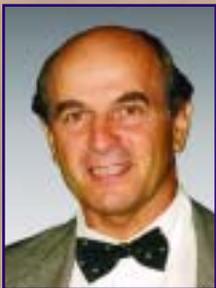


Orthodontic Perspectives

Clinical information for the orthodontic professional

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Winning Combinations



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• Message from the President

by Waldemar B. Sz wajkowski



As we design products and services for you, our aim is that these integrate seamlessly within themselves as well as into your practice. This integration should produce a system that is better than the sum of the individual parts or, in effect, be a winning combination for your practice.

We believe that among the most powerful winning combinations that work to your benefit are the cross-functional teams made up of motivated, hard-working employees that drive the success of 3M Unitek. You have been introduced to members of one of these teams, the 3M Unitek Management Operating Committee

(MOC), through their articles in each issue of the *Orthodontic Perspectives*.

To bring members of this important team even closer to you, my MOC colleagues and I have committed to spend much more time meeting with some of you in your practices. So do not be surprised if your sales representative contacts you to ask if this would be agreeable with you. We believe that this will allow us to gain further insights into how we can work more closely with you in order to give you the tools you need to improve the delivery of orthodontic care to the patient. We hope that you will take full advantage of these face-to-face opportunities to raise any issues that you believe are important for us to address in order to meet the expectations you have from 3M Unitek.

I want to bring to your attention two new alliances that 3M Unitek has recently entered. With Dolphin Imaging, we have a sales and marketing agreement that aligns us with the most respected imaging software in orthodontics. The joint development of Arnett/McLaughlin Interactive Treatment Analysis software in collaboration with Dr. G. William Arnett and Dr. Richard McLaughlin brings to your practice an analytical tool in case diagnosis and preparation for oral surgery that will be a winning combination for you and your oral surgeon. It is also a forerunner of future products to be offered as part of MBT™ Diagnostics.

With GeoDigm, our sales and marketing alliance brings you the eModel™ 3-D Digital Dental Model and ePlan™ Digital Treatment Planning, two services that allow easy storage, access and integration of virtual 3D models into your treatment planning and communication process with your patient. You will be hearing more about these new winning combinations from your sales representative and can find out more at the 3M Unitek, Dolphin Imaging and GeoDigm booths at the AAO meeting in Philadelphia.

Winning Combinations

by John Sanker, National Sales Manager



When I think about the theme of this edition of *Orthodontic Perspectives*, “Winning Combinations”, I automatically reflect on the winning team we have at 3M Unitek. From our innovative Research and Development department, whose mission is to create products that make the lives of the Orthodontists easier, to our state of the art manufacturing facility, and our creative marketing team. In short, winning combinations means teamwork. With that said, I would like to point out another winning combination/team which is our Sales Dept./GSSO (Global Sales Service Organization) & you, the Orthodontic practitioner.

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• Clinical Application and Effects of the Forsus™ Spring

A Study of a New Herbst Hybrid

by Nina Heinig, D.D.S. and Gernot R. Göz, M.D., D.M.D. D.D.S.



Dr. Nina Heinig received her dental degree from the University of Tübingen in Germany in 1995. In the next four years she received her orthodontic training both in a private orthodontic office and at the University. Since 2000 she has been in full time private practice of orthodontics in Wendlingen, Germany.



Dr. Gernot R. Göz is Sr. Professor and Head of the Department of Orthodontics and Dentofacial Orthopedics and Cleft Center, and Dean of the Dental School at Eberhard-Karls-University Tübingen, Germany. His numerous publications include works in German textbooks and National and International Journals on epidemiology, biology of tooth movement and clinical results.

Abstract

Background:

The best known of the fixed functional appliances are the Herbst appliance and the Jasper Jumper™. The Forsus™ spring [Forsus™ Nitinol Flat Spring] is a new development which has been tested in a clinical study to establish when it can be used and to compare it with its predecessors.

Patients and Method:

The Forsus™ spring was used over a period of 4 months to treat 13 patients with an average age of 14.2 years with Class II malocclusion.

Results:

Evaluation of the lateral cephalograms showed that dental effects accounted for 66% of the sagittal correction. The sagittal occlusal relations were improved by approximately 3/4 of a cusp width to the mesial on both the right and left side as a result of distal movement of the upper molars and mesial movement of the lower molars. Retrusion of the upper and protrusion of the lower incisors reduced the overjet by 4.6 mm. Intrusion and protrusion of the lower incisors reduced the overbite by 1.2 mm. The occlusal plane was rotated by 4.2° in clockwise direction as a result of intruding the lower incisors and the upper molars. The maxillary and mandibular arches were expanded at the front and rear during treatment. – Evaluation of a questionnaire filled in by the patients after 2 months of treatment showed that approximately half of them had experienced difficulties in brushing their teeth. The main problem, however, was the restriction experienced in the ability to yawn. Overall, two thirds of the adolescents found the Forsus™ spring better than the appliance previously used to correct their Class II malocclusion, such as headgear, activator or Class II elastics.

Conclusion:

The Forsus™ spring has stood the test in clinical application. It is a good supplement to the Class II appliance systems already available.

Introduction

A fixed functional appliance can save both time and trouble. The appliance is effective 24 hours a day without being dependent on patient compliance. This is of particular interest in the case of non-motivated, non-compliant adolescents or of handicapped patients. This treatment effectively shortens the duration of therapy, and ideal use can be made of the remaining growth of a patient beyond the pubertal growth spurt [13].

The fixed appliance is of minimal disturbance to the wearer since almost all oral functions are still possible. The only disadvantage is the limited mouth opening. Furthermore, the musculature is subject to both isometric and isotonic strains [19].

The first fixed functional appliance, still in use today, was developed as long ago as 1909 by Emil Herbst [8]. However, it was not until about 1970 that Hans Pancherz, amongst others, re-introduced the Herbst appliance and set it on its way to success. The original technique is not particularly comfortable for the patient, however, since the appliance is stiff and non-flexible, making chewing and tooth cleaning difficult. In addition, fitting it is complicated and both time- and cost-intensive [9, 10].

In 1987 James J. Jasper developed and patented the so-called Jasper Jumper™, a flexible helical compression spring in a gray plastic cover which is positioned between the upper and lower jaw during fixed orthodontic treatment.

The force module is rather large so that it is often possible to see the cheeks bulging in patients wearing the appliance [19]. A practical problem occurring with this device for Class II correction is the breakage rate of ca. 10% [20]. Endcaps with an eyelet are soldered onto the ends of the compression springs to attach them to the archwire of the existing multibracket appliances. These solder points form weak points which break easily under strain. The material in the Jasper Jumper™ often fatigues after about 3 months and new springs have to be inserted to guarantee continued forward positioning of the lower jaw [22]. Furthermore, the plastic is susceptible to colonization by plaque and bacteria, which causes the Jasper Jumper™ to become porous and its color to fade [19].

The American orthodontist Bill Vogt from Philadelphia has made a new development in the fixed Class II appliance systems with his Forsus™ spring (Figure 1). This comprises a 0.5 x 3.0 mm spring bar (45% nickel, 55% titanium) with a transparent plastic coating. Via its bent ends the spring can be attached to bands and archwires of the previously placed fixed orthodontic appliances.

The Forsus™ spring is supplied in four different lengths: 28 mm, 31 mm, 34 mm and 37 mm, in each case for right and left fitting. Measurements are made in habitual occlusion mesially from the headgear tube of the upper first molar distally to the bracket of the lower canine. 12 mm is added to this measurement (4 mm play, 4 mm headgear tube, 4 mm activation) and this gives the length of the module to be used.

Attachment is as for the Jasper Jumper™. A ball pin serves to attach it to the maxillary headgear tube. A bayonet bend is placed in the mandibular arch distal to the canine bracket and a ball stop is pushed onto it to form a stop for the Forsus™ spring. The ball pin and ball stop are both made of stainless steel. The bracket on the lower first premolar is removed so that the spring can slide along the whole archwire. Alternatively, a bypass sectional archwire can also be used for this purpose [15].

The Forsus™ spring keeps the mandible permanently in a forward position.

The purpose of this study was to clarify what changes can be identified on the lateral cephalograms and on the plaster models after the Forsus™ spring has been worn for 4 months, and what clinical problems arise during this time. Experience shows that this period is adequate for correction to be achieved and that there are as yet no significant effects of changes due to growth.

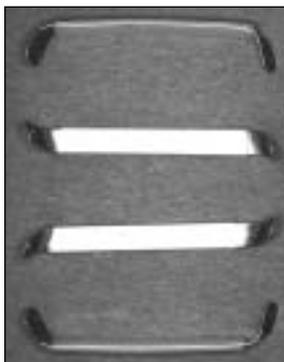


Figure 1: Forsus™ springs for right and left side.

