Historically, the United States has lagged behind other countries in the world in regards to offering lingual orthodontics as an option for treatment to our patients. In my opinion, the reason for this discrepancy between the U.S. and other countries for lingual treatment is due to the two main challenges associated with lingual orthodontics: 1) difficult retie appointments for both patient and clinician, and 2) significantly longer appointments. However, I personally see this changing very quickly over the next several years for three main reasons: 1) esthetic orthodontic treatment is something that is highly desirable for our patients, 2) many patients are now aware of lingual treatment and are actively seeking it out, and 3) advances with technologies such as SureSmile® (OraMetrix), cone beam computed tomography (CBCT), and small lingual self-ligating brackets have made treatment with lingual orthodontics much easier for both the clinician and the patient. Over the past 4 years, lingual orthodontic treatment utilized in combination with SureSmile/CBCT has become a big adjunct for me in my practice. In this article, I will review a complex case treated with upper lingual and lower labial fixed appliances.

Patient information
This patient presented at his new patient examination on May 20, 2009 as a healthy 44-year, 1-month-old adult male. He stated that his chief complaint was to resolve his crowding, have straighter teeth, and a nicer smile.

Diagnosis and etiology
Intraoral examination revealed a Class III, subdivision right molar and canine malocclusion. He presented with an overbite (OB) of 20% and overjet (OJ) of 1 mm. There was excessive maxillary and mandibular incisal wear present due to this OB/OJ relationship. Arch-length deficiencies were present in both maxillary – 7 mm – and mandibular arches – 7 mm. Both maxillary and mandibular arches were asymmetric and tapered in arch forms. A right posterior crossbite was present for his UR6, UR5, and LR6. An anterior crossbite was also present with his UR3, UR2, LR3, and LR2 as a result of his right Class III malocclusion. Periodontal evaluation revealed normal and healthy gingival tissue. There was some minor gingival recession present with his UR7, UR6, UL2, UL3, UL6, and LR6 (Figure 1).

Frontal facial evaluation revealed a symmetrical and balanced facial pattern for his upper, middle, and lower facial third heights. Profile evaluation revealed a straight profile with normal chin. His nasolabial angle was 110 degrees, and both upper and lower lips were normal and competent at repose. A frontal smile evaluation revealed acceptable upper and lower smile line with buccal corridors present. His maxillary midline was centered with his facial midline. However, his mandibular midline was deviated 3 mm to the right of his facial and maxillary midlines. Cephalometric analysis revealed a Class III skeletal relationship with ANB = -2.6. It also revealed a brachiocephalic facial pattern with a low MPA = 24.7 (Figure 2).

Panoramic evaluation revealed all third
molars were present and fully erupted. Alveolar bone height was healthy and within normal limits for both maxillary and mandibular arches. There were no other significant findings (Figure 3).

Treatment summary
The patient is a pediatric oncologist, and he requested treatment with lingual brackets in his maxillary arch and labial ceramic brackets in his mandibular arch since esthetics during the course of treatment was a concern for him. The patient was given a non-extraction treatment option, which consisted of full fixed orthodontic appliances in combination with a TAD placed in his lower right posterior quadrant. Due to the amount of crowding present and his Class III relationship, lower posterior interproximal reduction was also recommended. An estimated treatment time of 20 months was given due to complexity of his case.

On January 5, 2010, In-Ovation® L (Dentsply GAC) lingual fixed appliances were placed for U8-8, and In-Ovation®C (Dentsply GAC) labial fixed appliances were placed for L3-3 in combination with In-Ovation®R (Dentsply GAC) labial fixed appliances for her L5s – L8s using an indirect bonding technique. A 0.013 round CuNiti (G&H) lingual mushroom-shaped wire was kept in his maxillary arch to allow for additional leveling and aligning. A new 0.016 round Bioforce® Sentalloy® (Dentsply GAC) labial wire was placed in the mandibular arch. The mandibular arch wire was not placed into the LR8 and was left 3 mm long, and turned over distal to his LR7 so that the wire would not irritate and cause ulcerations of the mucosal tissue on the inside of his cheek. A very active open coil spring was placed distal to his LR6 to continue distalizing his LR8 and LR7. Indirect anchorage was still present with a steel ligature tied from the TAD to his LR6. The same elastics from his previous appointment were instructed to be worn full time again.

On March 10, 2010, the patient returned for his first retie appointment. The same 0.013 round CuNiti (G&H) lingual mushroom-shaped wire was kept in his maxillary arch since esthetics during the course of treatment was a concern for him. A new 0.016 round Bioforce® Sentalloy® (Dentsply GAC) labial wire was placed in the mandibular arch. The mandibular arch wire again was not placed into the LR8 and was left 3 mm long and turned over distal to his LR7 so that the wire would not irritate and cause ulcerations of the mucosal tissue on the inside of his cheek. A new very active open coil spring was placed distal to his LR6 to continue distalizing his LR8 and LR7. Indirect anchorage was still present with a steel ligature tied from the TAD to his LR6. The same elastics from his previous appointment were instructed to be worn full time again.

