Feature Article

The Bite Wafer Effect: The Use of a Viscoelastic Appliance in the Management of Orthodontic Pain with Sequential Aligner Therapy

by David Penn, BDS, MBA

Dr. David Penn is the Head of School of the Postgraduate School of Dentistry.

He graduated from Sydney University Dental School and commenced practice in Sydney's eastern suburbs. In 1983 he established Southern Cross Dental Laboratories, now regarded as one of the leading state-of-the-art dental laboratories.

Dr. Penn lectures and teaches extensively, principally in esthetic orthodontics and facial esthetics. He has taught more than 1000 postgraduate students in the use of sequential aligners and esthetics. Three editions of his book *A Guide to Impressions, Implants and Indirect Procedures* have been used by undergraduates and experienced dentists since 2006.

He also was responsible for the development of dental devices including the Penn Composite Stent, the Atlas Cabriolet orthodontic retainer, and a series of accelerated orthodontic devices (Munchies) which in 2015 received a prestigious grant from the NSW Department of Innovation.

In 2011, Dr. Penn won the Ernst & Young Entrepreneur of the Year in the services division.

Dr. Penn established Penn College in 2014 and a specific faculty, the Postgraduate School of Dentistry, in 2015. He has been featured in the NBC Universal TV series *Changing Faces*.

Orthodontic pain

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage. It is a subjective experience, with great individual variation, and depends on various factors such as age, gender, emotional state, culture and past pain experience.[1] Orthodontic pain is perceived as soreness, pressure and tension in affected teeth.[2]

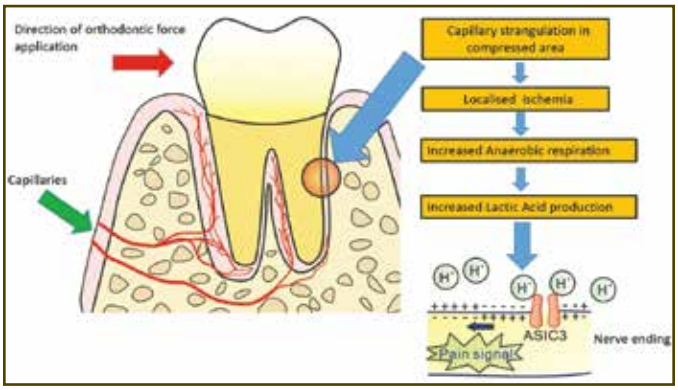

Figure 1: When an orthodontic force is applied to a tooth, the root moves in the direction of the force toward the periradicular bone, with the periodontal ligament wedged in between them. This produces a capillary strangulation due to compression, and local ischemia commences. Periodontal cells then undergo anaerobic respiration, causing local acidosis, and the proton ion (H+) binds to ASIC3 receptors on sensory endings to generate pain. As local ischemia progresses, mast cells and fibroblasts cause the release of bradykinin and prostaglandin, which bind to sensory endings to generate further pain.

Pain is a common experience in most orthodontic patients. In a study, 90% of adult patients described orthodontic treatment as being painful.[3] This percentage seems to increase to 95% in children undergoing treatment, according to another study.[4] Hence, pain is a major concern to patients and clinicians, and many studies have reported this discomfort to be a major obstacle in seeking orthodontic treatment, and an important reason for discontinuing treatment.[3-5] Saloom[3] reported that up to 30% of patients contemplated terminating their treatment early because of orthodontic pain.

The underlying mechanism for orthodontic pain is initiated by orthodontic forces which create zones of pressure and tension in the periodontal ligament space, resulting in an inflammatory reaction within the periodontium and pulp, along with the release of inflammatory mediators. It is assumed that the perception of pain is influenced by changes in blood flow and is correlated with the release of mediators such as prostaglandins,

leukotrienes, histamine, serotonin and substance P, which cause a hyperalgesic response (**Figure 1**).[1,2]

Management of orthodontic pain

Management of orthodontic pain is an important aspect of orthodontic treatment, whose aim is decreasing the discomfort level of patients, and thus improving health-related quality of life. Additionally, management of orthodontic pain increases patient compliance and reduces the interference with patients' masticatory performance and speech.[2,5]

To alleviate pain, pharmacological and mechanical interventions are commonly used in orthodontics. Alternative pain management mechanisms include behavioral intervention (cognitive behavioral therapy [CBT], physical activity, music therapy), laser irradiation therapy and gene therapy.

Pharmacological interventions

Nonsteroidal anti-inflammatory drugs (NSAIDs) such as acetaminophen, ibuprofen, and celecoxib are the most frequently recommended drugs for pain and work by inhibiting prostaglandin synthesis.[6] However, a number of risks associated with the use of traditional analgesics in orthodontics are raising doubts about the use of these drugs as a primary or sole pain control intervention.

