IMPORTANCE OF SCREENING

Sleep-Disordered Breathing and Its Potential Impact on Restorative Dentistry: A 14-Year Case Study

Bozidar L. Kuljic, DDS

Abstract: Understanding the effects sleep-disordered breathing can have on dentitions may be critical to the long-term success of restorative treatment. In the current case, a patient presented with a large diastema that was successfully closed using porcelain veneers only to have an unexpected unesthetic consequence occur years later. The case demonstrates that if the clinical focus is solely on reparatory modalities or clinical management, without recognition of possible airway issues, unintended restorative consequences may surface in the future. Studying and understanding the origin of the signs and symptoms of sleep-disordered breathing can be crucial for the prevention of future problems and optimization of a patient's overall health.

Few articles show long-term clinical outcomes, yet seeing such outcomes is essential to be able to fully evaluate the prognostic value of dental restorative treatment. Following up with patients and assessing the ongoing condition of their teeth and restorative treatment should be done over time, as this can help clinicians understand the etiology of undesirable outcomes and impact decision-making for dental treatment plans and their long-term predictability. This article discusses an implemented treatment plan, the clinical step-by-step process, and the follow-ups 3 and 14 years later where the supraeruption of all maxillary central and lateral incisors caused increased esthetic risk due to coronal and uneven movement of the teeth. In this case, the exposed margins of the restorations may have occurred because of possible airway issues.

Clinical Case Overview

A patient originally presented with a chief concern of being dissatisfied with the significant diastema between his maxillary central incisors (Figure 1 and Figure 2). The patient was considering maxillary veneers as a solution. After a thorough examination of the dentition and soft tissue and jaw relations, some minor esthetic issues in the dentition were noted and there were functional concerns with the current alignment in regard to satisfying the patient's chief concern; that is, the presenting diastema between the maxillary central incisors was too large to restore in the patient's existing alignment. Additionally, the anterior wear pattern on the patient's teeth indicated either a constricted or frictional chewing pattern (Figure 3). Therefore, pre-prosthetic orthodontic treatment was recommended as a conservative approach to both treat the patient's esthetic concerns and manage the functional challenge. The patient, however, opted to decline the orthodontic treatment recommendation at that time.

Two years later, the patient returned, having reconsidered the previous treatment plan recommendation. After data collection was updated and a complete evaluation was made of the patient's current condition, treatment recommendations were again discussed with the patient. In addition to having the large diastema, the patient was bimaxillary retrusive. This time, the patient accepted the proposed treatment plan. His medical history was noncontributory, although he reported a history of smoking. Dentally, the patient acknowledged the presence of worn surfaces on multiple posterior teeth, several sensitive teeth, and chronic clenching.

Risk Assessment

Periodontal: Stage I, grade B. Risk was moderate due to smoking; prognosis was fair (Figure 4). *Biomechanical:* Risk was low; prognosis was good. *Functional:* Risk was moderate due to a constricted chewing pattern or friction; prognosis was fair to poor. *Dentofacial:* Risk was low due to low lip dynamics; prognosis was poor because of the large maxillary central diastema and the patient's decision to forego orthodontic intervention.

The soft-tissue examination revealed prominent high labial lip and cheek frenums, both maxillary and mandibular, and a high tongue frenum. The patient also spoke with a moderate lisp.

Treatment Plan Sequence

The first phase of treatment involved performing full comprehensive orthodontic treatment to correct the functional concerns and improve alignment to predictably treat the esthetic challenges. Treatment steps included improving the curve of Spee by leveling the upper and lower occlusal planes and intruding teeth Nos. 4 and 5, which had supraerupted likely because of an ankylosed tooth T, and properly distributing the spacing between teeth Nos. 6 through 11 to achieve diastema closure with minimal restorative tooth preparation following orthodontics. The final objective was to establish a minimum of 1 mm overjet and overbite to allow horizontal space for an occlusal equilibration if needed. This treatment plan improved the functional risk and facilitated a predictable result of bilateral simultaneous occlusal contacts of equal intensity on the posterior teeth.