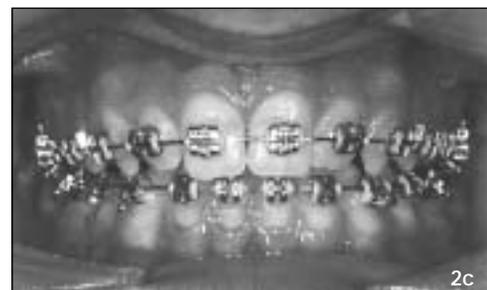
Patients and Methods

13 patients (five females, eight males) with Class II malocclusion were treated with a Forsus™ spring. The average age at insertion of the appliance was 14.2 years. The oldest patient was exactly 17 years old, and the youngest 12 years and 6 months. All patients were growing during the treatment; this was confirmed by hand-wrist radiographs.

Either the patients had already had their teeth straightened using a multibracket appliance up to 0.019 x 0.025 continuous archwire or the appliance was used passively with a heavy square archwire (in four cases). The Forsus™ spring was attached in the lower jaw to a 0.021 x 0.025 continuous archwire.

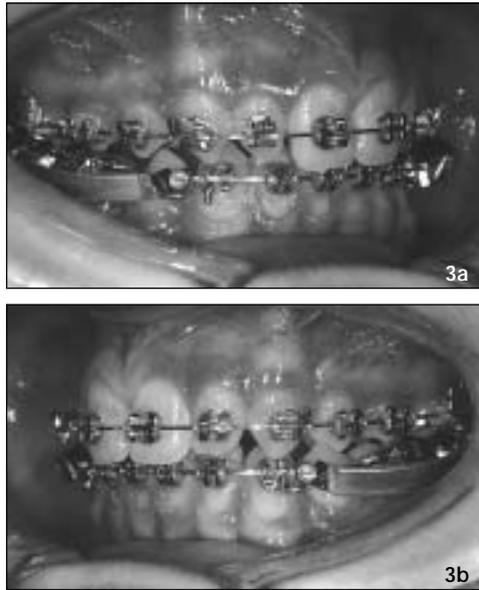
Dental casts, photographs and a lateral cephalogram were taken before the Forsus™ spring was inserted (Figures 2a to 2d).

Figures 2a to 2d:
2a) Patient before treatment.
2b, 2c, 2d) Intraoral situation before insertion of the Forsus™ spring.



The appliance was checked after 1 month and adjusted if necessary (Figures 3a and 3b).

Figures 3a and 3b: Forsus™ spring in situ.



After 2 months the patients were asked to fill in a questionnaire in which they were asked about problems they might have had with eating, yawning or cleaning their teeth, for example.

The appliance was removed after 4 months. Final plaster casts, photographs and lateral cephalograms were then taken (Figures 4a to 4d and 5).

Analysis of the Lateral Cephalograms

The sagittal skeletal and dental changes occurring during treatment were analyzed with reference to the lateral cephalograms taken before and after the Forsus™ spring was inserted. The lateral cephalograms were evaluated by one person at two different times, with a mean being formed from the two measurements. The mean of any double contours was determined. In each case measurements were made to the nearest 0.5° or 0.5 mm.

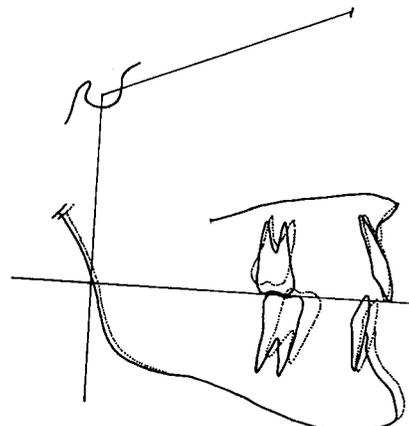
Metric analysis was carried out with reference to Pancherz [12], with all registrations being measured to the reference line OLp. The occlusal line OL is defined by the incisal point of the upper central incisor and the distobuccal cusp of the upper first molar. The perpendicular to OL through the sella point defines the OLp (occlusal line perpendicular). The occlusal line OL, the perpendicular OLp, and the sella-nasion line SNL of the cephalogram before treatment with the spring serve as the reference lines for evaluation of the post-treatment cephalogram.

Figures 4a to 4d:
4a) Patient after treatment.
4b, 4c, 4d) Intraoral situation after 4 months.



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Figure 5: Superimposed cephalometric tracings from the same patient before and after treatment: _____ before, after (because of the congenital absence of 35, 45 the treatment objective is mesioocclusion of the molars).



The measuring points used are defined as follows:

- ss/OLp = position of the maxillary bony base,
- pg/OLp = position of the mandibular bony base,
- is/OLp = position of the maxillary central incisor,
- ii/OLp = position of the mandibular central incisor,
- ms/OLp = position of the maxillary first molar,
- mi/OLp = position of the mandibular first molar,
- ar/OLp = position of the condyles,
- is/OLp minus ii/OLp = overjet,
- ms/OLp minus mi/OLp = molar relation (positive value = distal relation, negative value = normal or mesial relation),
- is/OLp minus ss/OLp = movement of is within the maxilla,
- ii/OLp minus pg/OLp = movement of ii within the mandible,
- ms/OLp minus ss/OLp = movement of ms within the maxilla,
- mi/OLp minus pg/OLp = movement of mi within the mandible,
- pg/OLp plus ar/OLp = length of the mandible.

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Besides the linear analysis, the following angles were also measured: SNA, SNB and ANB, SN-MeGo, SN-OcP (SN-occlusal plane), angle of inclination, basal plane angle, Y-axis, facial height ratio, index, U1-SN, and L1-MeGo.

Analysis of the Dental Casts

Analysis of the casts was confined to measurement of anterior and posterior arch widths (AAW and PAW) in the upper and lower jaws, malrelationship at the first molars and at the right and left canines in premolar widths, and of overjet and overbite.

Analysis of the Questionnaire

The individual questions were sorted as percentages of yes/no responses.

Method Error and Statistical Evaluation

The method error in the double measurements was calculated according to the formula

$$\pm \sqrt{\frac{\sum d^2}{2n}}$$

where d = difference between first and second measurements and n = number of double evaluations. The method error varied between $\pm 0.17^\circ$ and $\pm 0.62^\circ$ for angle measurements and between ± 0.22 mm and ± 0.39 mm for length measurements. The normal distribution was verified with the Shapiro-Wilk test. The statistical method used was the t-test for paired values. The significance level was set at $p < 0.05$. Statistical deviations are marked with an asterisk (*).

Results

Analysis of the Lateral Cephalograms

The angular and linear measurements determined before and after treatment are shown in Table 1 together with the differences.

The SNA angle remained virtually constant during treatment with the Forsus™ spring. The SNB angle increased by approximately 0.5° , while the ANB angle decreased. The SN-MeGo angle, the angle of inclination, the basal plane angle, the Y-axis, the facial height ratio, and the index remained largely unchanged despite the treatment. However, the change in the occlusal plane was notable, showing a 4.2° rotation measured at the anterior cranial base, in terms of a bite opening. During the treatment the upper anterior segment was retruded by 5.3° and the lower anterior segment was protruded by 9.6° . The change in both the occlusal plane and the upper and lower anterior segments was statistically significant.

Table 1: Angular and linear variables measured on the lateral cephalogram before and after treatment, and changes occurring during the treatment period with the Forsus™ spring (* $p < 0.05$).

	Before	After	Difference
SNA	80.88°	81.00°	+0.12°
SNB	76.21°	76.75°	+0.54° (*)
ANB	4.67°	4.25°	-0.42°
SN-MeGo	32.21°	32.06°	-0.15°
SN-OcP	15.81°	19.98°	+4.17° (*)
Angle of inclination	6.58°	6.56°	-0.02°
Basal plane angle	25.48°	25.52°	+0.04°
Y-axis	68.12°	67.98°	-0.13°
Facial height ratio	66.45%	66.41%	-0.04%
Index	79.09%	79.26%	+0.17%
U1-SN	101.88°	96.56°	-5.33° (*)
L1-MeGo	95.81°	105.41°	+9.60° (*)
ss	77.62 mm	77.94 mm	+0.32 mm
Pg	78.60 mm	80.04 mm	+1.44 mm (*)
ar	11.38 mm	11.12 mm	-0.27 mm
Is	83.46 mm	82.02 mm	-1.44 mm (*)
Ii	77.38 mm	80.65 mm	+3.27 mm (*)
Ms	54.83 mm	54.04 mm	-0.79 mm (*)
mi	53.65 mm	56.77 mm	+3.11 mm (*)
Is-ii	6.08 mm	1.37 mm	-4.71 mm
Ms-mi	1.18 mm	-2.73 mm	-3.91 mm
Is-ss	5.84 mm	4.08 mm	-1.76 mm
ii-pg	-1.22 mm	0.61 mm	+1.83 mm
Ms-ss	-22.79 mm	-23.90 mm	-1.11 mm
mi-pg	-24.95 mm	-23.27 mm	+1.68 mm
Pg+ar	89.98 mm	91.16 mm	+1.18 mm

Linear analysis according to Pancherz showed minor changes in the skeletal values of the maxilla, which increased by 0.3 mm, and of the condyle, which decreased by 0.2 mm. In the mandible, a statistically significant forward shift of the pogonion point by 1.4 mm was recorded. When the forward movement of the condyle out of the glenoid fossa is taken into account, this distance was effectively 1.2 mm.