Firstly, studies have suggested that NSAIDs reduce the rate of tooth movement during orthodontic treatment by inhibiting the activity of COX enzymes, a mediator for the synthesis of prostaglandin. Prostaglandin promotes local inflammation and bone remodeling, which facilitates tooth movement. Conversely, decreased levels of prostaglandin following NSAID intake inhibit osteoclasts and reduce the rate of tooth movement.[4,7,8] For orthodontic patients, this prolongs treatment.

Secondly, in recent years, the use of NSAIDs has been associated with different adverse reactions that include thrombocytopenia (blood platelet deficiency), skin rashes, and headaches, particularly in young orthodontic patients.[3,9] Lastly, the risk of overuse of NSAIDs has been raised as a concern, particularly when the drugs are over-the-counter (OTC) analgesics.[6]

Consequently, nondrug interventions for pain control, such as anatomically specific biting devices (e.g., Munchies®) or chewing gum, have been recommended in the Postgraduate Progam in Aesthetic Orthodontics at the Postgraduate School of Dentistry, where the device was developed.

Mechanical interventions

Mechanical modalities such as chewing gum and biting devices have been proposed as nondrug methods to relieve orthodontic pain.[9]

The proposed mechanism of these interventions is that they induce microdynamic movements and loosen the tightly grouped periodontal ligament fibers around the nerves and blood vessels, restoring the normal vascular and lymphatic circulation of the periodontal ligament, thus preventing or relieving inflammation and edema, and finally relieving pain and discomfort.[9]

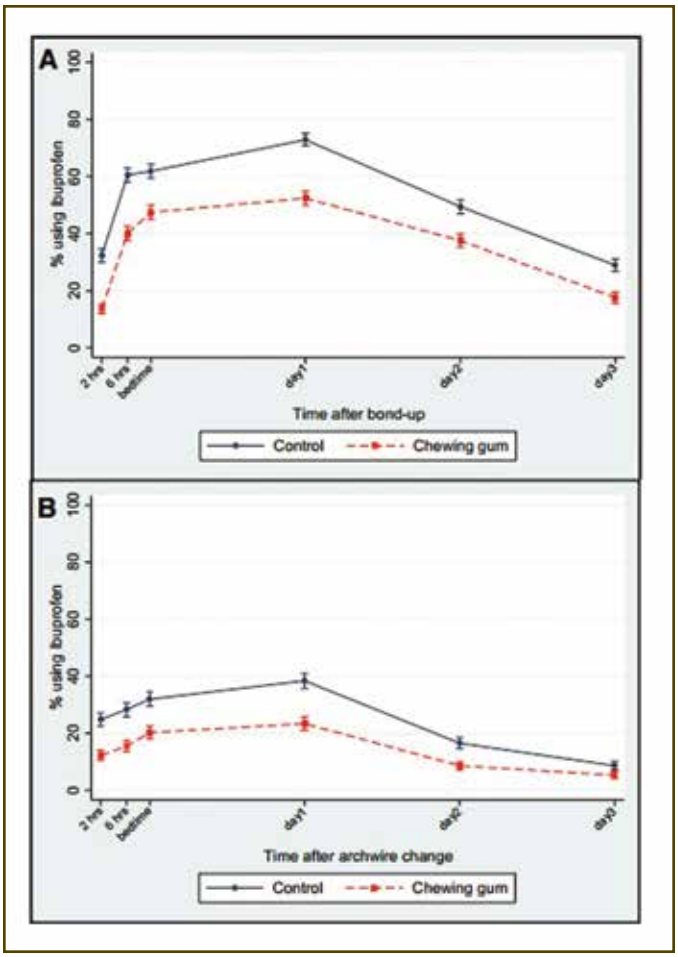

Figure 2: percentages of patients using ibuprofen after (A) bond-up and (B) arch wire change.

In other words, biting on a viscoelastic device such as Munchies or chewing on sugar-free gum induces what has been described as the "bite wafer" effect. The biting pressure temporarily displaces the teeth under orthodontic force, alleviates the orthodontic pressure, and prevents the formation of ischemic areas, thus relieving pain.

Many studies have compared the effects of pharmacological interventions and mechanical interventions. A 2016 randomized controlled trial (RCT), carried out in the United Kingdom with 1000 study participants undergoing fixed orthodontic treatment, concluded that the patients in the chewing-gum group (who used sugar-free chewing gum to manage orthodontic pain, with an option to use ibuprofen as well) reported significantly less use of ibuprofen for pain relief than those in the control group (who took ibuprofen as their only pain-management method) (**Figure 2**).[4] This study supports the assertion that the use of mechanical intervention can significantly reduce the need for traditional analgesics and hence the risk of adverse effects.

