Treatment and retreatment of a patient with a severe anterior open bite

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An 8-mm anterior and posterior open bite caused by a tongue rest posture habit was closed in a 25-year-old man by means of mandibular soldered tongue spurs and without orthognathic surgery. All maxillary and mandibular first molars were extracted, and the spaces were closed. Inappropriate retention protocol allowed for relapse in a 6-month period. A new 1-year orthodontic retreatment was conducted; after an appropriate retention protocol, the outcomes of treatment were significantly improved. (Am J Orthod Dentofacial Orthop 2013;144:594-606)

Open-bite patients with anterior tongue rest posture or thrust problems have been treated with many different therapies. Some examples are vertical elastics, orthognathic surgery, tongue cribs, tongue spurs, multiloop edgewise archwires, and temporary anchorage devices. However, it has been documented that relapse of the corrected open bite frequently occurs and is therefore a major concern. Improper tongue rest posture has been suggested as the primary contributing factor to anterior open bites. Justus demonstrated that anterior open bites can be safely and effectively closed using soldered tongue spurs to a maxillary lingual arch, and that the results remain stable because of the triggering of a nociceptive or proprioceptive reflex to prevent soreness; this results in a new engram. However, additional possible etiologies can cause anterior open bites, including vertical growth deficiencies and thumb and lip sucking habits.

A review of the scientific literature showed that anterior tongue rest posture is a primary contributing factor to anterior open bite, that the use of tongue spurs does correct an anterior open bite by modifying anterior tongue posture, and that long-term stability is achieved because a new tongue posture engram is established. Prevention of anterior open-bite relapse by using tongue spurs during orthodontic treatment to modify anterior tongue posture has been substantiated in numerous studies. The uniqueness of this case report lies in the fact that a significant open bite was closed simply by modifying an anterior tongue rest posture with tongue spurs and without the need for orthognathic surgery. This patient presented 3 challenges: a severe open-bite malocclusion, 4 first molar spaces to be closed, and the need for a proper retention protocol to prevent relapse. De Freitas et al reported that in a sample that required extraction of 4 premolars, the greater the treatment changes needed and the smaller the posttreatment peer assessment rating score, the greater the relapse. O’Neill, in a systematic review of long-term stability after orthodontic treatment, reported that despite many studies, evidence-based conclusions about retention are few. The lack of agreement on a retention protocol might have contributed to the wrong retention approach in this patient, who required retreatment.

DIAGNOSIS AND ETIOLOGY

A 25-year-old man was referred to the orthodontic office of the first author in Curitiba, Brazil, by his periodontist because he “could not close with his front teeth, and his first molars were significantly loose.” He did not report any medical problems and was not taking any medication. The periodontist had initiated treatment 1 year earlier and had performed deep root scaling associated with periodontal flap surgery in an attempt to save the mandibular first and second molars. At the initial orthodontic visit, it was observed that the patient had a convex soft-tissue profile with a

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significantly increased lower third of the face (Fig 1). The nasolabial angle was acute, and the lower lip was protrusive relative to Ricketts’ E-plane. At rest, his lips were apart, and a mentalis strain was observed. From the frontal view, his face was slightly asymmetric, with the right side a little longer than the left side, and the chin slightly deviated toward the left. The mandibular asymmetry could also be observed on the initial lateral cephalometric x-ray (Fig 2). When smiling, the patient had uneven gingival margin levels. Intraoral and dental cast examinations showed a molar half-cusp Angle Class III relationship on both sides (Fig 3). Overeruption (extrusion) of all maxillary and mandibular first molars was observed. An 8-mm anterior and a 3-mm bilateral posterior open bite were detected. The only teeth in contact were the extruded first molars and the third molars on both sides. A mesial inclination of the mandibular second molars developed, possibly because of the extrusion of the first molars. A significant tongue thrust and

Fig 1. Initial extraoral and intraoral photographs.

Fig 2. Initial lateral cephalometric film.
an anterior tongue rest posture were noticed at rest and also while swallowing. The maxillary arch was slightly narrow relative to the mandibular arch, possibly caused by the low and anterior tongue rest posture. Moderate maxillary anterior crowding and a small tooth-size discrepancy of the maxillary lateral incisors were observed. The temporomandibular joints had bilateral asymptomatic clicking, without deviation on opening, and no history of jaw locking in the closed position.

