Good Comfort Levels Reported by Patients When Inserting Full-Size Archwires Into SmartClip™ SL3 Self-Ligating Brackets After Leveling and Aligning of Bracket Slots

Rachel Ugai received a B.S. Degree in Chemistry from University of California, Irvine in 2002. She joined 3M Unitek Research and Development in 2007 and has been involved in many experiments in the laboratory. In 2011, she took part in APC™ Flash-Free Adhesive development team as an Advanced Technical Service Engineer.

Objective: To evaluate the comfort levels reported by patients when engaging a 0.019×0.025 archwire into 0.022 slot-size SmartClip™ SL3 Self-Ligating Brackets. Methodology: Dr. Mohammad Razavi surveyed 147 consecutive patients who received a change of archwire from 0.014/0.016 Super-Elastic Nitinol tandem archwires to 0.019×0.025 Heat-Activated Nitinol archwires. Each patient previously had tandem archwires placed for at least 8 weeks. Patients were asked to rate their comfort level during the engagement of the 0.019×0.025 Heat-Activated Nitinol archwire on a 0 to 10 visual analog scale, where 0 represented no pain and 10 represented the most intense pain. Results: Of the 147 patients surveyed, 86% experienced little to no pain during the insertion of the 0.019×0.025 Heat-Activated Nitinol archwire. Conclusion: Full-sized archwires can be comfortably inserted into SmartClip Self-Ligating Brackets. Keys for patient comfort are the prior use of tandem archwires and sufficient time to allow for these archwires to complete the initial leveling and aligning of the bracket slots, prior to transition to large rectangular wires.

Introduction

Self-ligating brackets were first introduced to the orthodontic world in the form of the Russell Lock bracket in the 1930s. Since then, these type appliances have slowly gained popularity among clinicians, with the largest growth occurring over the last two decades, as the design of these brackets have improved significantly. Reports by users of decreased treatment time and reduced frictional resistance compared to conventional ligated brackets have renewed interest in these brackets.

Harradine² described the ideal ligation system as one with robust and secure ligation, with full engagement of the wire by the bracket, resulting in low friction between the archwire and the bracket. In addition, the system should be easy to use, allow for attachment of elastic chain modules, and provide for increasing friction when desired in the finishing stages of treatment. Above all it should provide good oral hygiene, and produce a comfortable patient experience.

The SmartClip™ SL3 Self-Ligating Appliance System from 3M Unitek is a distinct bracket system that possesses all these qualities. A unique type of self-ligating bracket, this appliance has Nitinol clips attached on the mesial and distal aspects of the bracket to retain the archwire in the slot. This is a marked variation from the more commonly known self-ligating brackets, where doors or slides over the bracket slot hold the archwire in position. Consequently, the SmartClip SL3 Self-Ligating Appliance allows the archwire to move freely in the bracket slot, while maintaining the control required throughout treatment. Additional control can be gained as the bracket is “active-on-demand” and can be easily ligated when desired.

Orthodontic treatment has always been associated with some amount of patient discomfort. This comes from the fact that tooth movement is a complex phenomenon. The most widely accepted theory for tooth movement is the pressure-tension theory, where the initial pressure applied to teeth alters blood flow in the PDL, leading to the release of prostaglandin (PG) E and interleukin-1. These messengers employ osteoclasts to initiate bone resorption resulting in tooth movement. The same cell mediator, PGE, is also involved in the mediation of inflammatory pain stimuli. Salmassian, et al. reported pain from orthodontic tooth movement within three hours of appliance placement, reaching peak pain values at 19 hours after tooth movement initiated and relieved within seven days. In an effort to reduce patient discomfort, orthodontists have employed the use of pharmacological agents such as ibuprofen and acetaminophen to improve the patients’ experience.
discomfort throughout orthodontic treatment can negatively affect the patient’s overall satisfaction and experience and can lead to reduced compliance throughout treatment.6

One aspect of treatment that can also contribute to patient discomfort is the insertion of archwires.