The upper incisors were retruded by an absolute distance of 1.4 mm, or 1.7 mm in relation to the developmental increase in the length of the upper jaw. The upper molars drifted distally by an absolute distance of 0.8 mm, i.e. a relative distance of 1.1 mm. The lower incisors were protruded by 3.3 mm in absolute terms, but only by 1.8 mm relative to the development of the lower jaw. The lower molars drifted mesially by an absolute distance of 3.1 mm, i.e. 1.7 mm in relative terms. The overjet was reduced by 4.7 mm, and the molar relationship was improved by 3.9 mm. The changes in measurements of the mandible, the upper incisors and molars, and the lower incisors and molars were statistically significant.

Analysis of the Dental Casts

Table 2 shows the results of the measurements before and after treatment together with the changes achieved by treatment with the Forsus™ spring.

The upper and lower dental arches broadened during treatment with the Forsus™ spring, this effect being more apparent in the upper jaw with 2.2 mm anteriorly and 2.5 mm posteriorly. The lower jaw broadened by 0.6 mm anteriorly and 1.2 mm posteriorly. This broadening of the dental arch was statistically significant.

The sagittal occlusion relations were corrected to the mesial by 0.70 premolar width on the right and by 0.74 premolar width on the left, corresponding to a forward movement of almost 3/4 (= 0.75) premolar width on each side.

The overjet was reduced by 4.6 mm, and the overbite by 1.2 mm.

Table 2: Measurements taken from dental casts before and after treatment, and changes occurring during treatment with the Forsus™ spring (*p < 0.05).

	Before	After	Difference
UJ ATW	37.19 mm	39.42 mm	+2.23 mm
UJ PTW	46.77 mm	49.31 mm	+2.54 mm (*)
LJ ATW	36.92 mm	37.50 mm	+0.58 mm (*)
LJ PTW	47.15 mm	48.35 mm	+1.19 mm (*)
Malocclusion right	0.60 prem. width	-0.10 prem. width	-0.70 prem. width
Malocclusion left	0.62 prem. width	-0.11 prem. width	-0.74 prem. width
Overjet	5.42 mm	0.81 mm	-4.62 mm
Overbite	1.35 mm	0.15 mm	-1.19 mm

Analysis of the Questionnaire

The percentage distribution of the yes/no responses are shown in Table 3.

The patients reported no pain in the teeth or temporomandibular joint during treatment with the Forsus™ spring. Nor were any sleep disturbances reported. Eating and speech problems were only minor. The limited mouth opening was perceived as somewhat disturbing, as was the changed appearance. Some patients complained of pain on the inside of their cheeks. Approximately half of them reported difficulty in cleaning their teeth. However, the main problem for the probands was the interference with yawning.

Overall, two-thirds of the adolescents found the Forsus™ spring better than the appliance previously used to correct their Class II malocclusion, e.g. headgear, activator or Class II elastics.

Table 3: Percentage distribution of yes/no responses in the analysis of the questionnaire.

	Yes	No
Problems with eating?	8%	92%
With speaking?	8%	92%
Opening your mouth?	38%	62%
When yawning?	62%	38%
Pain in your teeth?	-	100%
In the jaw joint?	-	100%
On the inside of your cheek?	38%	62%
Problems cleaning your teeth?	46%	54%
With sleeping?	-	100%
With your appearance?	38%	62%
Is this appliance better than your previous one?	69%	31%

Discussion

In Central Europe, distocclusion has an incidence of approximately 37% and is thus the most frequently occurring malocclusion to be treated. Retrognathia of the lower jaw is recorded in most cases.

Headgear and functional orthodontic appliances are valuable means of treating sagittal discrepancies between the upper and lower jaws [1, 5, 10, 24].

Fixed appliances are welcome aids when patient compliance is declining. They can be used to treat dental or skeletal Class II malocclusions, with or without extraction therapy. The only contraindication cited to date has been a predisposition to root resorption [3]. The different effects of the various fixed Class II appliances have been widely described in the literature. The most popular appliances are the Herbst appliance and the Jasper Jumper™.

Table 4 summarizes the dental and skeletal changes reported in the literature relating to these two appliances. In this context, the various publications show only very generalized agreement, and there are many reasons for the disparate results. There was a broad variation in the age and gender of probands; sample numbers were small, so that atypical results had a heavy weighting; the appliances were left in situ for varying lengths of time, and various techniques were employed for evaluation and analysis. There may have been difficulties in reproducing the reference points. Even when all these factors are accurately selected and corrected, the individuality of the patient in terms of reaction to treatment and growth spurts remains as an unknown quantity [1, 5, 10].

During treatment with the Forsus™ spring the maxilla undergoes a minimal increase in length anteriorly (SNA and ss), i.e. the forward development is not fully blocked. Publications on the Herbst appliance all mention inhibition of maxillary growth [3, 10, 13]. Restraint of maxillary growth is mentioned in some publications on the Jasper Jumper™ [3, 4] but not in others [20, 24].

If the upper jaw is assumed to be displaced anteriorly in children with Class II malocclusion in the absence of orthodontic intervention [6], then all Class II appliance systems appear to exert some degree of growth inhibition on the upper jaw, even if this is confined to reduced forward growth. In addition, the A point and ss point are poor skeletal landmarks since they are influenced by the dentition [1]. A retrusion of the upper incisors with labial tipping of the roots can shift the A point so far forward as to mask the real effect of the backward displacement of the maxilla.

The results of this study (U1-SN, is) as well as those of all Herbst and Jasper Jumper™ studies [3, 4, 11, 20–22, 24] show that the upper incisor segment is changed in this way as a result of the treatment. Consolidation of all teeth in the maxillary arch by

Table 4: Compilation of changes observed in other studies after treatment with the Herbst appliance or the Jasper Jumper™: [7, 11, 12, 16, 18, 23] for the Herbst appliance and [4, 20, 21, 24] for the Jasper Jumper™.

Angular measurements	Herbst	Jasper Jumper™
SNA	−0.4° to −0.6°	−0.6° to −0.8°
SNB	+0.9° to +1.4°	+0.3° to +1.2°
ANB	−1.3° to −2.5°	−1.0° to −2.0°
SN-MeGo	−0.2° to +0.7°	−0.3° to −1.2°
SN-OcP	+1.1° to +2.8°	+2.4° to +3.2°
Angle of inclination	+0.5° to +0.8°	+0.2° to +0.5°
Basal plane angle	−0.9° to +0.2°	−0.6° to −1.5°
U1–SN	−6.6° to −6.8°	−5.8° to −6.0°
L1-MeGo	+2.5° to +9.5°	+4.2° to +7.9°
Linear measurements		
ss	+0.2 mm to +0.8 mm	−0.1 mm to +0.5 mm
Pg	+1.9 mm to +4.3 mm	+1.4 mm to +2.2 mm
Is	−1.5 mm to −2.4 mm	−0.6 mm to −2.5 mm
ii	+2.8 mm to +6.0 mm	+2.9 mm to +3.1 mm
Ms	−1.3 mm to −2.9 mm	−0.9 mm to −1.5 mm
Mi	+2.1 mm to +5.1 mm	+2.6 mm to +3.7 mm
Ar	−0.3 mm to +0.1 mm	0.0 mm to −0.4 mm
Is-ii	−3.1 mm to −9.8 mm	−4.1 mm to −5.2 mm
Ms-mi	−5.7 mm to −9.3 mm	−3.4 mm to −5.0 mm
Is-ss	−0.5 mm to −3.3 mm	−1.5 mm to −2.4 mm
ii-pg	+0.5 mm to +3.4 mm	+0.8 mm to +1.5 mm
Ms-ss	−1.5 mm to −3.0 mm	−1.0 mm to −1.4 mm
mi-pg	+0.2 mm to +2.5 mm	+1.2 mm to +1.6 mm
Pg+ar	+2.0 mm to +4.0 mm	+1.4 mm to +1.7 mm

means of a multibracket appliance into one unit shifts the point of force application downwards and backwards with respect to the unit's center of resistance. That is why both the incisors and the molars tip distally during treatment with these Class II appliance systems [3].

In the present investigation and in the Herbst [10, 11] and Jasper Jumper™ studies [2–4, 9, 20–22, 24], the upper molars are also subjected to force in distal direction. Without treatment they would drift slightly to mesial [6, 24]. The headgear effect of these types of Class II devices is thus also confirmed for the Forsus™ spring.

During treatment with the Forsus™ spring the mandible shifts to anterior (SNB). Since the mandible grows more in forward direction than the maxilla, the jaw relationship is improved. In children with untreated Class II malocclusion, on the other hand, the ANB angle would remain unchanged despite minimal increases in the SNA and SNB angles [6].

The effective increase in mandibular length (pg) was 1.2 mm. All Herbst appliance studies report a clinically significant increase in the length of the mandible [1, 3, 10, 11, 13, 17, 18].

Any increase in mandibular length is due to a remodeling process in the glenoid fossa, as demonstrated in animal experiments [25]. Observations during treatment of condyle fractures or during anterior positioning of the mandible in cases with articular disk displacement illustrate that the temporomandibular joint is still subject to remodeling processes after growth has ceased [18].

