contrasts. No significant changes were seen in all dentoalveolar relationships between the ages of 6 to 9 years and 9 to 12 years and between males and females. Maxillary teeth tended to be proclined, while mandibular teeth to become retroclined.*
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## REVIEW OF LITERATURE

Correction of class III malocclusion using protractions masks encompasses several skeletal and dentoalveolar changes. Most of these studies, have shown a combination of maxillary advancement and mandibular clockwise rotation.[1-16] However the dentoalveolar changes also help improve the overjet relationship and the facial profile.

Most studies showed an increased proinclination of the maxillary anterior teeth with a retroinclination of the lower incisors.[1-16] The changes in the mandible could be the result according to Chong[11] to a distally directed occlusal force to the anterior teeth, possibly in the intermediate stages of the overjet correction. Also, it could be the direct result of the soft tissue pressure exerted from the chin cup component of the protraction mask.

On the other hand, maxillary anterior teeth erupt more labially compared to the primary teeth. These teeth could be held back by the negative overjet, but will be reversed during treatment, passively by the tongue pressure or actively by the pressure exerted by the lower anterior teeth on the cingulum of its maxillary counterparts. It is also believed that the upper incisor proinclination is due to the mesial dental movement. Kapust[2] using the Pitchfork analysis, which compared the algebraic sum of treatment effects showed a significant foward movement of the upper incisors of 1.83mm and a non significant response in the mandibular incisors of 0.95mm .

### Effect of expansion vs non expansion

Two different studies compared the treatment results between two different intraoral appliances. One incorporated rapid maxillary expansion to the anterior traction to the maxilla while the second treatment modality only included anterior traction vía a labio-lingual appliance. Both studies showed a statistically significant proinclination of the maxillary central in the non expansion group of 2.81 degrees. In summary , the expansion enhances the protraction effect with a lesser dental treatment effect.[4-11] At older ages a greater slippage of the dento-alveolar complex exists producing a greater proinclination of the anterior teeth.

The primary purpose of this study will analyze the dentoalveolar response in males and females between the ages of 6 to 9 years and 9 to 12 years.

## MATERIALS AND METHODS

The material consisted of pretreatment and post-treatment lateral cephalograms of 74 patients from a private practice ages 6 through 12 and were divided in the following manner:

**Distribution of 74 Patients in this Study**

| Age in Years | Male | Female | Total |
|---|---|---|---|
| **6 to 9** | 25 | 30 | 55 |
| **9 to 12** | 7 | 12 | 19 |
| **Total** | 32 | 42 | 74 |

* Dr. Marc Saadia, Professor Department of Pediatric Dentistry, Department of Pediatric Dentistry, Universidad Tecnológica de México, Mexico City.

** Dr. Edgar Torres, Professor Department of Pediatric Dentistry, Department of Pediatric Dentistry, Universidad Tecnológica de México, Mexico City.

Send all correspondence to Dr. Marc Saadia, Prado Sur 290, Lomas de Chapultepec, Mexico 11000 D.F., Mexico.

**Table 1.** Changes of Cephalometric Dental Relationships in males at different ages treated with maxillary protraction therapy.

| *Dental measurements* | 6-9 (N25) | | | | | 9-12 (N7) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X before | S.D. | X after | S.D. | p.value | X before | S.D. | X after | S.D. | p.value |
| Maxillary 1-SN (deg.) | | | | | | 106.44 | 6.38 | 107.72 | 6.07 | 0.64 NS |
| Maxillary 1 Palatal plane (deg.) | | | | | | 114.54 | 5.91 | 115.19 | 6.29 | 0.60 NS |
| Maxillary 1 NA (deg.) | | | | | | 26.74 | 6.39 | 25.81 | 6.8 | 0.50 NS |
| Maxillary 1 NA seg. (mm) | | | | | | 5.38 | 2.28 | 5.58 | 1.96 | 0.69 NS |
| Madibular 1 NB (deg.) | 23.79 | 6.71 | 21.93 | 6.75 | 0.07 NS | 20.61 | 5.52 | 19.34 | 5.01 | 0.52 NS |
| Mandibular 1 NB seg. (mm) | 4.25 | 2.05 | 4.27 | 2.3 | 0.93 NS | 4.17 | 2.05 | 4.04 | 2.31 | 0.69 NS |
| IMPA (mm) | 89.38 | 6.58 | 87.64 | 5.97 | 0.07 NS | 85.04 | 6.05 | 83.78 | 3.79 | 0.52 NS |
| FMIA (mm) | 65.78 | 7.65 | 66.99 | 7.18 | 0.19 NS | 69.4 | 6.29 | 70.24 | 6.8 | 0.62 NS |
| | NS non significant | | | | | | | | | |

All patients had been treated with a protraction face-mask with transverse skeletal expansion

Patients wore the face-masks for an average of 9 months for the patients 6 to 9 years; and 12 months for patients between 9 and 12 years. They were instructed to wear the protraction mask at bedtime for children under the age of 9 and 14 hours for children over the age of 9 years.