The purpose of this study was to evaluate the level of patient discomfort during the transition from 0.014/0.016 tandem Super-Elastic Nitinol archwires to full-sized 0.019×0.025 Heat-ACTivated Nitinol archwires when using the SmartClip SL3 Self-Ligating Appliance System.

Materials and Methods

This clinical survey was undertaken by Dr. Mohammad Razavi at his private practice, Palladium Orthodontics, in Kanata, Ontario, Canada. Dr. Razavi is an American Board Certified orthodontic specialist who has been using the SmartClip SL3 Self-Ligating Appliance System since 2006 and who treats, on average, 500 comprehensive cases per year. Eligible patients for this clinical survey were those who had 0.014 and 0.016 Super Elastic tandem archwires in SmartClip Brackets for at least eight weeks.

When the archwires were fully expressed, they were removed and replaced with a 0.019×0.025 Heat-ACTivated Nitinol archwires. The participants were asked at the beginning of their appointment if they would keep track of any pain and rate it after the wire was placed. The patients rated the pain felt when the 0.019×0.025 Heat-ACTivated Nitinol archwires were inserted into the SmartClip SL3 brackets. Surveys were given to 150 eligible patients. All patients that were surveyed had appointments from June 2012 to December 2012. They provided written consent for the study.

Each patient recorded their pain level experienced on a visual analog scale. The visual analog scale was a horizontal 10 cm line with “no pain” and “worst possible pain” at the other end. Numerical values were marked from 0 to 10, where 0 indicated no pain and 10 indicated the worst pain. With each increment of two numerical values were faces, where a happy face was used for no pain and sad face with tears for extreme pain. The patients filled out this survey after the 0.019×0.025 Heat-ACTivated Nitinol archwire was placed. Three responses were eliminated from the analysis, as the patients have made errors in completion of the form. Therefore, there are a total of 147 data points in this survey.

Results

The results from the 147 patients who participated in the study are shown in Table 1. The mean pain rating from the 147 patients was 1.86 out of 10. The mean pain rating for patients who only had lower archwires placed was 2.05, whereas the rating for patients that only had upper archwires placed was slightly lower at 1.64. The mean pain rating for patients that had both upper and lower archwires placed was close to the overall average at 1.88.

<table>
<thead>
<tr>
<th>Treatment Phase</th>
<th>Archwire</th>
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<tbody>
<tr>
<td>Initial Phase</td>
<td>Nitinol SE 0.014</td>
</tr>
<tr>
<td>Intermediate Phase I</td>
<td>Nitinol SE 0.014 with Nitinol SE 0.016 tandem</td>
</tr>
<tr>
<td>Intermediate Phase II</td>
<td>Nitinol HA 0.019×0.025</td>
</tr>
<tr>
<td>Finishing Phase</td>
<td>Beta III Titanium 0.019×0.025</td>
</tr>
</tbody>
</table>

Table 1: Typical archwire sequence for SmartClip™ SL3 Self-Ligating Brackets used at Palladium Orthodontics.
Approximately 86% of the patients experienced little to no pain during the insertion of the 0.019×0.025 Heat-Activated Nitinol archwire. Overall, no patients felt moderate to severe pain.

**Statistical Analysis**

Table 2 shows the different mean scores for each different arch group. A one-way analysis of variance (ANOVA) was conducted to see if there was a significant difference in mean pain scores between the different arches. The p-value for the 1479 data points was 0.561. Since the calculated p-value for the mean scores is greater than 0.05, this shows that there is no significant difference between the mean pain scores for the three different arches. To confirm this statement, the Tukey multiple comparison test was used. Each mean score was compared against each other to confirm whether there was a significant statistical difference between the mean values.