In addition to reducing the use of analgesics, some studies have indicated that biting silicone wafers can be as effective as drugs, or even more effective, as a solution for pain control. Murdock[6] et al., when comparing pain response during the first week after initial arch wire placements in patients randomly assigned to two pain management groups—chewing on bite wafers as desired vs. taking NSAIDs—concluded that the bite wafers were at least as effective as NSAIDs for pain management after orthodontic procedures.

In a study by Farzanegan et al.,[9] the bite wafers were found more effective than ibuprofen in orthodontic pain reduction when compared with the placebo group. The authors recommended the use of chewing gum or bite wafers as a substitute for ibuprofen to relieve orthodontic pain.

Similarly, another RCT by Saloom,[3] comparing the use of bite wafers and paracetamol (acetaminophen) in reducing pain and discomfort associated with initial orthodontic tooth movement in both adolescents and adults, concluded that bite wafers reduced pain more obviously and safely in comparison to paracetamol, especially in adolescents (**Figures 3 and 4**).[3]

The majority of the comparative studies mentioned above suggest that both chewing gum and biting on mechanical devices have a similar effect in managing orthodontic pain. However, mechanical devices seem to present some additional benefits over chewing gum:

a) As Farzanegan et al.[9] observed, the viscoelastic bite wafers tend to have varying toughnesses (as opposed to a single hardness of chewing gum). This makes them more effective in displacing teeth, solving ischemia and, ultimately, managing orthodontic pain.

b) Unlike chewing gum (which most people chew with only their back teeth), a well-made, anatomically shaped mechanical biting device is more effective in pain control for both front and back teeth.

Munchies®

Munchies are an anatomically designed Type 1 medical device designed to accelerate aligner therapy by ensuring the optimization of aligner fit and the delivery of correct forces, and to minimize pain during treatment.

Munchies are specifically shaped to intimately fit upper anterior, lower anterior and posterior teeth, using 3 separate arms, in conjunction with the wear of clear aligners. They are fabricated using state-of-the-art medical-grade silicone technology, with ideal viscoelastic properties which allow them to deform momentarily when engaged by both arches (one arch pushes the device into the other arch).

The device generally captures about 30% of the clinical crown and its aligner. This optimizes seating, minimizes "aligner slip," and delivers a greater propensity for expression of intended orthodontic movements.

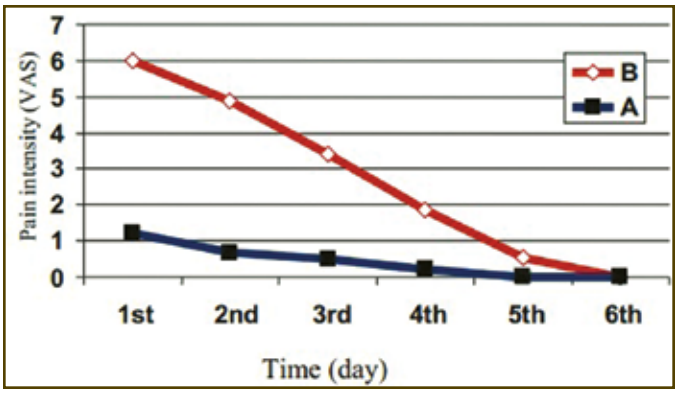

Figure 3: pain intensity before (B) and after (A) using bite wafers in adolescents.

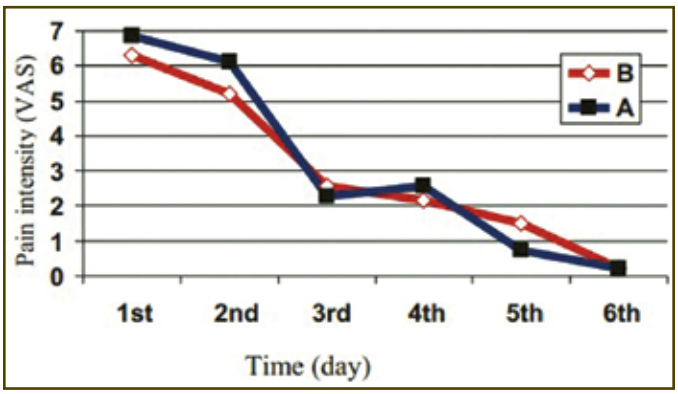

Figure 4: pain intensity before (B) and after (A) using paracetamol in adolescents.

In a study by Sharp and Dove[10] in 2015,100% of patients reported comprehensively superior fit of aligners when using the Munchies immediately after each aligner reinsertion, and 70% of patients reported pain relief during all stages of orthodontic treatment by inducing the bite wafer effect.

Munchies use a series of medical-grade silicones of differing Shore hardness measurements, described as "gentle" or "firm." The patient should commence with the softest Munchies device that provides pain relief after the insertion of a new aligner, and then move to a slightly harder device after about 8 hours.

