Airway Implications of Orthodontic Therapy in Obstructive Sleep Apnea Patients

by
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AAO 113th Annual Session  May 6, 2013

UBC Dentistry Sleep Apnea Team

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Sleep Disordered Breathing

Snoring → Upper Airway Resistance Syndrome → Obstructive Sleep Apnea

Why are Oral Appliances Effective?

Airway Size
Tongue and Jaw Muscle Activity
Mandibular Posture and Bruxism

Effects on Airway Size

EFFECTS OF AN ANTERIORITY-TITRATED MANDIBULAR POSITION ON AWAKE AIRWAY AND OSA SEVERITY

by
S Tsuiki, AA Lowe, and JA Fleetham
In the total sample, a significant forward displacement of the velopharynx was associated with forward repositioning of the soft palate.

**Anteroposterior Changes in Airway Size Before and After Titration**

- Increases size of the velopharynx
- Repositions anterior wall of the velopharynx
- Repositions the posterior wall of the hypopharynx
- Indicates hypothetical airway muscle activity

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**Klearway™ Responders**
EFFECTS OF MANDIBULAR ADVANCEMENT ON AWAKE AIRWAY CURVATURE AND OBSTRUCTIVE SLEEP APNEA SEVERITY

by
S Tsuki, A Lowe, F Almeida, N Kawahata and J Fleetham

European Respiratory Journal 23:263-8, 2004

Background:
Fluid Flow through Curved Tubes (aortic arch, coronal arteries)

- Sharper curvature
- Pressure losses
- Higher resistance

What about the upper airway??

“Human air passes through an angulated tube”
J Remmers; Symposia “Sleep and Breathing”, May 4, 2001, Univ Calg

Klearway™ Responders

- Repositioned anterior velopharyngeal wall
- Larger radius of curvature
- Increased velopharyngeal size

r, Before Insertion
r', After Insertion
* P<0.05

3D Airway Changes Before and After OA Insertion

Before Insertion
After Insertion
Mandibular Posture during Sleep in Patients with Obstructive Sleep Apnea

by

K Miyamoto, M Ozbek, A Lowe, T Sjoholm, L Love
J Fleetham and F Ryan


COMMON PATTERN OF MANDIBULAR MOVEMENT

Gradual opening followed by rapid closure of the mandible
Most quick closures followed an arousal response when a shift from deep to light sleep occurred

VERTICAL MANDIBULAR POSTURE BEFORE DURING AND AFTER APNEIC EVENTS

During NREM
Opening was larger in latter half of apneic event than before and at onset
Opening progressively increased during apneic event
Opening decreased at end of apneic event

During REM
No significant change

Oral appliances may be effective since they stabilize mandibular posture during apneic events
TIME IN EACH RANGE DURING NREM AND REM FOR OSA PATIENTS AND CONTROLS

During NREM
- Open 2 to 2.5 less in OSA
- Open 5 to 10 and more greater in OSA

During REM
- Open 0 to 2.5 less in OSA
- % total time open more than 5 is larger in OSA patients (69.3) than in controls (11.1) during NREM sleep

Sleep Bruxism in Patients with Sleep Disordered Breathing

by
T Sjoholm, A Lowe, K Miyamoto, J Fleetham and F Ryan

Archives Oral Biology 2000:45:889-896

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<th>Criteria</th>
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<td>54%</td>
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<td>Overall</td>
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OA and Sleep Bruxism

- An adjustable OA reduced episodes + number of bursts/hr and SB episodes with tooth-grinding noises
- 25% protrusion reduced SB events by 39%
- 75% protrusion reduced SB events by 47%
- An OA may be an alternative for SB and snoring/OSA patients


Snoring and Occlusal Splints

- Maxillary occlusal splint worn for 7 nights in subjects with snoring and OSA
- AHI increased 50% in half of the patients
- Snoring time increased by 40%
- Significant risk of aggravation of respiratory disturbances
- Potential reduction of intraoral and tongue space as well as an increase in the vertical dimension


Long-term Sequellae of Oral Appliance Therapy in OSA Patients:
Part 1 Cephalometric Analysis
Part 2 Study-model Analysis

FR Almeida, AALowe, JO Sung, S Tsuiki, R Otsuka
Am J Dentofacial Orthop 2006; 129, 195-213
Occlusal Changes After Five Years of OA Use