Forward displacement of the mandible leads to elongation of the muscle fibers and tendons. The pull of the muscle attachments at the bone surface is intensified by the modified function and induces bone remodeling processes. For example, stimulation of the lateral pterygoid muscle increases cell proliferation at the condyle. Through simultaneous adaptive bone deposition in the posterior area of the glenoid fossa and bone resorption in the anterior area, the glenoid fossa is relocated in forward and downward direction, ultimately resulting in an improved jaw relationship [3, 11, 13, 14, 17, 25]. The space created by condyle displacement is filled through fibrous proliferation of the posterior part of the articular disc so that the condyle is kept in its forward position [3, 25].

Recent Herbst appliance studies have shown that treatment with fixed functional Class II devices does not cause pathologic changes in the temporomandibular joint [17]. The older the patient to be treated, the less the condyle is subject to remodeling through forward displacement of the mandible and the more the correction is due to dentoalveolar changes. Treatment is most successful when carried out at the end of the growth period [4, 18].

There is some disparity in the results of studies on the Jasper Jumper™ with regard to the mandibular effect. Some authors report an effect on the mandible [20, 22] whilst others do not [3, 4].

One notable feature was the marked protrusion of the lower incisors (L1-MeGo, ii). This is hardly surprising, since the force vector of a spring on a continuous mandibular arch is slightly above the center of resistance at the level of the clinical crown, resulting in increased protrusion of the incisors. If the Forsus™ spring is used on a sectional arch, the line of force is directed more vertically and is thus likely to be more beneficial for the lower incisors [19]. Protrusion of the lower incisors was observed in all studies [2–4, 10, 11, 20–22, 24].

In the present investigation, the lower molars drifted to mesial (mi). Publications on the Herbst appliance [3, 10, 11] and the Jasper Jumper™ [2–4, 9, 21, 24] report the same results. Without treatment the lower molars would drift only very slightly to mesial [6, 24].

In this study, the SN-MeGo angle, the angle of inclination, the basal plane angle, the Y-axis, the facial height ratio and the index underwent changes only in the range of -0.2° to $+0.2^\circ$. Since the measuring error in angle measurements in the lateral cephalogram may be up to 1° [1], treatment with the Forsus™ spring obviously has no major impact on these angles and relationships.

In children with untreated Class II malocclusion, the SN-MeGo angle, the basal plane angle and the index remain almost constant during growth [1]. Some publications report a rotation of the mandible in terms of a bite opening in association with the Jasper Jumper™ [3, 22] but others fail to confirm this [4, 12]. All Class II studies report virtually no change in the angle of inclination [1]. Since the fixed functional Class II appliances exert their effect approximately along the Y-axis, the value of the Y-axis remains constant [2, 9, 20, 21].

Some studies report an increase in lower facial height with both the Herbst appliance [10] and the Jasper Jumper™ [3].

In our study there was noticeable tipping of the occlusal plane which, measured at the anterior cranial base, underwent a rotation in terms of a bite opening. This opening movement is dentally induced. The pushing effect of the spring on the upper molars and on the lower incisors intrudes these teeth [2–4, 10, 11, 20–22, 24] with consequent tipping of the occlusal plane. This was also reported in studies on the Herbst appliance [3] and the Jasper Jumper™ [2–4, 9, 20, 22].

In the present study 33% of the reduction in overjet was skeletally (ss plus pg) and 66% dentally induced (is-ss plus ii-pg). The improvement in molar relationship was 39% due to skeletal changes (ss plus pg) and 61% due to dental movements (ms-ss plus mi-pg). The correction of the malocclusion was thus due mainly to dentoalveolar effects in the upper and lower jaws and, to a lesser extent, to the altered position of the mandible.

Depending on the study, the changes in occlusion achieved with the Herbst appliance are induced to between 30% and 60% by skeletal effects (ss plus pg) and to between 40% and 70% by dental effects [10–12, 14, 16, 18, 23]. In the case of the Jasper Jumper™ the skeletal component is between 40% and 50%, and the dental component between 50% and 60% [4, 20–22, 24].

During treatment with the Forsus™ spring the upper dental arch is expanded. The lower arch is also expanded as a result of interdigitation with the upper jaw. This effect has also been reported for the Herbst appliance [3] and the Jasper Jumper™ [2, 9]. Since the broadening also occurs in patients with a passively acting multibracket appliance, it cannot be the cause of the expansion. If no broadening of the dental arch is desired, then a transpalatal arch must be inserted.

Distocclusion and enlarged overjet were improved considerably within a short time with the Forsus™ spring. Force modules inserted unilaterally to improve a midline displacement also showed good results. It cannot be stated at present whether the appliance can also be used to treat mesiocclusion, like the Jasper Jumper™, for example [15].

The overbite was decreased by 1.2 mm, which can be ascribed to the intrusion and protrusion of the lower incisors [24]. This is a beneficial effect in the treatment of deep bites.

The responses to our questionnaire indicated that the patients coped well with the inserted appliance. It is important to brief patients on potential problems beforehand. For example, mouth opening is slightly limited by the appliance, which may lead to problems when eating, speaking or cleaning the teeth, and the appearance may be altered as a result of the cheeks bulging.

If a patient complains of pain on the inside of the cheek, this is generally due to the spring being too firmly tensioned so that the metal cuts into the mucosa. This can usually be readily relieved by reducing the tension on the spring.

The main problem experienced by the patients was with yawning. In this study the force module for Class II correction was inserted on a continuous archwire in the lower jaw. A segmental archwire would have provided a longer sliding path, allowing the mouth to be opened wider [2, 19].

Overall, two-thirds of the adolescents preferred the Forsus™ spring to the appliance used previously for treatment of their Class II malocclusion, such as headgear or intermaxillary elastics.

Conclusion

The Forsus™ spring provides an alternative to other fixed functional Class II appliance systems. Together with dental effects, the mandibular displacement achieved leads to an improvement in sagittal discrepancy. The Forsus™ spring can be used to improve distocclusion and excessive overjet, irrespective of patient compliance. ■

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• Clinical Trial Report: Forsus™ Fatigue Resistant Device

by Dennis G. Dionne, D.D.S., Certified Orthodontist



Dr. Dennis G. Dionne is a 1995 graduate of the Oregon Health Sciences University. He maintains an active solo practice in Windsor, Ontario, Canada, where he resides with his wife Carolyn and his two children.

“Forsus™” – the word conjures images of an exotic resort island, or a high-performance Italian sports car. 3M Unitek uses the word to refer to something a trifle different, its new Class II fixed corrector. Nonetheless, as we shall see, the Forsus™ Fatigue Resistant Device is well-designed, elegant, easy and fun to use – just like that Italian sports car. Let’s first look at how and why this product arose.

Every orthodontist faces the day-to-day dilemma of how to manage mild to moderate dental Class II malocclusions. I am sure we have all used a range of force delivery systems, the majority of which supply distalizing force to the maxillary dentition and a mesial force to the mandibular dentition. I would venture that it is a safe guess to say that most orthodontists today use intraoral elastics, especially Class II elastics, as their primary means of correction of these problems. They move on to fixed correctors when it appears that compliance with elastics is not forthcoming. After all, elastics are inexpensive, fairly unobtrusive, and they in general work *when worn*.

The simple truth is that all of us are, at times, surprised when patients return and they have actually worn their prescribed elastics, and we see that they have corrected or over-corrected the Class II condition. The more usual encounter has the patient swearing they have worn their elastics, “*well, not ALL of the time*”, but at least between the time when they brush their teeth at night before bed, and when their head hits the pillow....., because, like, the elastics are so “*ickey*”.

There are a few ways to handle this circumstance. We can throw up our hands and say ‘oh well, the patient won’t cooperate’ and leave the Class II condition untreated/uncorrected (not my preferred approach, but one perhaps with some merit). We can threaten and actually carry out the removal of upper bicuspid. We can plead/beg/grovel for more elastic wear. We can use a so-called non-compliance approach, wherein we affix an appliance intra-orally that is working (in theory) 24 hours a day, 7 days a

week to get our needed correction. Those who have used any of the multitude of correctors available on the market inevitably find that a) they are expensive b) they frequently break and c) they are a pain to install clinically. Which brings us to today’s answer, the Forsus Fatigue Resistant Device.

As a young orthodontist, I am constantly ‘trying out’ the multitude of appliances available for non-compliance Class II correction. And I did indeed discover that the above listed problems were evident in virtually all products on the market. Frustration ensued. Then I was asked to participate in the clinical trials for the Forsus Fatigue Resistant Device (FRD) and eagerly accepted, hoping that at day’s end we would have built a better mousetrap.

The Forsus FRD is essentially a synthesis of numerous predecessors, incorporating (but not copying in any way) elements of Herbst, Jasper Jumper™, and Bite Fixer design, to create a distillate that is familiar and yet new. The hurdles to overcome were breakage, force-degradation over time, and ease of installation at the chair. Cost should also not be prohibitive.