On May 10, 2010, the patient returned for his second retie appointment. A new 0.016 round CuNiti (G&H) lingual mushroom-shaped wire was placed in his maxillary arch and a new 0.016 x 0.016 square Bioforce® Sentalloy® (Dentsply GAC) labial wire was placed in the mandibular arch. The mandibular arch wire again was not placed into the LR8 and was left 3 mm long and turned over distal to his LR7 so that the wire would not irritate and cause ulcerations of the mucosal tissue on the inside of his cheek. A new very active open coil spring was placed distal to his LR6 to continue distalizing his LR8 and LR7. Indirect anchorage was still present with a steel ligature tied from the TAD to his LR6. The crossbite elastic was discontinued as the right posterior crossbite had been corrected. The same Class III elastic was instructed to be worn full time.

On July 6, 2010, the patient returned for his third retie appointment. The same 0.016 round CuNiti (G&H) lingual mushroom-shaped arch wire was kept in his maxillary arch. A new 0.018 x 0.018 square Bioforce® Sentalloy® (Dentsply GAC) labial wire was placed in the mandibular arch. The mandibular arch wire again was not placed into the LR8 and was
left 3 mm long and turned over distal to his LR7 so that the wire would not irritate and cause ulcerations of the mucosal tissue on the inside of his cheek. A new very active open coil spring was placed distal to his LR6 to continue distalizing his LR8 and LR7. Indirect anchorage was still present with a steel ligature tied from the TAD to his LR6. All elastics were discontinued at this appointment.

On August 31, 2010, the patient returned for his fourth retie appointment. A 0.4 voxel, 8 cm field of view (FOV), and 10 second i-CAT® scan (Imaging Sciences International) were taken for evaluation prior to repositioning of his lower right TAD to just mesial of the mesiobuccal root of his LR7 (Figures 4 and 5). A closed elastomeric chain (American Orthodontics) was placed from his LL6-LR6 with direct anchorage to the TAD for en masse retraction for right Class III correction. The same 3/16” crossbite elastic was instructed to be worn 12 hours per day.

On October 29, 2010 and November 10, 2010, the patient returned for his fifth and sixth retie appointments to change his elastomeric chain from his LL7-LR6 to his TAD again for his right Class III correction. The same 3/16” crossbite elastic was instructed to be worn 12 hours per day.

On December 8, 2010, the patient returned for his seventh retie appointment. We began his transition into SureSmile at this appointment (Figure 6). His arch wires were removed, and the In-Ovation® L (Dentsply GAC), In-Ovation®C (Dentsply GAC), and In-Ovation®R (Dentsply GAC) bracket doors were closed. Upper and lower incisal recontouring was performed to give balance and symmetry to his incisal edges. A SureSmile i-CAT scan was taken with a wax bite present with the condyle seated in the glenoid fossa with the maxillary and mandibular dentition slightly separated (~2 mm) at 0.4 voxel, 8 cm FOV, and 10-second settings. Because of the amalgam present in his LR7 and the subsequent metal scatter present with his SureSmile i-CAT scan, a supplemental intraoral scan was taken with SureSmile’s intraoral scanner of his LR6-LR8 (Figure 7). The intraoral scan data was then merged with his SureSmile i-CAT scan data and was uploaded and submitted to SureSmile for creation of the clinical crown anatomy as well as the root anatomy for the patient’s SureSmile® virtual 3D models (Figure 8). The clinician was then able to correct the patient’s malocclusion using SureSmile’s® 3D software applications (Figure 9). The patient’s SureSmile® plan was completed, and his SureSmile® wires were ordered to be bent utilizing SureSmile’s proprietary software and robots (Figure 10). The same 3/16” crossbite elastic was instructed to be worn 12 hours per day. A closed elastomeric chain was placed from his LR7 to his LL6. There was nothing tied to his lower right TAD, and it was left in place to
provide mechanical anchorage to prevent the LR7 from drifting forward mesially.

