Factors of long-term efficacy of early Class III treatment

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CLASS III MALOCCLUSION:
A SERIOUS CHALLENGE IN DENTOFACIAL ORTHOPEDICS
Because growth in Class III Malocclusion is not helping at all!!!
Growth in Class III Malocclusion is not helping at all !!!

1. The amount of growth in subjects with Class III malocclusion is significantly different than in subjects with normal occlusion (unfavorable)

Class III vs. Class I
Excessive Growth of the Mandible with reference to the Maxilla in the Circumpubertal Period:

- 2 mm
  
  + 4 mm

2. In subjects with Class III Malocclusion the pubertal peak is more intense (males) and the postpeak growth is higher and lasts longer than Class I subjects

Growth in the Untreated Class III Subject
Tiziano Bassetti, Lorenzo Ponzio, and James A. McNamara, Jr.
Semin Orthod 2007;13:130-142
Orthopedic Treatment of Class III Malocclusion

RME

Facial Mask

Short-term dentoskeletal effects produced by RME and FM therapy
Conclusions

Facemask therapy in growing subjects with Class III malocclusion is effective in the short term.

The skeletal modifications induced by facemask are forward displacement of the maxilla (SNA +2.1 deg), backward displacement of the mandible (SNB -1.5 deg), clockwise rotation of the mandibular plane (SN to Mand Pl +1.5 deg), and counterclockwise rotation of the maxillary plane (SN to Palatal Pl. -0.8 deg).

Conclusions

During the follow-up period (medium term, 14-16 ys) the posttreatment changes in most variables reflected significant relapse, including backward retrusion of the maxilla, diminution of improvement in the intermaxillary relationship, and a decrease in OVJ.

More long-term studies are still required to further evaluate its skeletal benefits and whether this therapeutic approach can reduce the need for orthognathic surgery.
Long-Term Treatment Effects Produced by RME and FM

Stability of rapid maxillary expansion and facemask therapy: A long-term controlled study

Caterina Masucci,* Lorenzo Franchi,* Elissio Defraia,* Manuela Mucedoro,* Pieola Cozza,* and Tiziano Baccetti* Florence and Rome, Italy

AJO-DO 2011;140:493-500

Treated Group vs. Control Group

T1-T2 Interval (9.2 ys-14.5ys) Medium-term changes
(RME/FM + fixed appliances)

- Significant dentoalveolar effects
- Favorable skeletal changes mainly in the mandible
- No mandibular backward rotation
Treated Group vs. Control Group
T1-T3 (9.2 ys-18.7 ys) Long-term Changes

- Significant dentoalveolar effects
- Relapse in the maxilla
  Favorable changes in the mandible
- No mandibular backward rotation

Is it possible to improve the long-term efficacy of early Class III treatment with RME/FM?
Factors for Improving the Efficacy of Early Class III Treatment

1. Timing of Treatment: Stage of Skeletal Maturity

2. Individual Patient Responsiveness
What is the role of treatment timing in the efficacy of orthopedic therapy of Class III malocclusion?

Is pre-pubertal treatment more effective than treatment during puberty?

Post-Pubertal Assessment of Treatment Timing for Maxillary Expansion and Protraction Therapy followed by Fixed Appliances

Lorenzo Franchi, DDS, PhD, Tiziano Baccetti, DDS, PhD, and James A. McNamara, Jr, DDS, PhD

(Am J Orthod Dentofacial Orthop, 2004;126:555-68)
Physiologic changes in the maxillary sutures

Palato-maxillary suture  horizontal section

Museum of Anthropology,
The University of Florence

Sutural resistance to Maxillary Protraction


Maturational Stages of the Zygomaticomaxillary Sutures

Zygomaticomaxillary Suture Maturation: A Predictor of Maxillary Protraction? Part 1 – A Classification Method
Fernanda Angelieri; Lorenzo Franchi; Lucia H.S. Cevidanes; Claudia Toyama-Hino; Tung Nguyen; James A. McNamara Jr.