A panoramic film taken a year earlier by the periodontist and the initial orthodontic panoramic film showed the extension of the periodontal involvement of the molars (Fig 4). A periapical lesion of the mandibular right first molar, periodontal pockets corresponding to the maxillary and mandibular left first and second molars and the mandibular right first molar, and a carious lesion on the mandibular left second molar were present. The severe bone loss surrounding the maxillary left first molar, the mandibular right and left first molars, and the second molars could be seen on the panoramic film taken by the periodontist (Fig 4, A). One year later (Fig 4, B), after periodontal treatment, the bone level had improved, and the mandibular left second molar had been endodontically treated. All third molars were present in the mouth. The pretreatment cephalometric tracing measurements showed an ANB angle of 1.4° (Fig 5, Table). A vertical growth pattern was present, and the anterior portion of the mandible also had a vertical tendency. The mandibular plane angle was steep (SN-MP, 40.8°) possibly because of the extrusion of the first molars, adding to the vertical component. The maxillary incisors were extremely proclined (U1-FH, 119.6°), but the mandibular incisors were within normal limits (L1-MP, 89°).
TREATMENT OBJECTIVES

The primary treatment objectives were to obtain a harmonious facial profile, close the open bite, and establish a normal occlusion with all teeth having a normal periodontium. To achieve these objectives, the periodontally compromised first molars were to be extracted and the remaining spaces closed. Because of the extractions of the extruded first molars and the mesial orthodontic movement of the posterior teeth, the open bite was expected to close significantly from the scissor, or drawbridge, effect. The anterior tongue rest posture was to be modified using a mandibular lingual arch with soldered tongue spurs. Since the posterior portion of the tongue was also abnormally postured in the extraction spaces, tongue spurs would be added in the area of those spaces. The mandibular left second molar would be monitored with the intent to salvage it. If in the future this tooth needed to be extracted because of periodontal considerations, space for an implant would be maintained. Although significant mesial orthodontic movement of second and third molars was required, it was expected that the spaces would remain closed after orthodontic treatment.

TREATMENT ALTERNATIVES

A combined maxillary and mandibular surgical approach, associated with extraction of the first molars, could have facilitated bite closure. However, the patient had previously consulted 4 orthodontists; all had recommended an orthognathic surgical procedure to correct his problem, but he vehemently rejected surgery. Tongue spurs combined with extraction of the maxillary and mandibular third molars, and maintenance of the first molar spaces for future implants, could have shortened the treatment time significantly. However, the treatment cost would have been significantly increased because of the required restorative work. A tongue crib could have been used instead of tongue spurs to impede the tongue from posturing forward and thus helping to close the bite. However, the anterior tongue posture might have relapsed after crib removal because a new engram would probably not have been established.

TREATMENT PROGRESS

Before orthodontic treatment, the carious lesion was eliminated and the molar was restored with a filling; periodontal deep root scaling was performed, and instructions on oral hygiene were given. All maxillary and mandibular first molars were extracted. Bonded maxillary and mandibular 0.018 × 0.028-in slot Roth prescription Discovery brackets (Dentaurum USA, Newtown, Pa) were used to initiate leveling and alignment. After the initial treatment stages, a mandibular lingual arch was soldered onto the second molar bands, which were then cemented. The lingual arch had anterior and posterior tongue spurs soldered onto it (Fig 6, A and B). The anterior open bite closed in a 4-month period without anterior vertical elastics. However, Class III elastics (bilateral triangular 5/16 in, 4 oz) were used and might have contributed to the bite closure. Closing the maxillary first molar spaces and modifying the anterior tongue rest posture habit also contributed to the treatment success (Fig 6, C and D). The removal of the