The second phase of treatment was the preparation, fabrication, and delivery of four maxillary porcelain veneers for teeth Nos. 7 through 10 and a CAD/CAM cohesive crown (CEREC®, Dentsply Sirona, dentsplysirona.com) on tooth T. Prior to restoring teeth Nos. 7 through 10 with the porcelain veneers, a facebow and bite registration were taken and a diagnostic wax-up was ordered on a mounted platform (Figure 5). The platform allowed the dental technician to properly distribute the spaces between teeth and plan for the future restorations. Despite the considerable advanced planning, a small diastema would need to remain in order to maintain proper size of the restorations with appropriate spacing. Preparation of teeth Nos. 7 through 10 for feldspathic porcelain veneers was minimally invasive (Figure 6), and a polyvinyl sulfate impression was taken. After approval of the try-in for margins, esthetics, and function, the prepared teeth were etched with 35% phosphoric acid, and a bonding agent (OptiBond™ SoloPlus, Kerr, kerrdental.com) was applied. The veneers were then bonded with a light-cure resin luting material (RelyX™ Veneer Cement, 3M Oral Care, 3m.com) (Figure 7) using glycerin gel to prevent formation of any oxygen-inhibiting layers at the margins. At the same appointment, tooth T was cohesively prepared and a crown (CEREC) was fabricated and cemented with a self-adhesive resin cement (RelyX™ Unicem, 3M Oral Care).

In the third phase of treatment, a palatal acrylic maxillary Hawley retainer was fabricated and delivered while the mandibular anterior teeth were stabilized with a fixed bonded wire from Nos. 22 through 27. The patient strictly followed the recommendation to wear the maxillary retainer daily following delivery.

Problems Surface at 3 Years

At a routine prophylactic appointment 3 years later, fremitus and mobility were noted on the maxillary and mandibular central and lateral incisors during clinical examination. The occlusion, which had been successfully treated 3 years earlier, had changed, and the tight envelope of function had returned.

A maxillary Kois deprogrammer (Kois Center, koiscenter.com) was fabricated and delivered.[1] The follow-up visit confirmed a differential diagnosis of constricted chewing pattern (CCP), as the first contact in centric relation (CR) was on the anterior incisors. CR could be used as the reference point because the patient had both a negative load and no joint sounds or pain resulting from an


Fig 1.


Fig 2.


Fig 3.

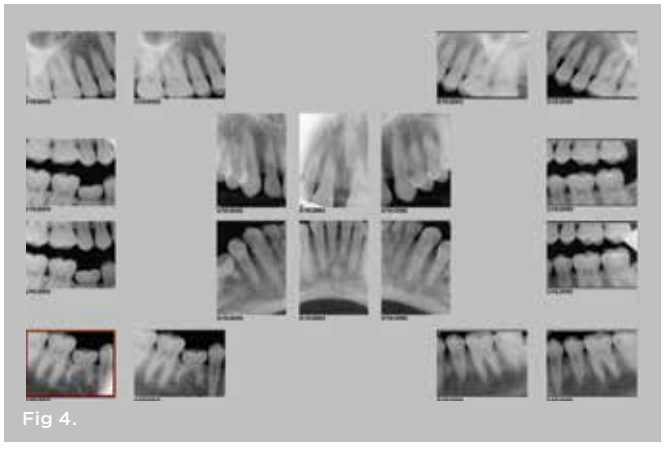
Fig 4.

Fig 1. Pretreatment frontal view of smile. Note large diastema between teeth Nos. 8 and 9. **Fig 2.** Pretreatment full-face smile. **Fig 3.** Pretreatment, patient in maximum intercuspation showing wear consistent with a frictional or constricted chewing pattern. **Fig 4.** Pretreatment full-mouth x-ray.

immobilization test. To help establish a stable, functional occlusion, the Kois deprogrammer was utilized to design orthodontic therapy and properly manage the CCP. The mandibular arch received orthodontic brackets to move teeth Nos. 23 through 26 lingually (Figure 8) and remove any premature centric occlusal contacts between the anterior incisors (Figure 9). The patient was fitted with a maxillary Hawley retainer and a mandibular Inman retainer.

Patient Returns After 11-Year Absence

Throughout the patient's care, he had always been a highly compliant and disciplined patient. Following treatment, however, he and his family moved out of state and left the practice. They were not heard from for 11 years when the patient's spouse contacted the office stating the patient planned to return to have the veneers replaced. His chief concern now was exposed, stained margins on the veneers.

The patient was asked to fill out current medical and dental history forms as well as a Lamberg sleep questionnaire© (LSQ) (https://drlamberg.com/storage/app/media/seminars/lq-14-final.pdf), which is designed to draw correlations between sleep quality and health. Additionally, current intraoral photographs and an updated panoramic x-ray were requested and received from the patient's dentist in his new hometown.

The patient's recent intraoral photographs indicated no structural failures of the porcelain veneers (Figure 10). There were no worn


Fig 5.


Fig 6.


Fig 7.


Fig 8.


Fig 9.