The initial product introduced was designed with attachment to maxillary arch via the headgear tube. There were three variations in attachment to the mandibular dentition.

One could, if an auxiliary tube was available on the lower molar, use a bypass auxiliary archwire segment.



One could remove the lower archwire a la Jasper Jumper, attach an attachment 'loop', and then affix the corrector.*



Lastly, one could simply attach a direct push rod directly to the archwire, without removing the archwire. We tried all of these and quickly found that the easiest, most easily delegated, predictable means of attachment was the direct push rod.



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With minimal training, an auxiliary can easily place a Forsus FRD, and better yet, the incidence of breakage in my experience is remarkably low. In fact, usually it is not the Forsus FRD that breaks, it is a band/bracket that is loose. And most often, when we dig a bit, we find that kick-boxing was somehow involved.

What are the advantages of the Forsus Fatigue Resistant Device, and how do we use it? As always, case selection is important. Do something else for your severe skeletal/dental Class II problems, and reserve the Forsus FRD for your garden-variety mild/moderate Class II dental problems. We usually give these patients one or two appointment intervals to demonstrate compliance with conventional intra-oral elastics. If they do, great, and we continue. If not, we immediately go to Forsus FRD's, either unilaterally or bilaterally, as needed.

The huge advantage of the Forsus Fatigue Resistant Device is its predictability. In moderate Class II molar relationships, we can fairly accurately say that in 2-3 appointments (12-18 weeks in my office), the cuspid relationship will be corrected to Class I.



Original OJ=8mm, correction after 15 weeks using the Forsus™ FRD (FRD disassembled for photo)

We usually over-correct to a degree, to account for the inevitable relapse potential. In fact, I found Forsus FRD's to be so predictable that I am debating whether or not to just bypass elastics altogether and go directly to Forsus FRD's in my dentally Class II patients. There is a cost to be sure, but if I can finish earlier and save visits, then I am ahead economically, with more predictable clinical outcomes to boot.

So is there a downside? Not really, but there are things to be aware of. First, you need a molar band/headgear tube on at least your upper first molars. We had moved away from banding upper molars a bit, but I find I routinely do it now, in anticipation of using a Forsus FRD.

Second, size is an important matter in the selection of the appropriate push rod used with the FRD spring. If the push rod is too long, there is an increased chance of breakage. You must allow for some compressibility of the spring when the patient is in the closed mouth position. If not, the appliance becomes Herbst-like, and you can count on rebonding your lower cuspid brackets.

Third, I would recommend ligating, as a group, the lower 6-5-4-3 block of teeth, or the constant force of the Forsus FRD on the lower cuspid will cause a space to open distal to the lower cuspid.



We often use the Forsus FRD as a complement to other Class II correction approaches, e.g. we will use a Pendex™ or Distal Jet™ appliance to distalize molars, then maintain our distalization with a FRD while we distalize/retract the other buccal dental units. It works great in this capacity.

In closing, I will say that you owe it to yourself and your staff to try a Forsus Fatigue Resistant Device. It is very easy to delegate, robust in clinical usage, predictable in clinical outcome. Much like the relentless cyborg in the movies, IT JUST WILL NOT STOP until its mission is accomplished. That, my friends, is one soldier you deserve to have on your side. ■

* currently in testing

• Forsus™ Fatigue Resistant Device: Fatigue Resistant by Design

by Jim Cleary and Bill Wyllie, 3M Unitek



Jim Cleary is a Senior Product Development Engineer, and has been with 3M Unitek for nearly 20 years. He is an inventor on 28 issued U.S. patents.



Bill Wyllie is a Materials Engineering Specialist in 3M Unitek Research and Development. He received his Ph.D. in Materials Engineering from Rensselaer Polytechnic Institute in 1996. He is an active member of ASM International – The Materials Information Society and has been with 3M Unitek since 1997.

The advantages of intra-oral, inter-arch Class II correction devices have prompted a number of new entries in that market. These active, compression devices are more acceptable to patients than external headgear, and require no patient cooperation to achieve treatment results. Since they operate in a pushing mode, these correctors unload when the patient's jaw opens. This mode is in contrast with Class II elastics or extension springs, which load in tension upon jaw opening, producing extrusive forces at their terminal ends. The resultant forces of the compression devices are intrusive rather than extrusive, and the force vectors on the upper molars are favorable to anchorage.

When 3M Unitek began to analyze in earnest, and later develop, such devices, two major problems also became evident.

- 1) Enough travel must be provided in the device, or freedom in its attachment, to allow full jaw opening.
- 2) Loading and unloading cycles from jaw movement over time caused fatigue failure in these devices before treatment goals were achieved. A device was desired that could withstand a million cycles. This was based on an estimated 300,000 to 500,000 cycles during class II treatment, with a safety factor of 2 applied.

Among the parallel development efforts at 3M Unitek was an active spring Class II corrector designed to provide the desired advantages and eliminate the two major problems of limited travel and fatigue. A compression spring was combined with a three part telescoping assembly to provide adequate opening travel. As the spring unloads, it extends the telescoping tube assembly, allowing easy interchange of the innermost third element (the push rod) for sizing variation. The issue of fatigue fracture was addressed in the spring design.

By definition, fatigue failure is a fracture caused by repeated application of stress that is less than the breaking stress (ultimate strength) of the material. Although the working stress is less than the breaking stress, cracks initiate along the outer surface and grow with increasing cycles. When the remaining material can no longer support the localized load, the wire fractures. To obtain long fatigue life in a dynamic spring application, the spring's working stress must be kept low. For engineering alloys used in springs, guidelines for working stresses for different service lifetimes are available in handbooks [*Machinery's Handbook, 21st Ed.*, 1980, Industrial Press, Inc., New York, NY 10016, pp. 494 –512].

Compression spring design is a mature science. The factors that determine spring stress are the applied load, the diameter of the coil, and most importantly the wire diameter. Along with the number of coils and wire material properties, these factors define the spring. All factors are related by design formulas found in engineering handbooks [ibid]. Based on analysis of devices for similar orthodontic applications, 8 ounces-force (227 grams-force or 2.22 Newton) was selected as the approximate target maximum activation load.

The spring parameters noted above all interact and affect the overall device design. Optimizing these parameters requires iterations of spring calculation, and a computer program was used to facilitate the task. With the resulting spring design, the total working stress at the target load, corrected for curvature, is just under 63,000 psi (434 MPa), and less than 70,000 psi (483 MPa) at the maximum deflection allowed by the telescoping tubes.

The graph in Figure 1 relates stress to expected spring life for given wire sizes of the stainless steel material noted. Springs with working stress below the “Severe Service” line are expected to last one million deflections or more [ibid], with lower stress giving longer cycle life. The working stress for the 3M Unitek device is significantly lower than the allowable stress for the “Severe Service,” indicating that the spring can withstand well over 1 million cycles. For comparison, the calculated range of stress for the most similar competitive telescoping device falls well above the “Severe Service” line to just below the “Average Service” (100,000 cycles [ibid]) line.

The described spring is more than fatigue resistant in theory alone. Extensive clinical and laboratory testing of the complete device have shown cycle life in practice meets expectations. When tested in axial compression to deflections consistent with the respective manufacturers’ instructions, the 3M Unitek spring assemblies reached five million cycles without spring fracture while the similar competitive device’s springs fractured at an average less than 200,000 cycles (testing conducted at 3M Unitek from 1999 through the end of 2000).

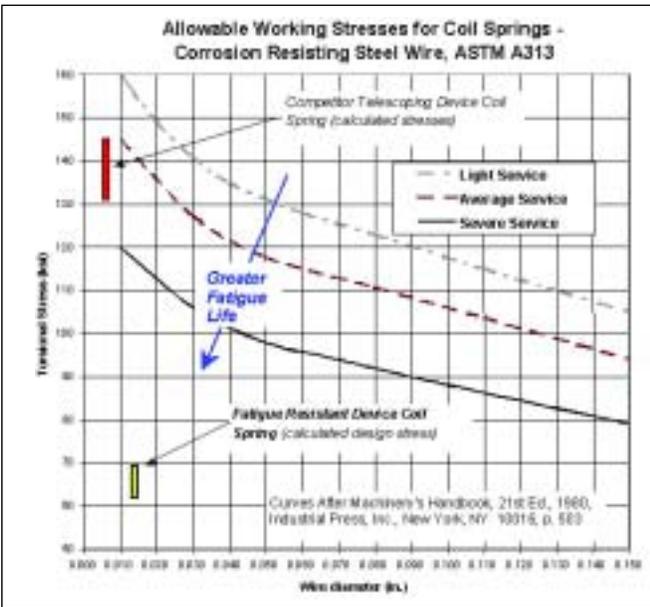


Figure 1: Allowable working stress curves for stainless steel spring wire in accordance with ASTM A313. The graph indicates that lower working stress in springs results in longer cycle life.

Figure 2 shows springs removed from the competitor’s telescoping device and from the 3M Unitek device after cycle testing. The competitor’s smaller spring suffered multiple fatigue fractures on an average of less than 200,000 cycles; the 3M Unitek spring showed no fatigue fractures at 5 million cycles. While the competitive device’s spring exerts a force comparable to that of the 3M Unitek spring, its smaller size and design result in high working stresses, and as seen in Figure 2, a tendency to fail by fatigue fracture.

