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Treatment of open bite in the mixed dentition: the long-term challenge

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What can the clinician do to best treat a patient with dento-skeletal open bite?


Treatment timing? Long-term stability?

What are the treatment options during the mixed dentition for an open-bite growing patient?

Anterior Openbite WITH persisting digit sucking habits
Dentoskeletal openbite WITHOUT sucking habits (vertical skeletal imbalance)

Anterior Openbite WITH persisting digit sucking habits

Recommendations for clinical practice cannot be made based only on the results of these trials. More randomized controlled trials are needed to elucidate the interventions for treating anterior open bite. Insufficient evidence could not provide reliable conclusions. Even though the methodological quality of the studies has been improving, evidence from future trials will be needed to answer these open questions.

Openbite in the mixed dentition

Anterior Openbite WITH persisting digit sucking habits
Dentoskeletal openbite WITHOUT sucking habits (vertical skeletal imbalance)
What are the treatment options during the mixed dentition for an open-bite growing patient?

- Anterior Openbite WITH persisting digit sucking habits
- Dentoskeletal openbite WITHOUT sucking habits (vertical skeletal imbalance)

Digit Sucking Habits

Little long-term effect during the primary dentition years

The sucking habit should be terminated before the eruption of the permanent teeth

The more prolonged the duration of the habit, the more severe the developing malocclusion tends to be (Warren and Bishara 2002, Singh 2008)

Digit Sucking Habits

Prolonged sucking habits can lead to malocclusions

dentoalveolar (anterior open bite)
maxillary protrusion and upward inclin. palatal pl.
mandibular retrusion and backward inclin. mand. pl.
constriction of the maxillary arch

Sucking habits and facial hyperdivergency as risk factors for anterior open bite in the mixed dentition

To evaluate sucking habits and hyperdivergency as risk factors for Anterior Open Bite (AOB) in mixed-dentition subjects

Large cross-sectional sample (N=1710)

Conclusions

- The presence of Thumbsucking in absence of Hyperdivergency IS NOT ASSOCIATED with an increased risk of AOB
- The presence of Hyperdivergency in absence of Thumbsucking IS NOT ASSOCIATED with an increased risk of AOB
- The concurrent presence of both Thumbsucking and Hyperdivergency IS ASSOCIATED with an increased risk of AOB

Vertical malocclusions develop as a result of the interaction of many different etiologic factors …

Sucking habits

... thumb and finger sucking, lip and tongue habits, airway obstruction, and true skeletal growth abnormalities
Anterior Open Bite (AOB) and Sucking Habits

AOB can self-correct after removal of the sucking habit, provided that no other secondary dysfunctions have set in.

Subtelny and Sakuda, 1964; Artese et al., 2011

Treatment timing of AOB in patients with prolonged thumb-sucking

AOB (associated with prolonged sucking habits and/or abnormal tongue posture) should be treated EARLY (in the early mixed dentition) to stop habits and/or correct tongue posture.

Removable or Fixed Appliances??

Comparison of 2 early treatment protocols for open-bite malocclusions


Dentoskeletal changes associated with fixed and removable appliances with a crib in open-bite patients in the mixed dentition.


Inclusion Criteria

- Persisting digit sucking
- Anterior open bite (negative OVB)
- Facial hyperdivergency (FH to Mand. PL > 35°)
- Fully erupted permanent first molars and incisors
- Pre-TX and post-treatment lateral cephs

Objective

To compare the efficacy of a Quad-Helix/Crib (QH-C) appliance versus the Open-Bite Bionator (OBB) and a Removable Plate with Crib (RP-C) in growing patients who presented with prolonged thumb-sucking habits and dento-skeletal openbite.

QH-C Treatment Protocol

Quad-Helix with bands on E+/E or 6+/6

A crib for thumb-sucking prevention and to prevent interposition of the tongue in the anterior openbite was formed from 3 or 4 segments of .036" stainless steel wires soldered on the anterior bridge of the Quad-Helix.
Quad-Helix/Crib Appliance for Early Treatment of Anterior Openbite
Tiziano Baccetti, Lorenzo Franchi, Fabiana Ballanti, Laura De Toffoli, Manuela Mucedero
Rome and Florence, Italy

AAO Las Vegas May 2006

TABLE CLINIC
“Joseph E. Johnson Table Clinic Award”
May 2006 Las Vegas

19

OBB Treatment Protocol
The OBB had posterior acrylic bite blocks to prevent extrusion of the posterior teeth
The acrylic portion of the lower lingual part extended into the maxillary incisor region as a lingual shield, closing off the anterior space without touching the maxillary teeth