Fig 10.


Fig 11.


Fig 12.

Fig 5. Diagnostic wax-up. **Fig 6.** Minimally invasive porcelain veneer preparations on teeth Nos. 7 through 10. **Fig 7.** Post-treatment porcelain veneers Nos. 7 through 10. Note the maxillary and mandibular facial levels in relation to the canines (as indicated by the black horizontal lines). **Fig 8.** Kois deprogrammer and mandibular orthodontic brackets in place, at 3-year follow-up. **Fig 9.** Post-orthodontic treatment (6 o'clock view, top; inverted frontal view, bottom). Note the patient's anterior clearance of 1 mm to 2 mm. **Fig 10.** Maxillary occlusal view 14 years post-treatment. Note intact porcelain veneers Nos. 7 through 10. **Fig 11.** Mandibular occlusal view 14 years post-treatment. Note no wear on unrestored incisal edges of the anterior teeth. **Fig 12.** Gingival levels 14 years post-treatment. Note supraeruption of teeth Nos. 7 through 10 (especially No. 9) and Nos. 23 through 26 (as indicated by the black horizontal lines).


Fig 13.

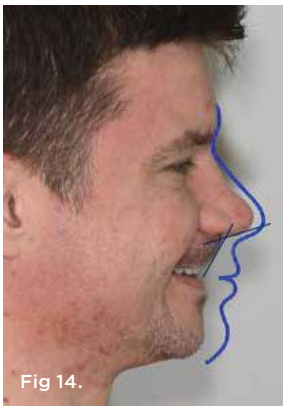
Fig 14.

Fig 13. Panoramic x-ray 14 years post-treatment. Note no radiographic bone loss. **Fig 14.** Patient's profile showing bimaxillary retrusion. Blue outline represents Bolton norm, used to asses maxillary and mandibular growth and development in the anterior-posterior direction. Straight lines show the obtuse angle between the lips and nose frequently found in people whose maxilla has not fully developed. **Fig 15.** Significant maxillary labial frenum visible at the patient's midline pretreatment. **Fig 16.** Pretreatment full-face photograph. Note scalloping of the tongue (right arrow) and mid-tongue dimple (lower arrow).


Fig 15.


Fig 16.

incisal edges or surfaces on either the maxillary veneers or mandibular unrestored anterior teeth (Figure 11). All the maxillary incisors had supraerupted, especially tooth No. 9, and the free gingival margins of the maxillary central and lateral incisors had migrated coronally (Figure 12). There was no radiographic bone loss, nor were there any increased pocket depths (Figure 13). The patient's profile indicated his unchanged maxillary and mandibular retrusion (Figure 14). Coronal migration of the gingival margins of the mandibular incisors was also noted, as was the significant labial frenum at the midline.

Risk Assessment: 14 Years Later

Fourteen years after the initial risk assessment, the patient's risk assessment was as follows:

Periodontal: Stage I, grade B. Risk was low, as both risk and status remained unchanged. *Biomechanical:* Risk was low, having remained unchanged. *Functional:* Risk was moderate (suspected, due to affirmative answers on dental history: anterior tooth position has changed, bite has changed, places his tongue between his teeth, bites his nails, and wears his retainers. Patient had acceptable function following treatment.) *Dentofacial:* Risk was low, having remained unchanged (due to low lip dynamics); however, the prognosis was now worse because the margins were exposed as the teeth moved unevenly, more incisally.

The patient's medical history had changed significantly since his previous history 14 years earlier. The patient now reported that he was taking the hormone testosterone and suffering from frequent sinus congestion. Additionally, on the LSQ screening questionnaire, he expressed frequently feeling exhaustion, tingling in the arms, muscle weakness, irritability in the morning, and a diminished sexual drive. These complaints were literature-supported signs and symptoms associated with airway concerns such as breathing and sleep disorders.[2-4]

"Red Flags" Were Present

In hindsight, the patient presented 14 years prior with many clinical forewarnings for airway concerns, including tethered oral soft tissue beneath the tongue and a significant lip frenum (Figure 15), which can negatively affect tooth position.[5-8] The scalloping of the tongue and a mid-tongue dimple were also evident (Figure 16); a prominent mid-tongue dimple on the dorsum of the tongue is often indicative of a tongue tie.[9,10] His historical profile and current profile photographs showed he had bimaxillary retrusion, which is a common risk factor in patients with sleep-disordered breathing.