| Table. Initial and final cephalometric measurements, differences, and norms |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                             | Initial | Final | Difference | Norm  |
| Maxilla to cranial base      |         |       |            |       |
| SNA (°)                     | 83.9    | 84.2  | 0.3        | 82    |
| Mandible to cranial base    |         |       |            |       |
| SNB (°)                     | 81.2    | 81.3  | 0.1        | 80    |
| SN-MP (°)                   | 40.8    | 39    | 1.8        | 32.9  |
| FMA (MP-FH) (°)             | 37.8    | 33.7  | 4.1        | 22.9  |
| Maxillomandibular            |         |       |            |       |
| ANB (°)                     | 2.6     | 2.8   | 0.2        | 1.6   |
| Y-axis (°)                  | 70.1    | 68.9  | 1.2        | 60    |
| Maxillary dentition         |         |       |            |       |
| U1-NA (mm)                  | 9.2     | 2.1   | 7.1        | 4.3   |
| U1-SN (°)                   | 119.3   | 101.4 | 17.9       | 103.1 |
| Mandibular dentition        |         |       |            |       |
| L1-NB (mm)                  | 11      | 3.5   | 7.5        | 4     |
| L1-MP (°)                   | 88.9    | 81.6  | 7.3        | 95    |
| Soft tissue                 |         |       |            |       |
| Lower lip to E-plane (mm)   | 5.2     | 0.6   | 4.6        | −2    |
| Upper lip to E-plane (mm)   | −1      | −2.3  | 1.3        | −8    |
Fig 6. Tongue spurs: A and B, at placement; C, 3 months after placement; D, 4 months after placement.

Fig 7. Posttreatment extraoral and intraoral photographs.
mandibular lingual arch and subsequent first molar space closure with elastomeric chains helped to close the anterior open bite because of the scissor effect. Class II elastics (3/16 in, 4 oz) were also used to help close the mandibular spaces by mesialization of the mandibular second molars. After the first molar extractions, the patient developed a habit of posturing the tongue into those newly created spaces. Tongue spurs were added to that area to prevent this new habit. Unlike the anterior tongue spurs, the posterior tongue spurs bothered the patient for more than 2 weeks.

Retention consisted of a maxillary circumferential Hawley retainer and a mandibular bonded canine-to-canine 0.036-in stainless steel wire. The maxillary Hawley retainer was fabricated with a hole in the palate as a reminder of the normal tongue rest posture. The patient was supposed to wear the removable retainer full time, removing it only for brushing and eating.

TREATMENT RESULTS

The posttreatment photographs, taken on the day of debonding, demonstrate ideal overjet (2 mm) and overbite (3 mm), and the second molars and canines in an Angle Class I occlusion had been achieved. A 1-mm open bite remained in the right third molar area. Invagination of gingival tissue can be seen bilaterally, just mesial to the second molars, as a consequence of the first molar space closure. The occlusal views show nicely rounded maxillary and mandibular arches. On the debonding day, no spaces were present (Fig 7). The final dental casts (Fig 8) and panoramic (Fig 9) and lateral cephalometric (Fig 10) films (all taken in an outside specialized orthodontic records center) were obtained 1 day after debonding, at which time 1-mm spaces mesial to the right and left second molars had appeared. Unfortunately, the spaces went unnoticed during that appointment when the retainers were placed.

The postdebonding panoramic radiograph (Fig 9) showed no detectable root resorption. However, the mandibular left second molar demonstrated a periodontal compromise, to such an extent that it would require extraction, and the mandibular right second molar showed a significant mesial bone defect. The postdebonding lateral cephalometric radiograph and tracing...
(Figs 10 and 11) showed retroclined mandibular incisors (L1-MP, 81.6°; L1-NB, 13.5 mm) and ideal anteroposterior bony relationships (ANB, 1.4°) (Table). Because the initial and the postdebonding lateral cephalometric radiographs were taken on different machines, adjustment for the magnification factor was necessary to compose the superimpositions (Figs 12 and 13). They showed significant retroclinations of the maxillary and mandibular incisors, mesial movement of the mandibular second molars, an increased nasolabial angle, and downward movement of the anterior part of the maxilla. The mandible did not alter its position, possibly because of the extraction of the first molars and the mesial movement of the second molars. The expected posterior scissors effect from the first molar extractions and the subsequent space closure were not noted. However, a significant scissors effect did occur after retraction of the incisors.

**POSTTREATMENT COMPLICATIONS**

The patient returned for a retention check 15 days after debonding. At that time, it was observed that the spaces mesial to the second molars had opened farther. The intraoral pictures taken 2 months after debonding (Fig 14) showed 2- to 3-mm spaces mesial to the right
and distal to the left second molars. The mandibular left second molar with the periodontal complications was extracted by the periodontist, who immediately inserted an implant for a future crown. New dental casts (Fig 15) and a new panoramic radiograph (Fig 16) were requested, and the maxillary and mandibular brackets were rebonded. The initial archwires were 0.017 × 0.025-in nickel-titanium archwire on 0.018 × 0.025-in slot Roth prescription brackets. The archwire progression, along with finishing and detailing bends, lasted about 1 year. During this period, a temporary crown, fabricated mesiodistally narrower than ideal, was cemented to the implant on the mandibular left second molar by the prosthodontist to start creating gingival contouring while finishing the orthodontic movements. This tooth was banded and used as an anchorage unit to help mesialize the mandibular left third molar and also to retract the anterior teeth to close the spaces. By the end of the second orthodontic treatment, all spaces had been closed, except those mesial to the implant crown on the mandibular left second molar area (Figs 17 and 18). A space for the ideal-sized crown was left

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**Fig 14.** Photographs 2 months after debonding.