Elastics that delivered 395gm of force per side were fitted on all patients, who were instructed to change them on a daily basis.

The Hyrax or Hass rapid maxillary expansion appliance was activated 3 times a week even in the absence of maxillary constriction or a posterior crossbite. Activation depended on the amount of constriction, but generally never lasted over two months.

The pretreatment radiographs were generally taken 1 month prior to appliance insertion and post-treatment radiographs after treatment completion.

Treatment was discontinued in the primary dentition when an overjet larger to normal (2 to 3 mm), class I or II canine relationships, a mesial step or and edge to edge molar relationships, and an improved facial profile were achieved. In the mixed dentition treatment was discontinued when a positive overjet was achieved and no more changes were noted after 3 months. No retention appliances were used afterwards.

**Appliances used for class III correction**

Bands were fitted on first permanent and first primary molars. In case permanent molars were not fully erupted, bands were placed on second primary molars and cuspids. The bands were joined by a heavy wire (0.043 inches) to the palatal plane and a midline Hass or Hyrax rapid maxillary expansion appliance.

A 0.043 inch wire was soldered bilaterally to the buccal aspects of the molar bands and canines or first primary molars and a hook for elastic traction was extended into the canine region. The adjustable Dynamic Protraction Facemask™ (Petit type) positioned just below the lower lip to provide a downward and forward pull to the maxilla of 30 degrees to the occlusal plane

Tracings were digitized on a Numonics digitizer, which was connected to an IBM computer. The Joe™ computerized program used cephalometric landmarks, which were incorporated from well known analysis to provide specific information on linear and angular dento-alveolar variables.

**Table 2** Changes of Cephalometric dental relationships in females at different ages treated with maxillary protraction therapy

| *Dental measurements* | 6-9 (N30) | | | | | 9-12 (N12) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | X before | S.D. | X after | S.D. | p.value | X before | S.D. | X after | S.D. | p.value |
| Maxillary 1-SN (deg.) | | | | | | 106.22 | 5.06 | 106.17 | 7.02 | 0.97 NS |
| Maxillary 1 Palatal plane (deg.) | | | | | | 114.26 | 4.86 | 114.46 | 7.37 | 0.88 NS |
| Maxillary 1 NA (deg.) | | | | | | 26.16 | 4.78 | 24.5 | 7.43 | 0.29 NS |
| Maxillary 1 NA seg. (mm) | | | | | | 5.62 | 1.95 | 5.63 | 2.23 | 0.98 NS |
| Madibular 1 NB (deg.) | 22.34 | 6.97 | 21.8 | 6.5 | 0.51 NS | 24.13 | 4.77 | 24.55 | 4.61 | 0.98 NS |
| Mandibular 1 NB seg. (mm) | 4.06 | 1.92 | 4.25 | 2.18 | 0.33 NS | 5.25 | 2.26 | 5.38 | 1.89 | 0.74 NS |
| IMPA (mm) | 86.75 | 7.89 | 86.15 | 7.51 | 0.46 NS | 88.07 | 6.24 | 87.5 | 5.7 | 0.66 NS |
| FMIA (mm) | 67.46 | 8.53 | 67.2 | 7.21 | 0.79 | 65.19 | 5.33 | 64.82 | 4.39 | 0.75 |
| | NS non significant | | | | | | | | | |

## RESULTS

No significant changes were seen between males and females in all measurements at different ages (Table 4).

### Mandibular tooth response

There is a non-significant decrease in the lower anterior teeth (1 to NB) from 23˚ to 21.8˚ in males and females between the ages of 6 to 9 years. IMPA angular measurements displayed a similar non-significant response from 87.94˚ to 86.83˚. A similar non-significant response was also seen between the ages of 9 to 12 years (Table 3). Males displayed a more labially proinclined teeth (1 to NB 23.7˚ IMPA 89.3˚) compared to females (lower incisor to NB 22.3˚, IMPA 86.7˚) between 6 to 9 years. The opposite response was seen between 9 to 12 years (Tables 1, 2, 4). Anterior teeth retroclined homogeneously between the ages of 6 to 12 years in males (Table 1).

### Maxillary tooth response

The maxillary dentoalveolar response was not discussed between the ages of 6 to 9 years, because all children at age 6 had their primary maxillary teeth present.

Non-significant changes were observed in all angular and linear maxillary tooth responses.

Between the ages of 9 to 12 years males showed a more labially inclined teeth, which increased after treatment. On the other hand, females tended to decrease the angulation towards a more acceptable relationship (Tables 1-4).

## DISCUSSION

The main changes in the correction of class III malocclusions are sketletal, including maxillary advancement and mandibular rotation. From the results in this study, one can also observe a non-significant contribution of the dentoalveolar component. The changes seen were protraction of the maxillary dentition and lingual tipping of the mandibular dentition. Some tooth compensation was seen prior protraction, with more labially placed anterior maxillary teeth and lingually placed anterior mandibular teeth. These measurements increased after protraction.