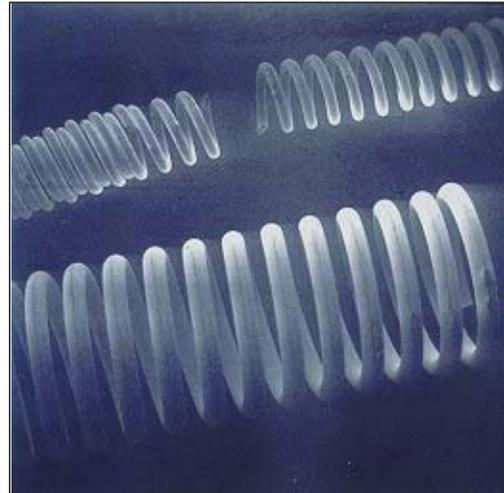


Figure 2: Scanning electron micrograph of coil springs after compression fatigue testing. a) (Upper) The competitor telescoping device failed in less than 200,000 cycles. b) (Lower) The 3M Unitek Forsus™ Fatigue Resistant Device survived 5 million cycles without fracture.

The factors chosen to achieve the low spring stresses also provide benefits beyond long cycle life. Although the large coil diameter places the spring on the outside of the tubes, the many coils and close pitch minimize the possibility of pinching soft tissue. Since anything not completely sealed will be in contact with saliva and food particles, the outside spring allows debris to rinse away, promoting better hygiene. The resulting low spring rate (approximately 20 gram-f/mm) provides 11 mm of active travel, as compared to a maximum 4 mm activation for flexing spring devices.

In the daily working world of product development, talking about the “Three Part Telescoping Coaxial Long Life Spring Class II Correction Device” was much too cumbersome. Since the key feature was the fatigue resistance, it was named the Fatigue Resistant Device. ■

• www.3MUnitek.com Your On-line Source for Information

by David Solid, Technology Marketing Manager, 3M Unitek

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www.3MUnitek.com offers resources and information that could be used virtually every day in an orthodontic office on a very practical level. But it also allows a view of a more general perspective of 3M Unitek, demonstrating the variety of solutions that are available and others that are newly introduced. The connection between the web page and the company is the Customer Support section, where customer service contact information around the world is in one place. Rather than serving as a separate entity, www.3MUnitek.com is a form of Customer Support in itself, but it serves as a part of the larger effort to provide continually dependable, accurate service as an integral part of 3M Unitek. ■



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Test dummy shown for dramatization purposes only.
Test information available on request.

We put our
Class II Correctors
through extreme punishment
just so you can relax.

Five million test cycles. Without breakage. And a consistent level of force maintained throughout the entire test. That's performance even a test dummy can admire. And that's the proven performance of the Forsus™ Fatigue Resistant Device from 3M Unitek. A Class II Corrector engineered to resist stress-fatigue failure and perform dependably, thanks to a revolutionary direct push rod coaxial spring design.



You can quickly see how reliability like this could remove some stress from your life. Because less breakage means fewer emergency office visits to disrupt your schedule. And the Forsus Fatigue Resistant Device also diminishes concerns about patient compliance. It's simple to install, there's no lab work required and it easily fits with your current appliance system.

The Forsus Fatigue Resistant Device delivers a winning combination of fatigue resistance, ease-of-use and predictable performance. Exactly what you've come to expect from 3M Unitek. Call today for more details.

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3M Unitek also offers the Forsus™
Nitinol Flat Spring for Class II cases
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Products that make your life easier.

The APC™ II Adhesive Coated Appliance System Update: Technical Notes and User Survey Results

by Joan V. Brennan, Product Development Specialist, 3M Unitek, David K. Cinader, Sr. Product Development Engineer, 3M Unitek and Armineh Khachatoorian, Sr. Technical Service Engineer, 3M Unitek



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David K. Cinader received his Bachelor of Science Degree in Chemical Engineering from Michigan Tech University in 1994. While working on his bachelor's degree, he worked for 3M as a cooperative education student in an abrasives factory and in a polymer processing laboratory. In 1999, he received his Ph.D. in Chemical Engineering from Northwestern University. He joined 3M Unitek Research and Development in September 1999. Since then, he has been involved in orthodontic adhesive development.



Armineh Khachatoorian received her B.S. in Chemistry from the University of Southern California in 1981. She worked as an R&D and Product Development Engineer before joining 3M Unitek in 1997 as a Sr. Technical Service Engineer. She has led clinical evaluations for products such as APC™ II Adhesive, Transbond™ Plus Self Etching Primer, Transbond™ MIP and Sondhi™ Rapid-Set Indirect Bonding System.

The APC™ II Adhesive Coated Appliance System provides a complete orthodontic bonding system with fewer steps and fewer bonding variables, which equates to greater productivity and efficiency in the orthodontic office environment. The APC II System is still the only orthodontic bonding system that precoats each bracket with adhesive, meaning no adhesive mixing, no adhesive application, and no opportunity to contaminate the base.

The APC II System delivers a softer, more workable adhesive, faster curing with the ORTHO Lite™ Curing Light, virtual elimination of bracket rotation in transit, and less waste and clean-up at chair side. When used in combination with Transbond™ Plus Self Etching Primer, etching and priming is conducted in one step with proven performance in both wet and dry fields.

Softer APC II Adhesive Provides Easy Seating and Positioning

The APC II adhesive has been formulated to provide a soft, pliable and tacky adhesive for better feel and easier seating and positioning. In a U.S. customer survey¹, bracket drift was shown to be virtually eliminated (Figure 1). Chemically, the adhesive is BisGMA-based and is similar to Transbond™ XT Light Cure Adhesive.

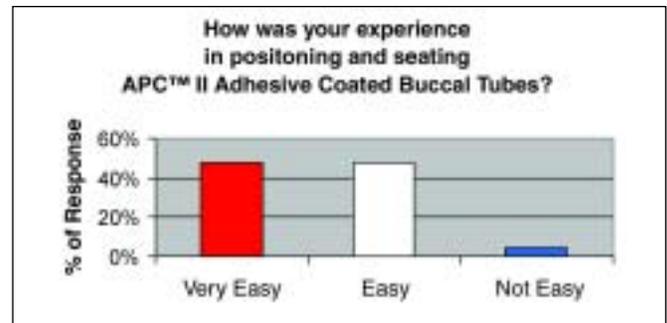


Figure 1: Easy positioning and seating of APC™ II buccal tubes found in survey.

Uncured APC II Adhesive Hardness

One of the attributes that customers desired of our precoated adhesive was a low effort required for pressing the bracket onto the tooth. This translates into a lower viscosity, softer adhesive. To ensure that we are making paste that meets this requirement, we developed an apparatus capable of quantifying this effort in terms of uncured paste viscosity. The following plot reveals that APC II Adhesive is much softer than APC Adhesive and delivers the handling property that our customers requested (Figure 2).

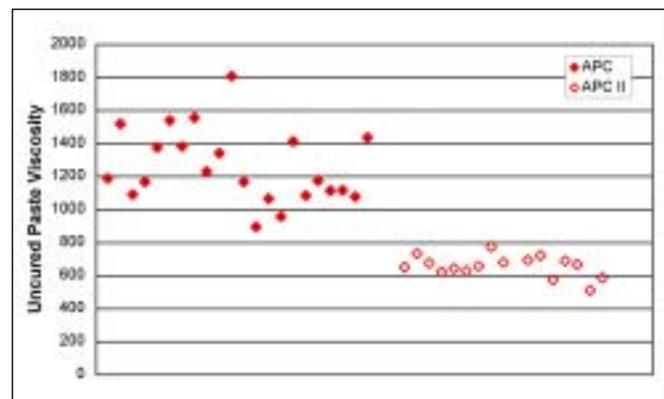


Figure 2: Uncured paste viscosity of APC™ II Adhesive versus that of APC Adhesive.

Bond Strength Studies

In shear peel bond strength studies comparing APC II, Transbond XT and APC adhesives with Transbond™ Plus Self Etching Primer under various contaminated conditions, no statistical differences in bond strengths were observed. Statistical analyses were performed using one way ANOVA (Figure 3).

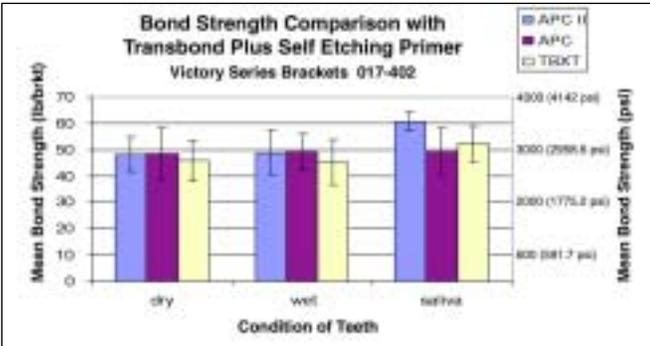


Figure 3: Bond strengths of APC™ II vs. APC and Transbond XT adhesives for different tooth conditions.