**Fig 15.** Dental casts 6 months after debonding.

**Fig 16.** Panoramic film 6 months after debonding.
on purpose to be restored. Coaxial 0.021-in retention wires were bonded bilaterally on the same day to the mandibular posterior teeth to prevent reopening of the spaces (Fig 19). Because spaces did not open in the maxillary arch during the first orthodontic treatment, no wires were bonded to the teeth adjacent to the extraction sites in that arch. A new maxillary Hawley retainer with a hole in the palate was fabricated and delivered on the day of debonding. This hole was created to encourage the patient to keep his tongue in a correct position. Similar to the first treatment, no root resorption or major bone deficiencies were found in the final panoramic film (Fig 19), and no major changes were seen on the final lateral cephalometric radiograph.

Fig 17. Photographs showing retreatment debonding.

Fig 18. Postretreatment dental casts.
DISCUSSION

The overall result for this patient, with a severe open bite, was good. Facial esthetics and function improved markedly, and his temporomandibular joint signs and symptoms remained unchanged. In retrospect, a few major lessons can be learned: it is possible to treat large open bites caused by anterior and lateral tongue rest posture without orthognathic surgery if the anterior tongue rest posture is actively modified by a tongue spur appliance; large mandibular and maxillary first molar extraction spaces can be closed without temporary anchorage devices; a correct retention protocol must be applied to maintain the extraction spaces that were closed; and realistic, not idealistic, orthodontic treatment objectives should be established in adult patients, especially in those with periodontal breakdown.

Since an abnormal tongue posture habit was considered to be the responsible factor for this anterior and posterior open bite, placement of a mandibular lingual arch with spurs was the preferred alternative treatment for habit management. Tongue spurs have been effectively used to modify tongue behavior, maintain stability of treated open bites, and prevent relapse. Thus, placement of anterior and bilateral posterior (on extraction sites) tongue spurs was the preferred treatment option. A study designed to determine patient acceptability and adaptability to tongue spurs was carried out by Araujo et al. They evaluated 72 patient questionnaires to determine patients’ and parents’ reactions to the orthodontic treatment of open bite with a mandibular lingual arch with spurs and to compare any changes in anxiety and discomfort during treatment in different age groups and sexes. They reported that 98% of the patients accepted treatment with mandibular lingual arches with spurs. The discomfort time was up to 10 days in most patients. Justus also reported that the discomfort lasted about 10 days in most patients who had maxillary tongue-spur treatment. Speech and chewing impairments were the most common functional problems, and 76% did not feel a lack of confidence while wearing the appliance.

The abnormal tongue rest posture in the posterior area was noticeable, so to establish a new posterior tongue posture, bilateral posterior tongue spurs were added. They were soldered to the lingual arch in the area of the extraction spaces (Fig 6, A and B). The spurs were constructed so that they would not be longer than the lingual aspects of the 2 adjacent teeth, with the intent to not encroach on the “natural” tongue posture. These posterior spurs were quite troublesome for this patient to tolerate. He had significant discomfort during the first 2 weeks, both at rest and while eating. The posterior tongue spurs were removed after 1 month, and the
anterior tongue spurs remained for another 3 months. During these 4 months, no mesial movement of the mandibular molars was allowed. If the mandibular lingual arch had been cemented on the second premolars, the mandibular spaces could have been closed earlier in treatment. As seen in Figure 21, the 1.5-year posttreatment pictures show that the tongue spurs were effective in preventing the open bite to relapse and demonstrating that a new engram was established.