After treatment, the interdental tooth compensation was greater in males than in females between 9 to 12 years. However, these responses went beyond the accepted norm mostly in males. This alteration, could give a false clinical positive overjet. For this reason we always recommend to overcorrect the overjet relationship (2 to 3 mm) in order to reduce the later, orthodontically, the dentoalveolar tooth compensation and achieve a more stable result.

All studies showed a similar dentoalveolar response as our study. Between the ages of 9 to 12 males had a more anteriorly placed maxillary incisors, while females tended to have them slightly more retoin-

**Table 3.** Changes of differences of cephalometric dental measurements in males and females at different ages treated with maxillary protraction therapy.

| *Dental measurements* | 6-9 (N55) | | | | | 9-12 (N19) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **S.D.** | **X after** | **S.D.** | **p.value** | **X before** | **S.D.** | **X after** | **S.D.** | **p.value** |
| Maxillary 1-SN (deg.) | | | | | | 106.44 | 6.38 | 107.02 | 6.07 | 0.64 NS |
| Maxillary 1 Palatal plane (deg.) | | | | | | 114.54 | 5.91 | 115.19 | 6.29 | 0.60 NS |
| Maxillary 1 NA (deg.) | | | | | | 26.74 | 6.39 | 25.81 | 6.8 | 0.50 NS |
| Maxillary 1 NA seg. (mm) | | | | | | 5.38 | 2.28 | 5.58 | 1.96 | 0.69 NS |
| Madibular 1 NB (deg.) | 23 | 6.83 | 21.86 | 6.55 | 0.08 NS | 22.83 | 5.2 | 22.37 | 5.2 | 0.64 NS |
| Mandibular 1 NB seg. (mm) | 4.15 | 1.96 | 4.26 | 2.21 | 0.46 NS | 4.85 | 2.2 | 4.88 | 2.1 | 0.90 NS |
| IMPA (mm) | 87.94 | 7.38 | 86.83 | 6.83 | 0.074 NS | 86.95 | 6.19 | 86.13 | 5.54 | 0.43 NS |
| FMIA (mm) | 66.7 | 8.11 | 67.1 | 7.13 | 0.55 NS | 66.74 | 5.91 | 66.82 | 5.87 | 0.93 NS |
| | NS non significant | | | | | | | | | |

clined. Chong[11] found lingually inclined mandibular incisors that after a follow up period tended to become more labially inclined. He also suggested that the greater amount of retroclination of the lower incisors the greater the successs in treatment. Chong[11] and Takada[4] showed similar linear and angular measurements to our study, and the controls showed greater retroinclination. However, Kapust[2] showed a very significant retroclination response in the lower incisor to NB of -5.54˚ compared to our study (-1.27˚ in males , 0.016˚ in females).

A greater lingual position of the lower anterior teeth was seen in females between 6 to 9 years, while a greater lingual position was observed in males between 9 to 12 years.

## CONCLUSION

No significant changes were seen in all dentoalveolar relationships between the ages of 6 to 9 years and 9 to 12 years. No significant changes were seen between males and females. Maxillary teeth tended to be proclined, while mandibular teeth to become retroclined. Even if this condition helps improve the overjet relationship we do suggest obtaining the greatest skeletal change possible in case tooth decompensation needs to be achieved later in order to maintain a stable result.

**Table 4.** Changes in differences of cephalometric dental measurements between males and females at different ages treated with maxillary protraction therapy

| *Dental measurements* | 6-9 Males (N25) | | 6-9 Females (N30) | | | 9-12 Males (N7) | | 9-12 Females (N12) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Mean** | **S.D.** | **Mean** | **S.D.** | **p.value** | **Mean** | **S.D.** | **Mean** | **S.D.** | **p.value** |
| Maxillary 1-SN (deg.) | | | | | | 106.44 | 6.38 | 107.02 | 6.07 | 0.64 NS |
| Maxillary 1 Palatal plane (deg.) | | | | | | 114.54 | 5.91 | 115.19 | 6.29 | 0.60 NS |
| Maxillary 1 NA (deg.) | | | | | | 26.74 | 6.39 | 25.81 | 6.8 | 0.50 NS |
| Maxillary 1 NA seg. (mm) | | | | | | 5.38 | 2.28 | 5.58 | 1.96 | 0.69 NS |
| Madibular 1 NB (deg.) | -1.85 | 5.04 | -0.53 | 4.48 | 0.30 NS | -1.27 | 4.8 | 0.016 | 4.02 | 0.53 NS |
| Mandibular 1 NB seg. (mm) | 0.02 | 1.2 | 0.18 | 1.05 | 0.58 NS | -0.12 | 0.83 | 0.12 | 1.27 | 0.64 NS |
| IMPA (mm) | -1.74 | 4.7 | -0.6 | 4.46 | 0.36 NS | -1.25 | 4.89 | 0.56 | 4.34 | 0.70 NS |
| FMIA (mm) | 1.2 | 4.49 | -0.26 | 5.55 | 0.29 NS | 0.84 | 4.33 | -0.36 | 4.04 | 0.54 NS |
| | NS non significant | | | | | | | | | |

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