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Biomechanical behavior of self-ligating interactive systems

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Increasing practice efficiency and profitability

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Abstract thinking

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Sleep apnea and orthodontics
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At the university level, educational institutions typically perform three main functions: education, research and service to their community. Two of the key points, research and education, are areas in which DENTSPLY GAC is directly involved. So a partnership between DENTSPLY GAC and the educational community is a natural fit.

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Unfortunately, universities are having the same problem many individuals and institutions are — they’re trying to do more with less. That’s where private companies like DENTSPLY can make an important difference.

The reality is that when corporations and universities form mutually beneficial relationships, both of them can achieve incremental outcomes that exceed what they could do alone. If we can provide the resources that give the universities a boost, and if we can connect and develop some tools that help in education, while at the same time providing the students with a higher level of education, then it’s a win for everyone involved.

Todd Metts
Professional Services Director
DENTSPLY GAC
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Biomechanical behavior of self-ligating interactive systems

Abstract

The purpose of this study was to determine if various bracket clips are strong enough to provide a proper archwire/slot engagement. If yes, then we wanted to determine if the active clip shows lack of power after loading.

Introduction

If a bracket system is not capable of offering an efficient and strong ligation to properly engage the archwire, the orthodontist will encounter varying degrees of difficulty during treatment. These problems will not occur during the leveling phase, when the force delivered by the archwire deflection is not so powerful. Therefore, during the initial phase, the ligation system doesn’t need to exert the same level of force.

However, during the phases that demand rectangular-geometry-archwires utilization for the torque incorporation, we must consider the ability — or not — of the clip to press and hold the wire firmly engaged to the bracket slot, bringing the desired prescription details needed for ideal positioning.

There are many reasons correct torque expression is important. The use of an interactive bracket system, whose clips are made of a reliable material that offers enough resilience and flexibility, is necessary for the application of constant and physiologic forces. These forces will guarantee proper control of the dental movements in the three planes of the space.

By understanding the importance of the affirmations above, this study aims to evaluate four different models of interactive self-ligating brackets in order to verify which group will show the best performance. In this case, “best” will be represented by the least force loss after being submitted to a certain load during a period of time.

Materials

In this trial, both metallic and ceramic self-ligation interactive brackets (second premolars, 0.022-inch by 0.028-inch slots, Roth prescription) were tested (Table 1). In all the groups, the clip is composed by Cr-Co stainless-steel alloy. A number of eight brackets composed each group.

Methods

Specific methodology was created based on a load cell machine. A custom metallic cylinder that held all eight brackets was designed for this experiment,
with a piece of rectangular 0.019-inch by 0.025-inch SS wire being used as a caliper to dampen any torque or angular interference during the measuring of the forces (Fig. 1).

This ensured that the wires used in the test could be passively inserted into the slots.

The cylinders were positioned in an EMIC DL 2000 (Tesc software version 3.01/05) for load/unload trials. Each bracket was tested in three different steps:

- **M1 – Moment 1 – (Pull Out)**. Measurement of the force that the clip exerts over the wire when pulled until the limit.

- **M2 – Moment 2 – (Load)**. Maintaining strength of a constant load of 20 N during a period of two hours.

- **M3 – Moment 3 – (Pull Out)**. Repetition of step No. 1 after the two previous steps.

For each bracket, a new piece of the SS wire was used. In total, 120 measurements were performed.

Force values that caused maximum and minimum deflection of the clips of five brands of self-ligating brackets were collected.

From these values (eight brackets per group), a mean score was calculated, representing the force

<table>
<thead>
<tr>
<th>Group</th>
<th>Bracket composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Ovation® R (GAC - USA)</td>
<td>Metallic</td>
</tr>
<tr>
<td>BioQuick® (Forestdent - USA)</td>
<td>Metallic</td>
</tr>
<tr>
<td>Empower® (American Orthodontics - USA)</td>
<td>Metallic</td>
</tr>
<tr>
<td>In-Ovation® C (GAC - USA)</td>
<td>Ceramic</td>
</tr>
<tr>
<td>QuickKlear® (Forestdent - USA)</td>
<td>Ceramic</td>
</tr>
</tbody>
</table>

Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>M1 Mean</th>
<th>M1 SD</th>
<th>M2 Mean</th>
<th>M2 SD</th>
<th>M3 Mean</th>
<th>M3 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-Ovation R</td>
<td>752.1</td>
<td>25.94</td>
<td>743.1</td>
<td>44.81</td>
<td>718.5</td>
<td>24.7</td>
</tr>
<tr>
<td>BioQuick</td>
<td>696.6</td>
<td>42.42</td>
<td>638.8</td>
<td>48.16</td>
<td>614.1</td>
<td>38.58</td>
</tr>
<tr>
<td>Empower</td>
<td>592.2</td>
<td>53.78</td>
<td>523.3</td>
<td>70.83</td>
<td>511.3</td>
<td>49.83</td>
</tr>
<tr>
<td>In-Ovation C</td>
<td>604.6</td>
<td>121.6</td>
<td>587.7</td>
<td>102.5</td>
<td>577.1</td>
<td>104.9</td>
</tr>
<tr>
<td>QuickKlear</td>
<td>715.7</td>
<td>21.53</td>
<td>648</td>
<td>26.25</td>
<td>637.9</td>
<td>21.3</td>
</tr>
</tbody>
</table>

Table 2

Table 3

Fig. 1 A custom cylinder designed for the experiment.

Tables and photo/Provided by Dr. Celestino Nobrega
that the clip exerts on the rectangular wire for each of steps Nos. 1, 2 and 3. The data allowed the researcher to compare the mean scores between steps Nos. 1 and 3, after subjecting the clips to the force of 20 N for two hours in step No. 2 (Table 2).

The purpose of step No. 2 was to submit the clip to a sustained effort, similar to what occurs in a complete orthodontic treatment. This made it possible to check the difference in the mechanical behavior of the clips between the initial and final stages.

**Results**

ANOVA (analysis of variance) was utilized to provide statistical calculation, complemented by the Tukey test of multiple comparisons, with a significance level at 5 percent.

Among the metallic interactive brackets, the In-Ovation R group showed the highest average, being significantly different than the other groups BioQuick and Empower (Table 3).

**Discussion**

Higher levels of force represent a disadvantage from the traditional systems of brackets when the load applied directly to the crowns exceeds biological limits. It is important to emphasize that the force generated by the clip is not delivered to the teeth. The importance is related to a proper engagement of the archwire into the slot, putting together the characteristics of the prescription in straight wire appliances.

It’s interesting to observe that it’s not just the initial force generated by the clip that’s relevant, but also how constant the force is maintained. Although some brands of interactive brackets showed initial forces apparently strong enough to maintain the archwire in position, they also showed that this strength is lost and dissipates over time, meaning the efficiency of an interactive bracket is related to the consistent power generated by the clip and not to the initial force provided by a brand new bracket.
The efficiency of an interactive system of self-ligating brackets is directly related to the uniformity and continuity of the spring clip activity over time. Excessive loss of force brings clinical difficulties during the treatment phases that require the utilization of rectangular-geometry archwires, such as the space closure and the finishing stage.

Therefore, from the clinical point of view, the most important data is the difference between the averages of steps Nos. 1 and 3 of the test (Table 4).

Through the test T at the level of significance of 5 percent, we can verify that for the majority of the groups, the means scores $M_1$ were significantly bigger than $M_3$, which means that there is always some lack of effectiveness of the spring clips, regardless of brand.

When the calculated $p$ value (minimum significance level) allowed rejection of the nullity hypothesis, an asterisk (*) was used to denote this. The nullity hypothesis was rejected only on the In-Ovation C group, which showed no statistical difference between $M_1$ and $M_3$. This situation reflects a better mechanical stability of its spring clips.

Among the metallic self-ligating brackets, the mean score for step No. 3 ($M_3$) was the highest for the In-Ovation R group. The group Empower suffered the greatest loss of tension, generating the lowest strength. The BioQuick group performed intermediate values at the end of the third moment of the test ($M_3$).

In the chart (Table 5), it is possible to observe and compare the mean scores for steps Nos. 1 and 3 of the test for each group of brackets.

Considering the differences in gf (grams of force) between the moments $M_1$ and $M_3$ (Table 6), the highest loss in terms of force magnitude between the metallic accessories after a 20 N load during two hours was shown by the BioQuick group (82.5 gf), quite similar to the Empower group (80.9 gf). The best performance (lowest lack of strength) was presented by the In-Ovation R group (33.6 gf).

Among the esthetic brackets, the highest loss of magnitude of force was shown by the QuickKlear group (77.8 gf), while the group In-Ovation C presented the lowest (27.5 gf).