20

RP-C Treatment Protocol
The removable plate consisted of a modified Schwarz upper plate with Adams clasps on the maxillary first molars and a crib consisting of loops modeled with 0.036-in stainless steel wire to prevent forward posturing of the tongue

21

Conclusions
- QH-C is more effective than OBB and RP-C for the improvement of overbite with greater extrusion of the maxillary incisors (OVB correction 4.0-4.5 mm with QH-C and 2.7-3.0 mm with removable appliances)
- The QH-C produces a greater reduction of intermaxillary divergence due to posterior rotation of the palatal plane (about 2 degrees)
- Since the fixed cribs are more effective than the removable ones, it is recommended to use fixed designs rather than removable ones (unless patients have poor oral hygiene or are at high risk for caries)

22

Vertical skeletal changes produced by the Q-H/C appliance

23

24

Original article
Comparisons of two protocols for early treatment of anterior open bite
Manuela Mucedero*, Maddalena Vichi*, Lorenzo Franchi*, Paolo Costa**, and Letizia Pertillo*
Eur J Orthod 2017 Nov 27

TPA, High-pull HG, LB
VS
Q-H/C
**Conclusions**

Both the Q-H/C and the TPA/HG/LB protocols produced a significant reduction of intermaxillary divergence of about 2.0 degrees with respect to untreated controls.

At the dentoskeletal level, both therapies were equally effective in correcting the anterior open bite with a mean increase in overbite of about 2.0–2.5 mm with respect to the control sample.

Since the 2 therapies showed similar effects, the protocol that requires less compliance (Q-H/C) is recommended.

**Systematic review**


Martín Boccazzi, Marco Rodríguez de Albornoz and Carlos Flores AM*

In conclusion, this systematic review with a meta-analysis suggested that crib therapy could be considered as an effective treatment for the correction of AOB in growing patients, with the approximate increase of 3 mm in overbite.
Vertical Skeletal Changes
(T₁ – T₂)

<table>
<thead>
<tr>
<th></th>
<th>RME/VPCC</th>
<th>RME only</th>
<th>Diff.</th>
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<tbody>
<tr>
<td>MPA (º)</td>
<td>-1.3 ± 1.5</td>
<td>-0.3 ± 1.7</td>
<td>-1.0 ns</td>
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<tr>
<td>LAFH (mm)</td>
<td>1.0 ± 2.6</td>
<td>3.8 ± 2.3</td>
<td>-2.8 **</td>
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<tr>
<td>Co-Go (mm)</td>
<td>2.4 ± 2.3</td>
<td>3.4 ± 2.8</td>
<td>-1.0 ns</td>
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ns = not significant * p>.05 ** p<.01

Vertical Skeletal Changes
(T₂ – T₃)

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<tr>
<td>MPA (º)</td>
<td>-0.2 ± 1.8</td>
<td>0.6 ± 1.9</td>
<td>-0.8 ns</td>
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<tr>
<td>LAFH (mm)</td>
<td>4.5 ± 2.8</td>
<td>4.3 ± 2.4</td>
<td>0.2 ns</td>
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<tr>
<td>Co-Go (mm)</td>
<td>4.1 ± 2.9</td>
<td>3.1 ± 4.1</td>
<td>0.8 ns</td>
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Vertical Skeletal Changes
(T₁ – T₃)

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<td>LAFH (mm)</td>
<td>5.5 ± 4.1</td>
<td>8.1 ± 2.8</td>
<td>-2.6 **</td>
</tr>
<tr>
<td>Co-Go (mm)</td>
<td>6.5 ± 3.1</td>
<td>6.6 ± 3.7</td>
<td>-0.1 ns</td>
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Is the treatment outcome worth the burden of treatment (especially during Phase II?)

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Treatment effects of bonded RME and vertical-pull chinup followed by fixed appliance in patients with increased vertical dimension

Conclusions

Over a 2-phase treatment period (5.7 years), VPCC and bonded RME during phase 1 and later with fixed appliances, can significantly limit the increases in mandibular plane angle (~ 2°), with respect to bonded RME and fixed appliances. When the overall treatment effects are evaluated, most of the positive effects attributed to the VPCC were achieved during the RME phase (phase 1), whereas only a minor benefit of the extraoral appliance was seen during phase 2.