No Change

Favorable Change
Correction of Class II molar
Correction of Class II cuspid
Reduced OJ or OB
Reduced palatal impingement
Reduced lower incisor crowding

Unfavorable Change
Edge to edge incisors
Reverse OJ or OB
Vertical open bite
Reduced interarch contacts
Posterior cross bite

Unfavorable Change

Favorable Change

No Change
10 (14.3%)
Favorable
29 (41.4%)
Change
60 (85.7%)

Unfavorable
31 (44.3%)

Skeletal Type and Outcomes

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<td>90%</td>
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<td>Class III</td>
<td>20%</td>
<td>80%</td>
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Duration of OA Wear and Amount of Change

Craniomaxillofacial

Appliance Design Changes

Appliance Design Changes

Case 5

Case 6
How long was an OA used in this next patient?

Four Years of Profile Lite Nasal Mask (Respironics)
Aim
To determine the prevalence and characteristics of dental and skeletal changes in long-term nCPAP users and to estimate the factors that affect such changes.

Hypothesis
Long-term use of a nCPAP machine could directly affect the maxilla as well as anterior tooth position.

Superimposition on the SN line of a typical OSA subject at baseline and after 35M of nCPCP wear

NASAL PILLOW ALTERNATIVES
Profile Lite Nasal Mask - Respironics
Mirage Swift - ResMed
Breeze SleepGear – Puritan Bennett

Pediatric Dental SDB at UBC

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Pediatric Dental Sleep Apnea Studies at The University of British Columbia
**Pediatric OSA Challenges at UBC**

- Small number of diagnosed children with OSA
- Complete data sets with pre and post PSG
- Difficult access to full PSG studies

**Methodology**

- **Standard SDB questionnaires** were answered by parents/guardians.
- **Validated diagnostic diagrams for standard tongue and tonsilar sizes** were assessed to categorize the visibility of the entrance of upper airway and also the shape and size of palatal tonsils.
- **Lateral cephalometric radiographs** were evaluated to assess craniofacial morphology.
- **Orthodontic models and intraoral photographs** were analyzed to determine the Angle classification.

**Statistically significant cephalometric variables between different gender and age groups**

**Linear measurements**
- PALHT (palatal height)
- UFH (upper facial height)
- LFH (lower facial height)
- TFH (total facial height)
- PNSP (length of soft palate)
- GOGN (mandibular length)
- PNSV (Vertical airway length)

**Angular measurements**
- SNB (A.P. position of mandible)
- SNPOG (Chin position relative to cranium)
- PGNB
- H-ANGLE

**KLEARWAY™ APPLIANCE**

**Baseline**

**After Klearway (9m3d)**
How do Klearway and Twin Block functional appliances compare when used in young children with retruded mandibles?

### Clinical Aspects

**Klearway**
- Protocol consistent
- Rarely lost
- Compliance higher since only wear during sleep
- Keeps both jaws closed while sleeping
- Less chair side adjustment
- No transverse expansion adjustments
- Retention less compromised in the mixed dentition

**Twin block**
- Protocol various (combined with FEA, HG, etc)
- Higher chance to be lost
- Compliance lower due to full time wear
- No orthopedic effect during sleep if mouth breathing
- Longer appointment if adjustment needed
- Can adjust to allow transverse expansion
- Retention can be compromised in the mixed dentition

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### Pediatric OSA Guidelines for Orthodontists

- Not all Class II patients have OSA / not all OSA patients are Class II
- Don’t hesitate to refer to adult/pediatric sleep specialists
- Avoid treatment without a written referral from a physician
- Be cautious in patients who have had previous orthodontic therapy
- Use well recognized appliances with research that includes RCTs
- Both case and appliance selection are both very important
- Be aware of silent apneics and the need for post titration follow up
- Don’t overtreat when post OA or nCPAP occlusal changes occur
- Stay engaged in this rapidly changing and exciting OSA field

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Web Site: www.aadsm.org

The Web site has information about the AADSM, a geographic listing of members, certification status and Web site links.
ACKNOWLEDGEMENT

Klearway™ was invented by the presenter at The University of British Columbia. International patents have been obtained by the University and specific licensees are assigned the rights to manufacture and distribute the appliance worldwide.

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