Another significant challenge in this case was to close the extraction spaces. Previous studies have demonstrated that a wide tooth root can be moved through a narrow alveolar ridge without compromising the eventual bone support around the repositioned tooth root. Ostler and Kokich evaluated the long-term changes in the width of the alveolar ridge after extracting mandibular deciduous second molars. Their data showed that the ridge narrows by 25% during the first 4 years after deciduous tooth extraction. After 7 years, the ridge narrows by another 5%, for a total reduction of 30% over 7 years. Their report could be extrapolated to the extraction of the mandibular permanent molars, as in this report. The width of the mandibular alveolar ridge reduced significantly after extraction of the extruded mandibular first molars. Nonetheless, the same ridge was developed by mesial movement of the second molars. The space closure was carried out without temporary skeletal anchorage devices. Currently, many patients are treated with temporary skeletal anchorage devices. However, when this patient was treated, these devices were not readily available; thus, a conventional reciprocal anchorage space closure with elastomeric chains was used in both the maxillary and the mandibular dentitions.

For adults, realistic treatment objectives that fit the patient’s needs, desires, and financial abilities must be established. Because of the complex situation of the first molars and the patient’s refusal to undergo orthognathic treatment, a realistic approach was determined. He was referred by a periodontist who had treated him previously and made all possible efforts to salvage the mandibular second molars, such as treating the furcation and referring the patient to a general dentist for endodontic treatment. The periodontist monitored the patient throughout the entire orthodontic treatment. After the first orthodontic treatment, a vertical osseous defect was detected on the mesial aspects of the mandibular second molars. However, a discussion about the periodontal defects did not take place between the orthodontist and the periodontist. Thus, the orthodontist was not aware whether the defects were 1 or 2 wall defects, leading to misinterpretation of who would take care of them, the orthodontist or the periodontist. Interproximal craters can be the most unpredictable intrabony defects in orthodontic patients. They cannot be corrected by orthodontic movement alone. If the patient cannot maintain good oral hygiene in those areas and the craters are small or mild, it might be necessary to have resective osseous surgery and recontouring before the placement of brackets. These procedures were not done for this patient. The final panoramic radiograph (Fig 19) shows that the mesial crater on the mandibular right second molar was eliminated. However, despite the efforts to salvage the mandibular left second molar, such as root canal therapy and furcation treatment (not reported by the periodontist as Class I, Class II, or Class III), this tooth had to be extracted. Viewed in retrospect, this tooth was useful during the
first orthodontic treatment because it served as an anchorage unit to help move the remaining teeth and also to maintain the bone width in that area until the end of the treatment. Kokich\textsuperscript{15} recommended that hopeless teeth should be extracted after orthodontic treatment rather than before, as long as the periodontal health of the adjacent teeth can be maintained.

An implant with a crown was placed at the conclusion of the first orthodontic treatment. It was placed in the area of the extracted mandibular left second molar to restore a balanced occlusion.\textsuperscript{21} The implant was not placed at the beginning of the first treatment because it was planned to maintain the mandibular left second molar in occlusion. Perhaps if the tooth had been extracted earlier, it could have been used as a better orthodontic anchorage unit, later serving, as it was, as an abutment for a permanent crown.\textsuperscript{15}

An important lesson learned from this treatment result is related to the retention protocol used after the first orthodontic treatment. If the supporting periodontal structures lack adaptation after orthodontic extraction space closure, an invagination of the gingiva might be present in these areas. Rivera Circuns and Tulloch\textsuperscript{23} studied the incidence and possible association of structural changes with gingival health and stability of premolar extraction space closures, and they found a high incidence of invaginations forming during extraction space closures. Invaginations were more frequent, complex, and severe in the mandibular arch than in the maxillary arch. The general trend was toward some resolution of these defects with time, but many persisted years after retention was discontinued. There was no evidence of an association with reopening of extraction spaces. Although no association was found in their study, it cannot be stated that invagination of the gingiva in the molar areas of our patient was not the responsible factor for reopening of the mandibular first molar extraction sites. If flexible wires had been bonded on the teeth adjacent to the extraction sites as the retention protocol after the first treatment and possibly surgically excising the excess gingival tissues in the invaginated areas, no extra orthodontic treatment would have been necessary. It would have saved the patient and the orthodontist the additional year it took to retreat him. Since the patient was not responsible for the relapse, the retreatment was conducted without any additional fee.

CONCLUSIONS
Large open bites caused by tongue rest posture can be closed using a mandibular lingual arch with soldered tongue spurs, bone width can be developed on edentulous spaces by orthodontic movement, and large dental space closures, such as first molar spaces, should be retained immediately after debonding with bonded wires to prevent the spaces from reopening.

REFERENCES