Usual and frequent causes of dental restorative failures are often found in the periodontal, biomechanical, or functional areas. It is noteworthy that the patient's current dental history indicated that his teeth had changed in the previous 5 years and he frequently placed his tongue between his teeth. Clinically, the cervical margins had changed and teeth had supraerupted. Although the cervical margins could have been a result of toothbrush abrasion, that would not explain the supraeruption of the teeth and the change in tooth position. The actual cause(s) appeared to be much more complex and multifactorial.

The recent presenting clinical scenario, 14 years after a successful treatment result, as well as the need to determine a predictable new treatment plan, poses important questions: What caused the teeth to move and to move unevenly? In retreating the patient, how predictable would it be to treat him in a similar manner and expect a different long-term result? What was the etiology of the failure, and could it be found in the dental or medical literature? Were there clinical signs and symptoms or clues in the patient's histories, LSQ, or data collection? Could changes in the teeth, such as supraeruption, malalignment, wear, or erosion, be signs associated with a medical risk rather than an isolated problem? Could the soft tissue, tongue, and buccal and labial frenums, even several years prior, have provided forewarnings of an unstable outcome? Did the patient's structural anatomy, evident in his profile photographs, present "red flags"?

A patient's positive answers on the LSQ are indicative of sleep-disordered breathing and should trigger suspicion of potential

breathing, sleep, and soft-tissue dysfunction, the latter of which encompasses proven causes (eg, tattered tissue, mouth breathing, reverse swallowing, etc) of post-orthodontic treatment instability. If such dysfunction is diagnosed and rectified, or at least improved, before restorative treatment, the long-term outcome and stability will be greatly enhanced. As for occlusal changes, since there is no evidence in the literature about the inherent ability of teeth to move on their own past the eruption stage, then continuous forces, whether light or strong, are the cause, which must originate from the muscles; hence, the need for soft-tissue stabilization.

This case illustrates the potential complications that can result from unrecognized signs of patient airway issues. Left untreated, such issues can significantly negatively impact long-term success of dental restorative treatment and patient systemic health. Additionally, it presents the importance of proper screening and discussion with patients regarding their risks, both dental restoratively and medically.

To paraphrase Machiavelli, the 16th century Italian statesman, diplomat, and philosopher: "...because, in the beginning, diagnosis is hard, but the treatment is easy. Later, the diagnosis becomes easy, but the treatment is hard, if at all possible."[11]

ABOUT THE AUTHOR

Bozidar L. Kuljic, DDS
Private Practice, Beverly and Newburyport, Massachusetts; Fellow, Academy of General Dentistry

REFERENCES

1. Revilla-León M, Zeitler JM, Kois DE, Kois JC. Utilizing an additively manufactured Kois deprogrammer to record centric relation: a simplified workflow and delivery technique. *J Prosthet Dent*. 2022:S0022-3913(22)00364-X. doi: 10.1016/j.prosdent.2022.04.034.
2. Vizcarra-Escobar D, Duque KR, Barbagelata-Agüero F, Vizcarra JA. Quality of life in upper airway resistance syndrome. *J Clin Sleep Med*. 2022;18(5):1263-1270.
3. Bao G, Guilleminault C. Upper airway resistance syndrome—one decade later. *Curr Opin Pulm Med*. 2004;10(6):461-467.
4. Stevens D, Appleton S, Vincent AD, et al. Associations of OSA and nocturnal hypoxemia with strength and body composition in community dwelling middle aged and older men. *Nat Sci Sleep*. 2020;12:959-968.
5. Maspero C, Prevedello C, Giannini L, et al. Atypical swallowing: a review. *Minerva Stomatol*. 2014;63(6):217-227.
6. Proffit WR. Equilibrium theory revisited: factors influencing position of the teeth. *Angle Orthod*. 1978;48(3):175-186.
7. Jalaly T, Ahrari F, Amini F. Effect of tongue thrust swallowing on position of anterior teeth. *J Dent Res Dent Clin Dent Prospects*. 2009;3(3):73-77.
8. Mills N, Pransky SM, Geddes DT, Mirjalili SA. What is a tongue tie? Defining the anatomy of the in-situ lingual frenulum. *Clin Anat*. 2019;32(6):749-761.
9. Zhao Z, Zheng L, Huang X, et al. Effects of mouth breathing on facial skeletal development in children: a systematic review and meta-analysis. *BMC Oral Health*. 2021;21(1):108.
10. Walsh J, McKenna Benoit M. Ankyloglossia and other oral ties. *Otolaryngol Clin North Am*. 2019;52(5):795-811.
11. Machiavelli N. *The Prince*. Bull G, trans-ed. London, England: Penguin Classics; 2003.