This use of Munchies of varying hardness at different stages after orthodontic adjustment or new aligner insertion is critical in order to maximize pain relief.[11] Ideal pain management is achieved if Munchies are used by biting in the posterior region (back teeth) for 3 to 4 minutes at 6- to 8-hour intervals, for up to 1 week if pain persists.

To sum up, the pilot study carried out by Sharp and Dove showed that Munchies are a very effective method of management of orthodontic pain. However, further studies using Munchies with sequential aligner therapy and fixed orthodontic appliance therapy are required to complement the results. Issues remaining to be resolved include

- Optimal intraoral time per day with Munchies for pain relief and for ideal aligner seating

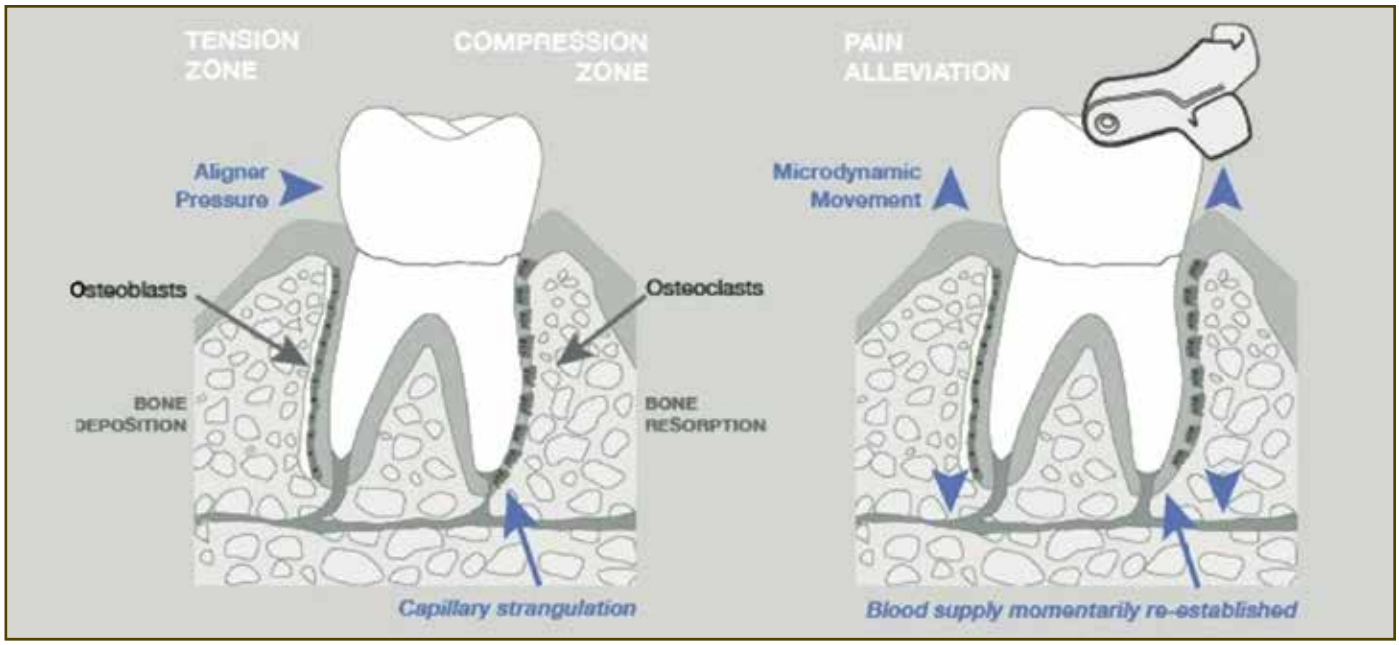

Figure 5: pain alleviation from use of Munchies.

- Which hardness of silicone is most efficacious for specific movements (Among about 2000 patients who have been using them, the harder devices seem to be more popular for seating, and softer devices for pain alleviation.) ■

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Figure 6a: Munchies®.

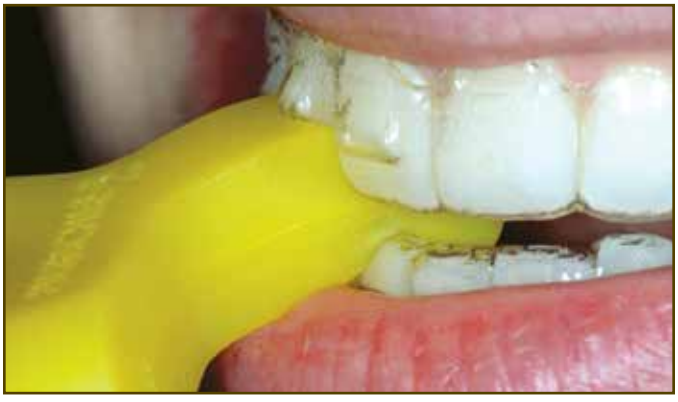

Figure 6b: Munchies®.