Long-term stability???
2 factors can affect long-term stability of treatment outcomes in openbite patients

1) Unfavorable vertical growth pattern
2) Abnormal tongue posture (forward and downward)

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1) Unfavorable vertical growth pattern
2) Abnormal tongue posture (forward and downward)

Patterns of Mandibular Development

Open Bite Björk, 1963

Role of the soft tissue in AOB relapse

Anterior tongue rest posture IS clinically significant due to its long duration

Anterior tongue thrust IS NOT as significant clinically because of its short duration (1- to 3-second maximum during swallowing) Proffit, 1978
The aim of a myofunctional program is to establish a new neuromuscular pattern and to correct abnormal functional and resting posture.

Neuromuscular re-education of abnormal tongue posture and myofunctional treatment

The therapist should train the patient to lift the body of the tongue in order to learn a normal resting position of the tongue. Other treatment objectives are strengthening of the orofacial muscles to pave the way for mouth closure, establish nasal breathing, and learn a physiological swallowing pattern.

Other treatment objectives are strengthening of the orofacial muscles to pave the way for mouth closure, establish nasal breathing, and learn a physiological swallowing pattern.

Role of the soft tissue in AOB relapse

It is believed that voluntary activities such as swallowing and speech are easier to correct using myofunctional exercises. Involuntary activities such as tongue posture habits are harder to automate.

Artese et al., 2011

Relapse of anterior open bites treated with orthodontic appliances with and without orofacial myofunctional therapy

OMT with orthodontic treatment was effective in closing and maintaining closure of dental open bites in Angle Class I and Class II malocclusions, and it dramatically reduced the relapse of open bites in patients who had forward tongue posture and tongue thrust. Correcting low forward tongue posture and tongue thrust swallows minimized the risk of orthodontic relapse.

A Critical Question:

Is treatment of openbite patients stable in the long term?

Stability of quad-helix/crib therapy in dentoskeletal open bite: A long-term controlled study

To evaluate the long-term stability of QH-C treatment in patients with thumb-sucking habits, AOB, and skeletal open bite tendency.
Subjects

QH-C Group
- University of Rome Tor Vergata
- 28 subjects
- T1 = 8 y 2 m ± 1 y 3 m
- T2 = 9 y 7 m ± 1 y 6 m
- T3 = 14 y 6 m ± 1 y 9 m

Control Group
- University of Michigan Growth Study
- University of Denver Growth Study
- 20 subjects
- T1 = 8 y 1 m ± 4 m
- T2 = 9 y 8 m ± 4 m
- T3 = 14 y 5 m ± 7 m

Inclusion Criteria
- Thumb-sucking habit before treatment
- Negative overbite
- Constricted maxillary arch
- Full eruption of first permanent molars and permanent incisors
- T1 prepeak (CS 1-2); T3 postpeak (CS 4-6)

T1-T2 Changes
- 1.5 y
- All patients received fixed appliances with no auxiliaries (vertical or sagittal elastics)

T1-T3 Changes
- 6.4 y
- Increase in Overbite (+2.2 mm)
- Downward rotation (+1.8°) of the Palatal Plane to FH
- Reduction in the Palatal Plane-Mandibular Plane angle (-2.2°)
- 5.7° of lingual tipping of the mandibular incisors

In the long term, the use of the Q-H/C appliance led to successful outcomes in about 93% of the patients and a mean closure of the anterior open bite of about 5 mm (2.1 mm with respect to the controls).

The Q-H/C protocol produced a clinically significant downward rotation of palatal plane (1.8°). This favorable outcome contributed significantly to the overall correction of the anterior open bite with an improvement in the vertical skeletal relationships.

Conclusions

In prolonged sucking habits and hyperdivergency in the mixed dentition are associated with narrow maxillary intermolar and intercanine widths, increased posterior transverse discrepancies, and increased prevalence of posterior crossbites.

The aim of the present study was to evaluate the dentoskeletal features of subjects with anterior open bite in the mixed dentition using both conventional cephalometric analysis and morphometric analysis (TPS analysis) applied to posteroanterior (PA) films.
OPEN BITE PATIENTS showed a significant reduction in:

- Zygomatic width
- Maxillary width (skeletal and dentoalveolar levels)
- Mandibular width (condylar lateral width, gonial width)

Subjects with anterior open bite malocclusion show indications for rapid maxillary expansion.

**Aim**

To evaluate the skeletal and dental changes in the short and long terms in hyperdivergent patients treated with rapid maxillary expansion and fixed appliances.