The maturation stage was determined in the sagittal view at the infraorbital (superior) and infrazygomatic (inferior) portions of the suture.

Classification of the ZMS maturation

Stage A
Stage B
Stage C
Stage D
Stage E
Classification of the ZMS maturation

Stage A
Straight high density line

Stage B
Scalloped high density line

Stage C
2 thin, parallel, high-density lines separated by low-density spaces

Stage D
Fusion of ZMS in the inferior part

Stage E
Complete fusion of ZMS

Classification of the midpalatal suture maturity

Stage A

Stage B

Stage C

Stage D

Stage E

Angelieri et al 2013
Diagnostic performance of skeletal maturity for the assessment of midpalatal suture maturation

Angelieri F., Franchi L., Cevidanes L., McNamara J.A.Jr.

Maturational Stages of the Zygomaticomaxillary Sutures

Zygomaticomaxillary Suture Maturation: Part 2-The influence of sutural maturation on the response to maxillary protraction
Angelieri F, Ruellas AC, Yatabe MS, Cevidanes LHS, Franchi L, Toyama-Hino C, De Clerck HJ, Nguyen T, McNamara JA Jr.

Orthod Craniofac Res. 2017;20:152-163
Common 3-dimensional coordinate system for assessment of directional changes

18 patients RME/FM Group (mean age T1 8.3 ys)
19 patients BAMP Group (mean age T1 11.8 ys)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>P</th>
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<tbody>
<tr>
<td>ZMS Stage</td>
<td>2</td>
<td>12.918</td>
<td>6.459</td>
<td>5.978</td>
<td>0.006</td>
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<tr>
<td>Treatment</td>
<td>1</td>
<td>30.525</td>
<td>30.525</td>
<td>28.251</td>
<td>&lt;0.001</td>
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<td>ZMS Stage x Treatment</td>
<td>2</td>
<td>3.565</td>
<td>1.782</td>
<td>1.650</td>
<td>0.209</td>
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Comparisons for factor: ZMS Stage

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Diff. of Means</th>
<th>t</th>
<th>P</th>
<th>Critical Level</th>
<th>Significant?</th>
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<tbody>
<tr>
<td>Stage B vs. Stage C</td>
<td>1.4</td>
<td>3.336</td>
<td>0.002</td>
<td>0.017</td>
<td>Yes</td>
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<tr>
<td>Stage A vs. Stage C</td>
<td>1.3</td>
<td>2.619</td>
<td>0.014</td>
<td>0.025</td>
<td>Yes</td>
</tr>
<tr>
<td>Stage B vs. Stage A</td>
<td>0.1</td>
<td>0.284</td>
<td>0.778</td>
<td>0.050</td>
<td>No</td>
</tr>
</tbody>
</table>
2. Individual Patient Responsiveness

1. Timing of Treatment:
   Stage of Skeletal Maturity

2. Individual Patient Responsiveness
Long-Term Treatment Effects Produced by RME and FM

Stability of rapid maxillary expansion and facemask therapy: A long-term controlled study

Caterina Misucci,*, Lorenzo Franchi,† Ellisio DeFraia,‡ Manuela Mucedero,‡, Pasca Cozza,* and Tiziano Baccetti‡
Florence and Rome, Italy

SUCCESS RATE:
73% (16 out of 22 patients)

27% UNSUCCESSFUL CASES
(6 out of 22 patients)
Class III molar rel. and negative overjet at T3
Long-term Efficacy of Reverse Pull Headgear Therapy
Andrew P. Wells*; David M. Sarver*; William R. Proffit*

Angle Orthod 2006;76:915-22

18 patients at 10 y posttreatment

25% UNSUCCESSFUL CASES negative overjet at 10-year recall

UNSUCCESSFUL CLASS III CASES
modest degree of compliance during active therapy with the facial mask

CRANIOFACIAL FEATURES vs SUCCESSFUL CASES AT T1

↑ Facial divergency (FMA +4.1 deg)

↑ Gonial angle (+3.8 deg)

↑ Mesial molar relationship (+1.5 mm)
Is it possible to predict long-term outcomes of orthopedic treatment of Class III malocclusion in the individual patient?