**Conclusion**

From the above results, we can draw the following three conclusions:

- It’s important for clinicians to understand that the main component of an interactive self-ligation system is the spring clip, which is supposed to provide flexibility and resilience along the treatment time. Therefore, the choice among the different brands offered by the current market should be focused on this point.

- The spring clips of the interactive self-ligating brackets are not free from loss of force exertion.
power after being subjected to a load of 20 N for a period of two hours.

- The differences between the stages M1 and M3 were statistically non-significant only for In-Ovation C group (GAC–DENTSPLY, United States), which denoted greater mechanical stability. There is not a perfect and ideal interactive self-ligating bracket system. However, both groups In-Ovation R and In-Ovation C performed better than the other brands in all the trials when the magnitude of force loss was considered.

References


About the Author

Dr. Celestino Nobrega completed his general dental training at Sao Paulo State University, Brazil, in 1984. He completed his certificate in orthodontics at Rio de Janeiro State at Brazilian Dental Association. His masters of dental science degree came in 1996, after publishing material about MRIs of TMJs. After taking the Roth-Williams continuing education course at Burlingame in 1997, he received the position of educator at several academic associations in Brazil, organizing courses as post-graduate program director. The search for innovative technologies led Nobrega to Dr. Elliot Moskowitz, who introduced him to NYU Ortho Department Chairman Dr. George Cisneros. Months later, Nobrega began bringing groups of his students and former students to NYU for one-week programs created especially for them. During these programs, Nobrega was able to have a closer and definitive contact with ISL mechanics, learning about biological and mechanical details. Today, Nobrega is leading a project in his country focusing on 19 biomechanical studies regarding characteristics of the interactive self-ligating system. The research is based on friction and flexibility studies and also on low-intensity laser and vibration therapy during orthodontic treatment.
Increasing practice efficiency, profitability using In-Ovation R self-ligating brackets

A white paper report

Authors: Jerry R. Clark, DDS, MS, and Jack Gebbie, BS

Many unsubstantiated claims have been made concerning self-ligating bracket systems as to their efficiency in moving teeth, the time savings that can be realized by using these appliances and the “magic” that is somehow stored up in these brackets to more effectively align teeth.

This study was done in an effort to draw some scientifically based conclusions to more accurately differentiate between what is “hype” and what is actually true regarding the purported increased efficiency and time savings of one such self-ligating bracket system: In-Ovation R, manufactured by GAC International.

The study was performed to determine if cases treated with In-Ovation R brackets were actually treated faster, with fewer and shorter appointments with less clinical chair time needed to complete treatment, and if they truly increase practice efficiency and profitability compared to similar cases treated with traditional edgewise brackets.

Are there other scientific studies available?

Recently, there has been a cry from the scientific community regarding evidence-based studies that will differentiate between opinion and fact.1–4 It is important for our profession, if we are to remain rooted in scientific principles, to honestly research, study and report on the claims made by our fellow professionals and the orthodontic supply companies.

At the present time, there actually have been a surprising number of scientific studies performed that have reported the increased efficiency of self-ligating brackets.5–13 Most of these reports, however, have studied other bracket systems, such as Damon and Speed.

To date, no scientific study has been applied exclusively to the In-Ovation R bracket system to measure the treatment and chair-time savings resulting from using this appliance. That is the reason for this research study.

How was this study performed?

Treated orthodontic cases were randomly selected from the practice of Dr. Jerry Clark, a board-certified orthodontist. No attempt was made, in this study, to quantify the quality of the final treatment results. It was assumed that Clark utilized all his technical skills and abilities to achieve the best treatment results possible for each individual patient.

One hundred fourteen cases treated with In-Ovation R were studied and compared to 241
1 The study was fairly simple in its design. Patents treated with traditional edgewise brackets and Roth and Tweed-type mechanics with the goal of attaining the Andrews 6 Keys to Occlusion were compared to cases treated with In-Ovation R brackets and the light wire mechanics typically used with self-ligating brackets. This produced a confidence level for this sample of 95 percent +/- 8 percent.

Certain types of cases were eliminated from the study. Those excluded were: cases with an unusual number of missed or broken appointments, cases with an unusual number of loose or broken brackets, cases that required two-phase treatment, cases with significant skeletal discrepancies (Class III, skeletal open bites), cases with impacted canines, cases with extremely poor cooperation and cases where some other circumstance significantly impacted Clark’s ability to complete treatment in a reasonable length of time.