Patented Liner Technology

Each individual bracket is pre-oriented on a special foam liner (Figure 4). This new, patented liner virtually eliminates bracket rotation and bracket slip in transit. The low surface energy foam is made of a special, crosslinked polyolefin material (Figure 5).

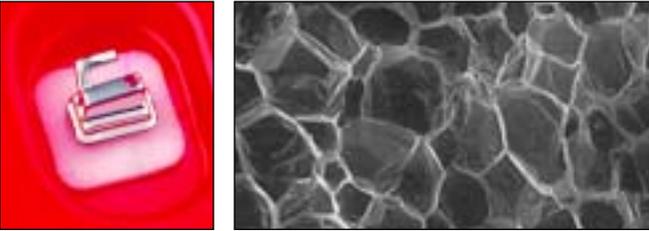


Figure 4: Buccal tube with APC™ II Adhesive on foam lined blister.

Figure 5: Scanning electron micrograph of foam liner.

The release surface of the foam has been uniquely prepared to provide optimal release and, at the same time, provides an anchoring effect of the adhesive coated bracket to the liner (Figure 6A). This anchoring property greatly minimizes and, in most cases, eliminates bracket movement during shipping (Figure 6B).

Figure 6A: Adhesive flowing slightly into the porous foam surface, “anchoring” the bracket in place until ready for removal from package.

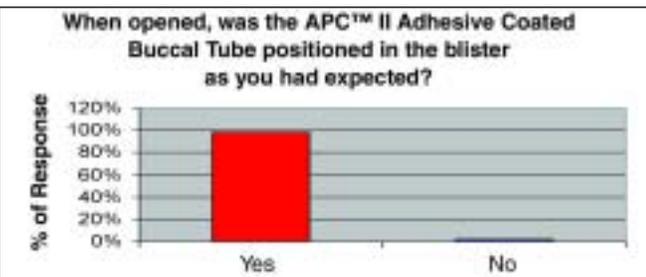
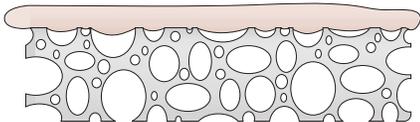


Figure 6B: Users found the bracket positioned as expected in the blister¹.

Gentle Liner Release Technique

Because the patented foam surface has been prepared for optimal release, only gentle upward force is required to remove the APC II adhesive coated bracket from the liner. Do not snap or pull vigorously. Pull with minimal force in an upward motion until the bracket easily releases from the liner. (See Figure 7).

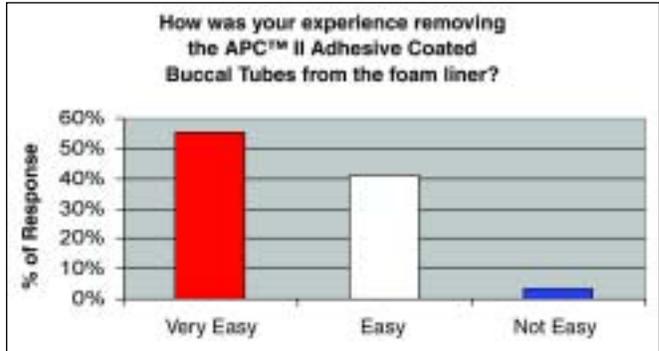


Figure 7: Easy release of APC™ II Adhesive Coated buccal tubes from foam liner found in survey¹.

Transbond Plus Self Etching Primer

One of the opportunities for increasing efficiency in the bonding process involves elimination of steps. Transbond Plus Self Etching Primer contains a methacrylated phosphoric acid ester which provides simultaneous etching and priming, effectively combining these steps. The phosphate group on the ester provides the acidity to selectively dissolve calcium from the enamel. In turn, the calcium neutralizes the acidic primer (Figure 8). At the same time, the primer molecules permeate the enamel structure (Figure 9). Finally, light curing locks the primer into place (Figure 10).

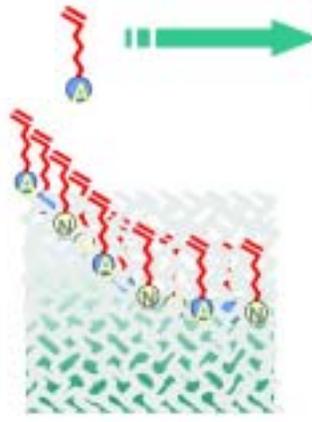


Figure 8: During the etching process, the acid group is neutralized by reaction with calcium.

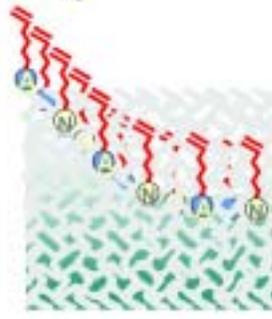


Figure 9: Primer molecules penetrate the enamel rods concurrent with etching.

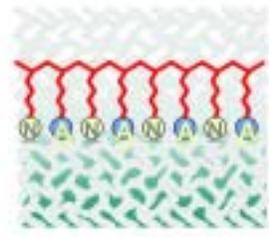


Figure 10: Following light cure, primer molecules are polymerized to form a network.

One of the advantages of this simultaneous etching and priming is that the primer penetrates to the entire depth of the etch, ensuring an excellent mechanical interlock. The improved formulation of Transbond Plus Self Etching Primer offers the additional advantage of a pale yellow tint that allows the liquid to be seen more easily on the applicator. For a more complete discussion of the mechanism and performance of Transbond Plus Self Etching Primer, see Orthodontic Perspectives² Vol. VII No. 1 available on the 3M Unitek web site.

ORTHO Lite™ Curing Light

Another opportunity for time savings in the bonding process is in curing the adhesive. Typical curing times with a standard halogen curing light are 10 seconds interproximally and 10 seconds for each ceramic bracket. Use of the ORTHO Lite high intensity curing light reduces both of these times to 3 seconds (Figure 11). The ORTHO Lite curing light delivers light of a similar wavelength band to a halogen light, but at a much higher intensity (Figure 12). The heart of the ORTHO Lite curing light is a xenon lamp that creates an arc between two electrodes, similar to the process that occurs in a spark plug. The arc ionizes the gas contained in the lamp, stripping it of electrons and creating a plasma. The free electrons collide with and transfer energy to molecules in the surrounding gas. The gas molecules shed this energy in the form of light. This light is filtered and channeled to the desired area by the liquid light guide. For a comparison of plasma arc curing lights with halogen and laser curing lights, see *Orthodontic Perspectives*³ Vol. VI No. 2 available on the 3M Unitek web site..

ORTHO Lite™ Curing Light

Metal brackets: 3 seconds interproximally
 Ceramic: 3 seconds, straight through the bracket
 Direct Bond Tubes: 6 seconds mesial, 6 seconds occlusal

Ortholux™ XT Curing Light

Metal brackets: 10 seconds interproximally
 Ceramic: 10 seconds, straight through the bracket
 Direct Bond Tubes: 20 seconds mesial, 20 seconds occlusal

Figure 11: Comparative Light Curing Times.

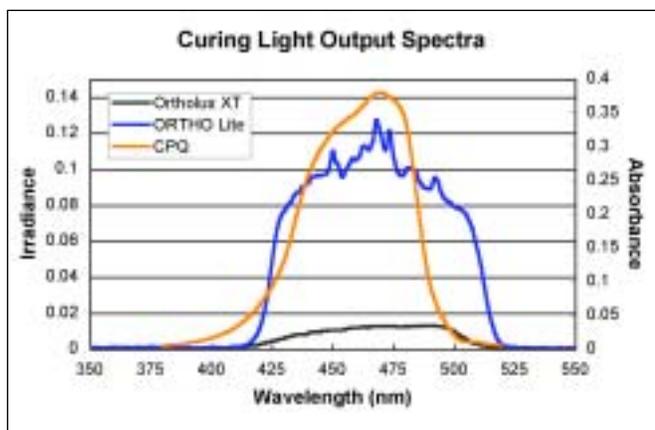


Figure 12: The output spectra of the Ortholux™ XT and the ORTHO Lite curing light are tuned to deliver light in the wavelength range in which the light cure initiator, CPQ, absorbs.

APC II Adhesive Field Evaluations – User Comments

Two U.S. and one global field evaluations were performed for the APC II Adhesive product⁴. The following properties were tested in the field evaluations: loose brackets, adhesive release from liner, amount of adhesive on bracket, initial tack, drift on initial placement, viscosity/feel, ease of adhesive expression, drift after final seating and flash clean up. The system was very well accepted and anticipated.

There were two groups of evaluators: current APC Adhesive users and former APC Adhesive users. The results showed that the new foam liner prevents the bracket from skating inside the blister. It also provides an easier and less technique-sensitive bracket removal from the blister. The adhesive stays on the bracket pad instead of partially remaining on the liner (Figure 13).