<table>
<thead>
<tr>
<th>Arch</th>
<th>Mean Pain Scores (SD)</th>
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<tbody>
<tr>
<td>Lower Arch Only</td>
<td>2.048 (1.161)</td>
</tr>
<tr>
<td>Upper Arch Only</td>
<td>1.640 (1.381)</td>
</tr>
<tr>
<td>Upper and Lower Arch</td>
<td>1.881 (1.321)</td>
</tr>
<tr>
<td>Overall Sample</td>
<td>1.864 (1.307)</td>
</tr>
</tbody>
</table>

*Table 2: Mean Pain Scores for given Arch/Arches where full sized 0.019×0.025 archwire was inserted.*

**Conclusion**

The SmartClip SL3 Self-Ligating Appliance System has been shown to comfortably engage large archwires after leveling and aligning the bracket slots. After use of tandem archwires for at least eight weeks as a means to level and align the bracket slots prior to transition to full-sized 19×25 Heat-Activated Nitinol wires, there was no reported discomfort resulting from insertion of the larger archwires by 86% of consecutively treated patients.

**References**


Additional information on the SmartClip SL3 Self-Ligating Appliance System can be found at 3MUnitek.com.
Dr. Mohammad Razavi received his dental training at Case Western Reserve University – DDS ('02), orthodontic certificate ('05), and MSD ('05).

Upon completion of his orthodontic training, he was invited to join the department as an assistant clinical professor, where he founded and directed the Skeletal Anchorage Clinic, and has integrated various TAD systems into the training program.

He served as the orthodontist for the Cleveland Browns, and is currently a member of the clinical staff at the University of Alberta.

Dr. Razavi is a diplomate of the American Board of Orthodontists, a Fellow of the Royal College of Dentists in Canada, and an ad hoc reviewer for the American Journal of Orthodontics, and the Journal of Clinical Orthodontics.

Dr. Razavi maintains a private practice in Ottawa, Canada.

Elements to Comfortable Treatment with SmartClip™ SL3 Self-Ligating Appliances:
Commentary from Dr. Mohammad Razavi

Since 2006, the fixed appliance (full treatment) bracket of choice in our office has exclusively been the SmartClip™ SL3 Self-Ligating Appliance System, in both the MBT™ Versatile+ Appliance System and VPO prescriptions, in the 0.022 slot size. The current archwire sequence has been utilized since 2008 and it has allowed for increased treatment efficiency as well as a comfortable and improved treatment experience for our patients.

A 0.014 Super-Elastic Nitinol archwire is used as the initial archwire and is generally in place from eight to 12 weeks based on the initial level of crowding and tooth rotations. Once this initial wire becomes passive, another 0.016 Super-Elastic Nitinol archwire is placed tandem to the initial 0.014 archwire. With the use of tandem wires, most rotations, leveling and alignment are corrected in the early stages of treatment. Tandem wires usually become passive in six to 12 weeks, at which time a 0.019×0.025 Heat-Activated Nitinol archwire is placed. Finally, a 0.019×0.025 Beta III Titanium archwire is used for the finishing stages of treatment.

The key to successful treatment results using any self-ligating appliance is allowing the archwires to fully express their effects. Orthodontists and their clinical team members often make the mistake of progressing to the next archwire prematurely, before the current wire is fully passive. Premature archwire changes can lead to patient discomfort, bond failure due to increased force applied to the bracket, and, specific to the SmartClip SL3 Self-Ligating Appliance, spontaneous clip disengagement.

Orthodontic practitioners often ask me how long each archwire should be left in place. As we can all appreciate, no two malocclusions are identical. In our experience, we have had the initial 0.014 Super-Elastic archwire in place anywhere from four to 15 weeks. These are variables that are determined by specific malocclusion, tooth position, and levels of rotation of teeth.

Equally important with the SmartClip SL3 Self-Ligating Appliance System is the use of tandem archwires. Prior to transition to large rectangular archwires, the orthodontic practitioner must ensure complete alignment and leveling of the bracket slots. To accomplish this task, we must completely fill the bracket slots; either by using tandem archwires, or by using a larger round archwire. In our earlier days of using the SmartClip SL3 Self-Ligating Appliance System, we employed a 0.0215 Super-Elastic as the second archwire. This proved at the time to be difficult to insert and extremely painful and uncomfortable for patients. The use of tandem wires has significantly improved the patient experience, and allows for efficient progression through our archwire sequence.