This research project was managed by Jack Gebbie, president, DATATEX Inc., an independent research and consulting firm specializing in market research. The data files were carefully reviewed, and marketing research standards were applied to the sampling to ensure comparisons would be valid across the two alternatives being studied.

DATATEX is a member of CASRO (Council of American Survey Research Organizations) and maintains research integrity and standards consistent with this organization.

What was specifically studied?

Fig. 1. The average number of months required to treat cases utilizing In-Ovation R was 4.14 months less than comparable cases being treated using traditional edgewise brackets. (Illustrations/Provided by DENTSPLY GAC)
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brackets with the objective of achieving similar treatment objectives.

The time required to place brackets at the beginning of treatment and the time necessary to remove appliances at the end of treatment was not included because it is realistic to assume that it takes approximately the same amount of time to place and remove brackets regardless of the type of brackets being used.

What was studied was the actual treatment time from the day treatment was begun to the day appliances were removed. Also, the total number of patient visits needed to complete treatment was measured, as was the total number of minutes of patient chair time necessary to complete treatment.


The answer is YES!

What were the findings of the study?

Months in treatment
The average number of months required to treat cases utilizing In-Ovation R was 4.14 months less than comparable cases being treated using traditional edgewise brackets.

Number of appointments
The average number of patient appointments
The number of minutes of clinical chair time patients required in order to complete treatment was reduced by an average of 174.21 minutes per patient or, put another way, approximately three hours of chair time was saved on each treated patient. That means the average case being treated with In-Ovation R took approximately five hours of chair time to treat while the average case being treated with traditional appliances took almost eight hours to treat, a time savings of approximately 36 percent.

How does the reduced chair time impact practice profitability?

Suppose your practice produces a profit of $350 per hour (an average figure for an active well-managed practice), and you are able to save three hours on each case you treat. Then the profit for each case treated is increased by approximately $1,050.

However, In-Ovation R brackets do cost more than traditional edgewise brackets by approximately $5 per bracket. That means if you bond five to five, you use approximately 20 brackets on each case for an additional expense of about $100 per case. So the actual estimated additional profit for each case using this scenario is about $950. That is a pretty good return on an additional investment of $100 for In-Ovation R brackets.
However, this is just an average. If your practice profit per hour is less than $350 per hour, then your savings will be somewhat less. But if your practice profit is more than $350 per hour, then your profit will increase even more.

So what’s the bottom line?

Granted, a competent and conscientious orthodontist can most likely obtain excellent treatment results regardless of the type of appliances he or she chooses to utilize. I am often questioned by my colleagues, “Why should I change? Why should I pay more for In-Ovation R brackets when I am already achieving excellent results with my present bracket system?”

The critical and more important question is, “What is best for our patients?”

If we as orthodontists are committed to providing the very finest treatment for our patients, I personally feel it is important we look at the findings of this study and draw the obvious conclusions concerning the treatment of our patients.

If we want to provide the very finest orthodontic care, in the most cost-effective manner with the least amount of discomfort to our patients, with the fewest number of visits required, and provide shorter appointment times while completing treatment as quickly as possible, I feel it now requires us to avail ourselves of the advanced technology of self-ligation.

Anything less would not be providing the finest available treatment for our patients.

Editor’s note: Dr. Jerry Clark and Jack Gebbie would like to sincerely thank Debbie Terrell, Kyle Bechtel and Dr. John Oubre for their efforts and invaluable assistance in accumulating data for this study. The complete study is available upon request by contacting DENTSPLY GAC.

References

The DENTSPLY GAC Orthodontic World Congress is dedicated to bringing top quality professional and clinical development to further the advancement and discussion within the orthodontic community.

This year’s meeting will feature sessions on a range of topics from Contagious Marketing to Contemporary Transverse Diagnosis. The conference will include notable speakers, workshops tailored for orthodontists and staff, group discussions, and a half-day tactical session on implementation of practice differentiators for your staff.

The 2015 Annual Meeting brings together orthodontists from around the world for two days of meetings, insightful speakers, recreation and plenty of networking time that we are sure will create a community of valuable relationships.