Prediction of the outcome of orthodontic treatment of Class III malocclusions—a systematic review

Piotr Fudalej*, Magdalena Dragan** and Barbara Wedrychowska-Szuic***

*Department of Orthodontics, Palacky University, Olomouc, Czech Republic and Department of Pediatric Surgery, Institute of Mother and Child, Warsaw, **Department of Periodontics, Warsaw Medical University and ***Department of Orthodontics, Pomeranian Medical University, Szczecin, Poland

Correspondence to: Piotr Fudalej, Department of Pediatric Surgery, Institute of Mother and Child, Kasprzaka Strasse 17a, 01-211 Warszawa, Poland. E-mail: pfudalej@gmail.com

SUMMARY The purpose of this study was to systematically review the orthodontic literature to assess the effectiveness of a prediction of outcome of orthodontic treatment in subjects with a Class III malocclusion. A structured search of electronic databases, as well as hand searching, retrieved 232 publications concerning the topic. Following application of inclusion and exclusion criteria, 14 studies remained. Among other data, sample ethnicity, treatment method, age at the start and completion of treatment, age at follow-up, outcome measures, and identified predictors were extracted from the relevant studies. A subjective assessment of study quality was performed.

The heterogeneity of the samples and treatment methods prevented carrying out a meta-analysis. Thirty-eight different predictors of treatment outcome were identified: 35 cephalometric and three derived from analysis of study casts. Prediction models comprising three to four predictors were reported in most studies. However, only two shared more than one predictor. Gonial angle was identified most frequently—in five publications. The studies were of low or medium quality.

Due to the large variety of predictors and differences among developed prediction models, the existence of a universal predictor of outcome of treatment of Class III malocclusions is questionable.
The following methodological problems were identified:

a) the method of statistical analysis (discriminant analysis instead of logistic regression analysis);

b) the relatively small sample size (varying between 26 to 64 individuals, which might impair the multivariate analyses);

c) the immature age of the patients at the final evaluation (some were not given, but in most papers the final age was before 15 years old);

d) lack of validation of the prediction model.
Brazilian Group

73 Class III patients (Caucasian)
41 females, 32 males

Therapy: RME & FM + fixed appliances

1st OBSERVATION (T1):
7.1 ± 1.6 ys (CS 1-2)
Age range 4.4-11.1 ys

2nd OBSERVATION (T2):
21.8 ys ± 3.2 ys (CS 5 or 6)
Age range 17.0-30.5 ys

T1-T2 interval:
14.7 ± 3.3 ys
Range 8.4-25.3 ys

73 patients

Time 2
Assessment of Outcome of Treatment

"success"
SUCCESSFUL GROUP (SG)
51 patients (70.0%)

"failure"
UNSUCCESSFUL GROUP (USG)
22 patients (30.0%)

- anterior cross-bite (at least one incisor)
- Class III permanent molar relationship
- Class III profile
Cephalometric Analysis at T1 (before treatment)

12 Angular measures

- NSBa
- SNA
- SNB
- ANB
- AB-MP
- SN-Pal. Pl.
- Pal. Pl to Mand. Pl
- SN Mand. Pl.
- CondAx-Mand. Pl.
- CoGoMe
- CoGoN
- NGoMe

10 Linear measures

- S-N mm
- S-Ar mm
- Wits Appraisal mm
- Co-A mm
- PNS-A mm
- Co-Gn mm
- Co-Go mm
- Go-Gn mm
- N-Me mm
- ANS-Me mm

2 Ratios

- ANS-Me/N-Me mm
- Co-Go/S-Ar mm
Statistical Analysis

Bivariate logistic regression was performed on all predictors (24 cephalometric variables) for unsuccessful outcome.