**TREATMENT PROTOCOL**

1. Haas expander activated for 3 weeks
2. Expansion 10.0 - 10.5 mm
3. 2+ months post-activation period
4. RME followed by fixed appliances

Subjects were divided into 3 groups according to the pre-treatment value of the mandibular plane angle (MPA):

- Normal (N=52): 20 deg ≤ MPA < 27 deg
- Moderately Hyperdivergent (N=62): 27 deg ≤ MPA < 32 deg
- Very Hyperdivergent (N=29): MPA ≥ 32 deg
Comparison of Treatment Effects

Normal Group  Mod Hyper Group

Very Hyper Group  Mod Hyper Group

Comparison of Treatment Effects

Long Term Treatment Effects (T2-T3)
Subjects were stratified based on magnitude of change in MPA from T1 to T2
Opening Group (N=26): increase of 1.5 degrees or more
Closing Group (N=23): decrease of 1.5 degrees or more

Long Term Treatment Effects (T3-T2)
Opening vs Closing Groups
No significant differences were found between the opening and closing groups for any cephalometric variables
MPA T2-T3 change in the opening group: -1.1 ± 2.3 deg.
MPA T2-T3 change in the closing group: -1.2 ± 2.3 deg.

Comparison of Treatment Effects

Opening Group  Closing Group

Comparison of Treatment Effects

Conclusions
1. RME combined with full fixed appliances had no significant long-term skeletal effects in the vertical dimension in hyperdivergent subjects compared to patients with normal vertical relationships
2. Rapid maxillary expansion can be used effectively in patients with increased vertical dimension without detrimental effects to the dental and skeletal structures

An increased mandibular plane angle IS NOT a contraindication to RME therapy in growing patients
Aim to evaluate the long-term stability of Rapid Maxillary Expansion (RME) and removable mandibular Bite-block (RMBB) therapy in growing subjects with anterior dentoskeletal open bite when compared to a control group with untreated open bite.

Treatment protocol
RME soldered to bands on the second deciduous molars or on the first permanent molars. The RME was left in place for at least 8 months as a passive retainer. No removable appliance was applied after RME removal.

The removable mandibular bite block (RMBB) appliance consisted of a lower Schwartz plate with 5-mm thick posterior occlusal resin splints. The RMBB was prescribed for 12 months to control the vertical dimension. The patients were instructed to wear the RMBB 24 hours a day.

Subjects

**Treated Group**

- University of Rome Tor Vergata
- 16 subjects (14 f 2 m)
- T1 = 8.1 y ± 1.1 y
- T2 = 9.6 y ± 1.2 y
- T3 = 13.5 y ± 1.4 y

**Control Group**

- 16 subjects (14 f 2 m)
- T1 = 8.3 y ± 1.2 y
- T2 = 9.6 y ± 1.4 y
- T3 = 13.3 y ± 1.2 y

Inclusion Criteria:
- No sucking habit
- Negative overbite
- MPA > 26°
- Full eruption of first permanent molars and permanent incisors

3 consecutive lateral cephalograms were taken before treatment (T1), at the end of the active treatment with the RME and RMBB (T2), and at a follow-up observation (T3) at least 4 years after the completion of treatment (CS 4-6).
significant changes in facial divergence and increase in overbite (+1.8 mm) increase in overbite (+1.8 mm). Small extrusion of U6^PP (-1.9 mm) and L6^MP (-1.3 mm). Decrease of the vertical skeletal relationship (FH^Mand. Pl. -2.6°). Significant changes in facial divergence.

Conclusions

The treated group exhibited reduced extrusion of maxillary and mandibular molars and, consequently, a significant improvement in vertical skeletal dimension when compared with untreated open bite subjects.

The effects of early treatment with RME and RMBB resulted stable at a long-term follow-up.

Take home messages

- Anterior open bite (associated with sucking habits and/or abnormal tongue posture) can be treated effectively EARLY (in the early mixed dentition) with either removable or fixed cribs.
- Since the fixed cribs are more effective than the removable ones, it is recommended to use fixed designs rather than removable ones (unless patients have poor oral hygiene or are at high risk for caries).

Take home messages

- In patients with sucking habits, AOB, and skeletal open bite tendency, the QH-C appliance produces favorable long-term changes in overbite and intermaxillary divergence.
- Rapid maxillary expansion is not contraindicated in patients with skeletal openbite.
- In patients without sucking habits, AOB, and skeletal open bite tendency the RME and RMBB produce favorable long-term changes in overbite and facial divergence.

Take home messages

- Long-term stability of orthodontic openbite treatment can be compromised by an anterior and/or low tongue posture:
- Orthodontic treatment of OB relapse can be attempted only if combined with neuromuscular re-education of abnormal tongue posture.

Take home messages

- Over a 2-phase treatment period (5.7 years), VPCC in combination with a bonded acrylic splint expander, can significantly limit the increases in mandibular plane angle (about 2°), when compared with subjects treated with RME and fixed appliances only.