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Jonah Barger  
Steve Curtain  
Jon Acuff

**Featuring: Thursday 2/19**
Dr. Ben Burris  
Dr. Lou Shuman

**Featuring: Friday 2/20**
Dr. Antonino Sacchi  
Dr. Ryan Tumburinno  
Dr. Martin Palomo

Dr. Julia Garcia-Baeza  
Dr. Rebecca Bockow  
Dr. Raffaele Spena

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Each year in Canada, second-year orthodontic residents are tasked with summarizing their thesis ideas and then converting them to a poster-style format for the scientific session of the annual Canadian Association of Orthodontics (CAO). This annual rite of passage does more than simply provide each resident with a rewarding technical experience — it also provides all of orthodontics with some valuable research. Here is one of these resident studies.

Study


Objectives
To evaluate the lower incisor (Li) changes after completion of comprehensive fixed treatment in subjects with different facial patterns who were treated with a FSIA for Class II correction.

Hypothesis
Once the lower incisor position has been established at the end of a FSIA treatment, they will remain stable in the same position after fixed treatment.

Subjects and methods
A retrospective chart review was undertaken, consisting of 115 subjects with Class II malocclusions, 43 male and 72 female. The average length of treatment was one year and seven months (S.E ± 0.57). The average age of the subjects at T1 was 13.7 years (S.E ± 1.5). Subjects were then categorized into three growth types based on pre-treatment (T0) cephalometric variables (MPA, Y-axis, LFH) with 29 brachycephalic, 53 mesocephalic and 33 dolichocephalic subjects resulting. Data was compiled using digital lateral cephalometric analysis of the post-treatment FSIA subjects’ (T1) and post-treatment comprehensive fixed therapy subjects’ (T2) radiographs.

Statistical evaluation used a mixed model repeated command to calculate marginal means and a post-hoc analysis to determine pairwise differences with the Tukey’s test, reporting least square means.

Results
Dental changes induced by fixed treatment included:
1. retroclination of the Li (LI-MP 5.7-9.7°±1.3 p<0.05)
2. retrusion of Li (LI-APo 0.1-1.0mm ±0.3mm p<0.05)

There was no significant difference among the different facial groups (p>0.05). There was an increased trend of less incisor retroclination and retrusion for the dolichocephalic group.

Conclusions
Incisor proclination resulting from the FSIA is reversed after fixed orthodontic treatment, and Li tend to retrocline and retrude. Use of zero or negative torque prescription in the Li bracket and Li uprighting mechanics throughout treatment ensure the Li return to a position between the initial treatment (To) and the final position established with the FSIA (T1).

Facial growth pattern demonstrate no relation to the amount of Li movement. The dolichocephalic group shows less Li change when compared to the other facial patterns.
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Sleep apnea and orthodontics: An interdisciplinary approach to treating a chronic sleep condition

Author: Jim Duffy

Interdisciplinary treatment planning is a concept that’s gaining relevance among oral health professionals. It’s one of the chief tenets of the popular Seattle Study Club, and many find it extremely rewarding to work with a group of like-minded professionals when treating their patients. This evolving holistic approach to oral health is exemplified in the evolving role that the orthodontist can play in addressing sleep apnea.

The notion that people should see an orthodontist about the sleeping problems they or their children endure might come as a surprise to the general public, but more and more medical and orthodontic experts are pointing toward a future that heads in that direction.

Consider, for example, the most common type of sleep-disordered breathing: obsessive sleep apnea syndrome (OSAS). It’s quite common among both children and adults, though precisely how common can be difficult to say because the condition is significantly under-diagnosed.

A 2012 paper in the journal Pediatrics placed sleep apnea numbers among children within the broad range of 1 to 5 percent of the population. The nonprofit Sleep Foundation estimates that at least 18 million adults have OSAS.

The syndrome can affect patients in a range from mild to severe, with the more serious cases being quite dangerous to long-term health. Among children, OSAS has been linked with poor school performance, learning disabilities, behavior problems and even some cardiac abnormalities. In adults, it can boost the risk of hypertension, cardiovascular disease, coronary artery disease and insulin-dependent diabetes.

What causes sleep apnea?

The word apnea comes from the Greek apnoia, which means “breathless.” That’s exactly what happens in OSAS, as sufferers stop breathing for brief intervals in their sleep, and they do this over and over again throughout the night.

Such breathing gaps create wide variations in the heart rate and in levels of oxygen saturation.

In the simplest sense, this happens because either the upper airway collapses or it’s obstructed. Why that happens is a more complicated question.

• Excessive weight can cause upper airway complications. An estimated two out of three OSAS patients are obese. People with big necks are at higher risk as well; size 16 in men and 16 in women seem to be a cutoff point for medical professionals
when it comes to asking patients about possible OSAS issues.