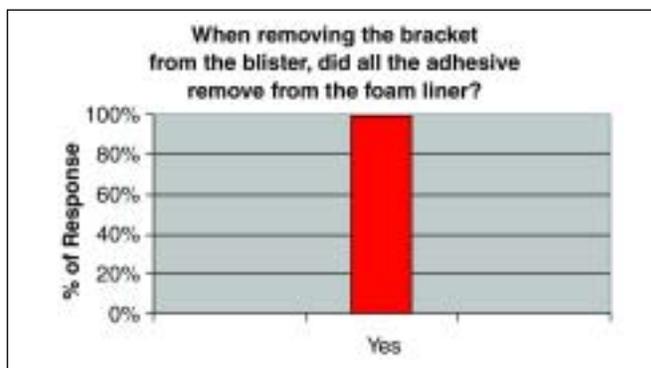


Figure 13: In field evaluations, adhesive easily removed from the foam liner⁴.

Sixty percent of buccal tube evaluators, ninety percent of Clarity™ Ceramic Bracket evaluators and seventy seven percent of metal bracket evaluators said that the APC II Adhesive system was an improvement over their current adhesive system (Figure 14).

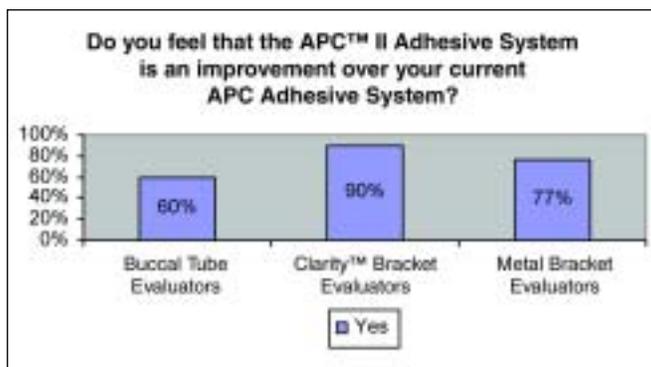


Figure 14: The majority of APC Adhesive customers polled after field evaluations thought the APC II Adhesive System was an improvement over the previous APC Adhesive System⁴. ■

REFERENCES

1. APC™ II Adhesive Coated Appliance survey polled customers that had bought APC II Buccal Tubes since their introduction in May, 2001.
2. See *Orthodontic Perspectives* Vol. VII No.1 for a more complete discussion of the mechanism and performance of Transbond™ Plus Self Etching Primer.
3. See *Orthodontic Perspectives* Vol. VI No.2 for a comparison of plasma arc curing lights and laser curing lights.
4. APC™ II Adhesive field study: Phase 1 (U.S.) January 2000; Phase 2, (U.S.) October 2000. APC™ II Adhesive field study: Phase 1, (non-U.S.) conducted April 2001.

• Transbond™ Plus Self Etching Primer in use: Does it bond securely?

by Darla E. Bowling, Certified Orthodontic Assistant

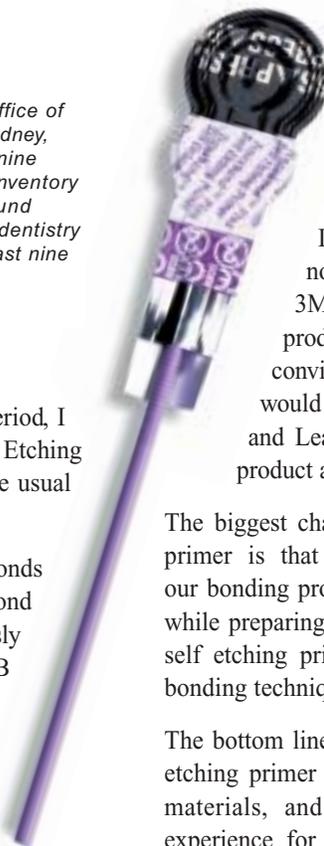


Darla E. Bowling is a Certified Orthodontic Assistant with the office of Dr. Lisa Alvetro, D.D.S., M.S.D., Sidney, Ohio, where she has worked for nine years. She is also in charge of inventory control. Her healthcare background began in 1987 including general dentistry and medical assisting, with the last nine years in Orthodontics.

After tracking more than 700 bonds in a five month period, I have found that bonding with Transbond™ Plus Self Etching Primer is as successful, if not more successful, than the usual acid etch followed by A&B sealant.

In a recent study I conducted in our office, of 746 bonds placed using Transbond Plus self etching primer, the bond failure was 17 bonds, or a success rate of 98%. Previously tracked bonds in our office with acid gel etch and A&B sealant showed similar success rate.

However, our practice has also found several benefits which lead us to prefer Transbond Plus self etching primer over traditional bonding technique. The primary concern is patient comfort. With Transbond Plus self etching primer, the obvious, lingering foul taste from the acid etch is avoided. I have noticed a significant reduction in the amount of saliva produced during the bonding technique. There is no need for rinsing and suctioning the acid, which in turn uses fewer materials for drying. And with the



elimination of rinsing the foul-tasting gel, we would expect that bonding some cases, such as small children as well as severely handicapped people, would be accomplished with greater success.

I must point out that this bonding success rate did not come without additional training from our 3M Unitek representative. Our initial try with the product was not as successful. It took a lot of convincing from our representative that the product would work, an understanding Doctor, and two “Lunch and Learns” going over technique before we gave the product a second chance.

The biggest challenge I see with Transbond Plus self etching primer is that we assistants need to re-train and re-think our bonding process. We must also be very aware of our time while preparing brackets. It is my feeling that Transbond Plus self etching primer is the wave of the future in orthodontic bonding technique.

The bottom line is this: In my experience, Transbond Plus self etching primer works. If you would really like to save time, materials, and more importantly create a more pleasant experience for your orthodontic patient, then you owe it to yourself to learn the techniques of bonding with Transbond Plus self etching primer. ■

Notes: Use of this product should be performed by a licensed orthodontist or by a supervised assistant consistent with state delegation laws/requirements. Bonding success is determined by a combination of many factors and the success rate experienced in this office may not be the rate experienced by all users. – Editor

Winning Combinations *continued from page 2*

It is the Vision Statement of 3M Unitek to develop the *Best Customer Relationships* in the orthodontic industry. Keeping that vision in mind, we in the Sales arena are focused on insuring that we accurately hear & relay to our internal team the voice of you, our customer/partner, and deliver on our promise of *Innovative, High Quality Products and Services*. I believe we have been successful in accomplishing that mission with open communications, best-in-industry sales associates, and state of the art Information Technology. We want to insure that we continue to earn your loyalty in the future and will, to that end, focus our efforts on what we can do to stay as your preferred partner/team member.

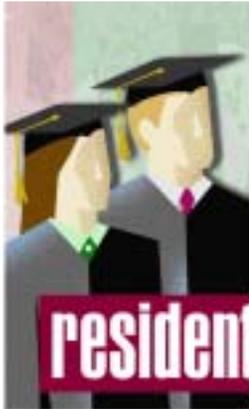
How will we accomplish this? Going forward, we will bring to you winning technology in the form of the latest in patient

diagnostic services with our business relationship with Dolphin Imaging and GeoDigm. We will build on our reputation as the leader in appliance development and delivery with product upgrades in our MBT™ Appliance System, Sondhi™ Signature Series and Clarity™ Ceramic Brackets. We will continue to be the leader in bonding technology with improved APC™ II Adhesive, Transbond™ Plus Self Etching Primer and our ORTHO Lite™ Quick Curing Light. Additionally, we will enhance your ability to manage your inventory and ease the ordering process through the introduction of a computerized inventory control system that will be shown at this year's AAO.

I think you'll agree with all of this and the teamwork we have in place that we truly have the “Winning Combination” for you. ■

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Continuing Education Schedule

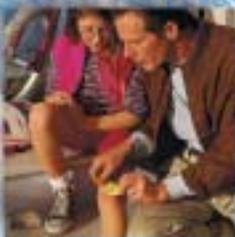
DATE	SUBJECT	PRESENTER(S)	LOCATION
6/14/02	Inter-Arch and Intra-Arch Treatment Mechanics "Efficient & Effective Indirect Bonding" & "Effect of Bracket Placement on Expressed 1st, 2nd and 3rd Order Movements"	<i>Dr. Anoop Sondhi</i>	New York Society of Orthodontists Albany, NY
6/21/02	"Current Concepts in Orthodontic Treatment with Preadjusted Edgewise Appliances"	<i>Dr. Anoop Sondhi</i>	UCSF San Francisco, CA
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9/20/02	"The Essence of Efficiency"	<i>Dr. Anoop Sondhi</i>	Maryland Ortho Society
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11/2/02-11/4/02	"Effects of Bracket Placement on Expressed 1st, 2nd and 3rd Order Movements" and "Virtual Treatment Model to Assess Orthodontic Mechanics"	<i>Dr. Anoop Sondhi</i>	GLAO/MASO
11/3/02-11/6/02	MBT™ System – In-Office Seminar	<i>Dr. Richard McLaughlin</i>	San Diego, CA
11/8/02-11/9/02	"The Essence of Efficiency" In-Office 2-Day Seminar	<i>Dr. Anoop Sondhi</i>	Indianapolis, IN

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