Six weeks later, on January 18, 2011, the patient returned for his eighth retie appointment for his SureSmile wire inserts. A 0.017 x 0.025 SureSmile® CuNiTi lingual wire was placed in his maxillary arch, and a 0.017 x 0.025 SureSmile® CuNiTi labial wire was placed in his mandibular arch. Interproximal reduction was performed in both maxillary and mandibular arches that had been determined from his SureSmile plan (Figure 10). His lower right TAD was removed as anchorage was no longer needed. His right crossbite elastic was discontinued. Clear plastic buttons (ceramic bondable button, Dentsply GAC) were placed on his UR3, UL3, and the patient was instructed to wear triangle-vertical 3/16" elastics with 2.7 oz. of force bilaterally for 12 hours per day from his U3s to his L3s and L4s. Closed elastomeric chain was placed from U6-6 and LR7-LL6. On March 16, 2011, the patient returned for his ninth retie appointment. Photos were taken to track treatment progress (Figure 11). His vertical-triangle elastics were discontinued, and 5/16" with 2.7 oz. of force Class III elastics were instructed to be worn full time on his right side only from his UR6 to his LR3 and UR3. As a result, a clear plastic button was bonded to his UR6 in order for him to wear the new elastic, and the plastic button on his UL3 was removed. Closed elastomeric chain was placed from U6-6 and LR7-LL6.

On May 10, 2011, the patient returned for his tenth retie appointment, and photos were taken again to track his treatment progress (Figure 12). Utilizing SureSmile’s proprietary software, virtual wire modifications were submitted for finishing and detailing based upon clinical evaluation of the patient’s occlusion. Finishing SureSmile wires were then ordered to be bent by SureSmile’s proprietary robots (Figures 13 and 14). A closed elastomeric chain was placed from his U6-6. All elastics were discontinued at this time.

On June 6, 2011, the patient returned for his eleventh retie appointment, and his finishing SureSmile wires were placed: maxillary 0.016 x 0.022 lingual CuNiTi and mandibular 0.017 x 0.025 labial CuNiTi. All plastic buttons and elastics were discontinued. Closed elastomeric chain was placed for U6-6 and LR7-LL6.

On July 18, 2011, the patient returned to have his fixed appliances removed. He was moved into retention with an Essix ACE® retainer with full-time wear and a L3-3 fixed lingual splint. Three months later, the patient returned for his final records, and retention wear of his Essix ACE® retainer was reduced to bedtime only (Figure 15). Total treatment time for this patient was 18 months and 13 days. The total number of appointments from the initial bonding appointment to his debond appointment was 16, including three emergency appointments.
Summary and conclusions

In the early 1980s, lingual orthodontic treatment reached its height in popularity in the U.S. However, its popularity quickly declined as clinicians began to experience the technical difficulties associated with lingual mechanics: 1) visual and working access was significantly less, and ligating the arch wires was much more difficult in comparison to labial resulting in difficult and longer retie appointments, 2) shorter interbracket distances posed problems with being able to place certain bends in the arch wire and engaging the arch wire into the bracket slots, and 3) comfort of the lingual appliances was a problem, and certain patients could not tolerate them, and the appliances had to be removed.1,2

The In-Ovation® L (Dentsply GAC) bracket has given our profession a small, low profile, self-ligating bracket and has helped to make the appliances much more comfortable for the patient. It has also made ligating the arch wires into the bracket slots significantly easier. I chose to utilize the i-CAT®, Dolphin 3D, TAD, and SureSmile® technologies within my treatment plan because I personally believe that these four technologies greatly improve my capability to diagnose and treatment plan (i-CAT® and Dolphin® 3D), as well as deliver active therapeutic care (TAD, i-CAT, and SureSmile).3 Utilizing SureSmile, I was able to correct his malocclusion to a high degree of precision and accuracy without having to reposition brackets or bend wires by hand, which for lingual, is incredibly challenging. This is clearly illustrated with the development of his upper smile arc, in which I was able to utilize SureSmile’s software to intrude his UR3, UL3 and extrude his UR2-UL2 (Figure 16).

The advantages of using SureSmile has been substantiated in two recent and separate studies with SureSmile cases grading better with American Board of Orthodontics (ABO) scores and completing treatment with an average of 25% reduced treatment times in comparison to conventional orthodontics.4,5 In this author’s opinion, the advantages of using SureSmile in combination with i-CAT to create the SureSmile 3-D CAD/CAM models and to evaluate malocclusion and root positions are invaluable, and I truly believe that I am a better orthodontist today because of them. With SureSmile, treating this patient with lingual appliances is also no longer a daunting task. In the past decade, esthetic orthodontic treatment has exploded with the development of removable, invisible aligners. However, there are limitations with what can be accomplished with aligner treatment.6 As mentioned previously, lingual with SureSmile has become a big adjunct for my practice with my being able to offer esthetic treatment with shorter treatment times and without having to compromise on the finished end result. And as we all know, technology will only continue to get better!  

Give a child fighting cancer a beautiful smile: donate to childhood cancer charities in support of research or financial assistance, offer to provide dental care, or even offer to assist their parents with errands. Thanks to all for this opportunity to raise awareness.

REFERENCES