In order to identify a prediction model, only the statistically significant variables of the bivariate logistic regression were subjected to mixed stepwise logistic regression with $P=0.05$ to enter and to leave.

Accuracy, sensitivity, specificity, positive predictive value (PPV) negative predictive value (NPV) were calculated for the selected prediction model (JMP® version 13.0.0 2016, SAS Institute Inc., Cary, North Carolina, US).

Results of Logistic Regression Analysis

<table>
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<tr>
<th>P value</th>
<th>Odds ratio</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
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</thead>
<tbody>
<tr>
<td>CondAx to Mand Pl. (deg)</td>
<td>&lt;0.0001</td>
<td>1.52</td>
<td>1.25</td>
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</tbody>
</table>
Souki et al 2019

Predictive variable CondAx-Mand. Pl.
Unsuccessful cases > 147.8 deg.
Successful cases ≤ 147.8 deg.

\[ P = \frac{1}{1 + e^{-(-62.029 + 0.41973 \text{CondaxMP})}} \]

\[
A1  \quad \times  \quad \checkmark  \quad fx  \quad = 1/(1+(1/\text{EXP}(-62.029+0.41973*(B1))))*100
\]

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<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<td>1.15119E-25</td>
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\[
A11  \quad \times  \quad \checkmark  \quad fx
\]

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<td>3</td>
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</tbody>
</table>
Souki et al 2019

Unsuccessful Patients with CondAx-Mand Pl. > 147.8 deg.

**Accuracy** (percentage of patients predicted correctly) = 95%

**Sensitivity** (percentage of actual unsuccessful cases that are correctly identified as such) = 86%

**Specificity** (percentage of actual successful cases that are correctly identified as such) = 98%

**PPV** (probability that patients with CondAx-MandPl >148 deg are truly unsuccessful cases) = 95%

**NPV** (probability that patients with CondAx-MandPl ≤148 deg are truly successful cases) = 94%

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Italian Group (Validation Cohort)

28 Class III patients (Caucasian)
14 females, 14 males

**Therapy:** RME & FM + fixed appliances

1st OBSERVATION (T1):
9.0 ± 1.3 ys (CS 1-3)
Age range 6.0-11.2 ys

2nd OBSERVATION (T2):
18.2 ys ± 1.4 ys (CS 5 or 6)
Age range 17.0-23.9 ys

**T1-T2 interval:**
9.3 ± 1.9 ys
Range 5.9-14.3 ys
Italian Group (Validation Cohort)

Unsuccessful Patients with CondAx-Mand Pl. > 147.8 deg.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td><strong>Accuracy</strong></td>
<td>(percentage of patients predicted correctly)</td>
<td>96%</td>
</tr>
<tr>
<td><strong>Sensitivity</strong></td>
<td>(percentage of actual unsuccessful cases that are correctly identified as such)</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Specificity</strong></td>
<td>(percentage of actual successful cases that are correctly identified as such)</td>
<td>96%</td>
</tr>
<tr>
<td><strong>PPV</strong></td>
<td>(probability that patients with CondAx-MandPl &gt;148 deg are truly unsuccessful cases)</td>
<td>83%</td>
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<tr>
<td><strong>NPV</strong></td>
<td>(probability that patients with CondAx-MandPl &lt;148 deg are truly successful cases)</td>
<td>100%</td>
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</table>

Conclusions

RME/FM tx is effective if performed BEFORE PUBERTY

The long-term success rate for RME/FM is 70-75%.

The inclination of the Condylar Axis to the Mandibular Plane (CondAx-MP) can be regarded as a powerful and reliable predictor for long-term stability of early Class III treatment with RME and FM in patients aged 4.5 to 11 years.

Unsuccess of treatment at T1 can be predicted for pre-treatment values of CondAx-MP greater than the cut-off value of 147.8 deg.
Thank you!!!

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