- Some sleep apnea is linked with aging. The natural loss of muscle tone that happens as the years go by can lead to the development of airway obstructions.
- Smoking and alcohol use may not cause sleep apnea, but both can aggravate the condition.
- In recent decades, increasing attention has been paid to OSAS cases linked with abnormalities in oral-facial development among non-obese children.
  
  A review of the evidence supporting this hypothesis was published last year in Frontiers in Neurology. Co-author Christian Guilleminault is a pioneering sleep scientist at the Stanford School of Medicine who helped to discover and name the syndrome back in the 1970s.

  The paper identifies several facial characteristics associated with OSAS in non-obese patients, including the narrowing of dental arches, a decrease in maxillary arch length and an increase in anterior facial height.

  What causes these developmental abnormalities is uncertain; the paper speculates that they are sparked by something that happens in utero. They are also common among premature births.

  Harry Legan, the chairman of orthodontics at the Vanderbilt University School of Medicine, noted these characteristics in a 2008 presentation before the Pacific Coast Society of Orthodontists and added a couple of others to the mix, including a large tongue and an inferiorly positioned hyoid bone.

  The list made it clear, Legan said, that "the orthodontist is uniquely suited to recognize the symptoms of obsessive sleep apnea, make a tentative diagnosis and make the necessary referral to coordinate treatment options."

_The orthodontist and pediatric OSAS_

Early diagnosis and successful treatment can make a huge difference in the lives of young sleep apnea patients. Among the outcomes cited in an August 2013 paper in the journal JSM Dentistry by developmental dentist Zheng Xu of the University of Texas Health Science Center are improved cognitive development, better academic outcomes and improved social skills.

  The treatment of pediatric OSAS generally involves a multidisciplinary team that can include sleep specialists, weight-loss experts and pediatricians, as well as dentists and orthodontists.

  The participation of orthodontists seems poised to increase, given a growing body of evidence that rapid maxillary expansion (RME) is an effective treatment.

  RME has been around for more than a century now, but its usage in disordered sleep patterns is a relatively recent phenomenon. The treatment involves the placement of an expandable brace on the
technique _ sleep apnea

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**The orthodontist and adult OSAS**

Formal diagnosis of sleep apnea is made by a sleep specialist after an overnight polysomnography exam. Once adult OSAS is identified, first steps tend to be of the common sense variety — weight loss for obese patients, as well as changes in sleeping habits. Many patients do better if they sleep on the side rather than on the back.

Another popular treatment, continuous positive airway pressure (CPAP), involves sleeping with a breathing mask that’s attached to a machine that helps generate more air pressure in the throat. CPAP is highly effective when used properly, but patient compliance is a big problem. Many people find the device so uncomfortable they simply stop using it.

At this point, various surgical interventions may come into play, including tonsillectomy and adenoidectomy, cranofacial operations or tracheostomy. These can be successful on occasion, but they are far from sure-fire and lasting solutions in all cases.

Here is where the orthodontist comes in. Various types of oral appliances offer partial relief to OSAS patients, especially in cases that fall in the mild to moderate range. The American Academy of Sleep Medicine recommends two different types of devices — tongue-retaining appliances that hold the tongue in a forward position and mandibular-repositioning appliances that keep the lower jaw in a protruded position while sleeping.

California-based orthodontist Robert G. Keim discussed the difference such devices can make in a 2011 article in the Journal of Clinical Orthodontics: "Even a few millimeters of mandibular advancement during sleep may be enough ... to produce relatively normal breathing patterns," he wrote.

Keim also noted that sleep apnea is now receiving significant attention in both dental and orthodontic graduate schools — a sure sign that the trend of increased orthodontic involvement in OSAS is likely to continue.

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‘Even a few millimeters of mandibular advancement during sleep may be enough ... to produce relatively normal breathing patterns.’

— California-based orthodontist Robert G. Keim
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Dr. Tim Dumore, DMD, MS
submissions
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Please note that all the textual elements of your submission:

- complete article
- figure captions
- literature list
- contact info (include e-mail address)
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must be combined into one Microsoft Word document. Please do not submit multiple files for each of these items. In addition, images (tables, charts, photographs, etc.) must not be embedded in the text document.

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Questions? Comments?

Please do not hesitate to contact us for our International C.E. Magazine Author Kit or if you have other questions/comments about the article submission process:

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