OVERVIEW

A Modified Monobloc for Treatment of Young Children with Obstructive Sleep Apnea

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(Editor's Note: In this quarterly column, JCO provides a brief overview of a clinical topic of interest to orthodontists. Contributions and suggestions for future subjects are welcome.)

Obstructive Sleep Apnea (OSA) is a common chronic disorder of sleep and breathing characterized by intermittent upper airway obstruction during sleep.[1] It has a number of harmful effects, including excessive snoring, increased daytime sleepiness, and reduced cognitive functions.[2] Failure to diagnose and treat OSA, especially in children, can result in serious consequences, including enuresis, growth retardation, lack of performance in school, neurobehavioral problems, cardiorespiratory failure, and even death.[3]

OSA occurs in 1.5-2.5% of children, with approximately equal percentages of boys and girls. The peak incidence in children is between the ages of 2 and 6. In contrast to the predominance of obesity in adult OSA patients, the majority of children with OSA are of normal weight.[4-6]

The polysomnographic features of childhood OSA also differ from those of adults. The overall obstructive apnea indices are lower, and instead of repetitive discrete obstructive apneas, children often exhibit a pattern of partial obstructive hypoventilation, characterized by snoring, paradoxical rib-cage motion, phasic oxyhemoglobin desaturation, and hypercapnia.[4,7]

A number of abnormal cervicocraniofacial structures have been reported in adult patients, such as retrognathism of the maxilla and mandible, increased lower facial height, reduced anteroposterior size of the bony pharynx, an enlarged soft palate and tongue, diminished posterior airway space, and inferior positioning of the hyoid bone.[8] In children, the skeletal relationship is significantly more likely to be Class II, with a reduced mandibular length, an increased overbite, a more superior position of the hyoid bone, and shorter first and second deciduous intermolar distances.[9]

Treatment of OSA depends upon the severity of symptoms, the magnitude of clinical com-

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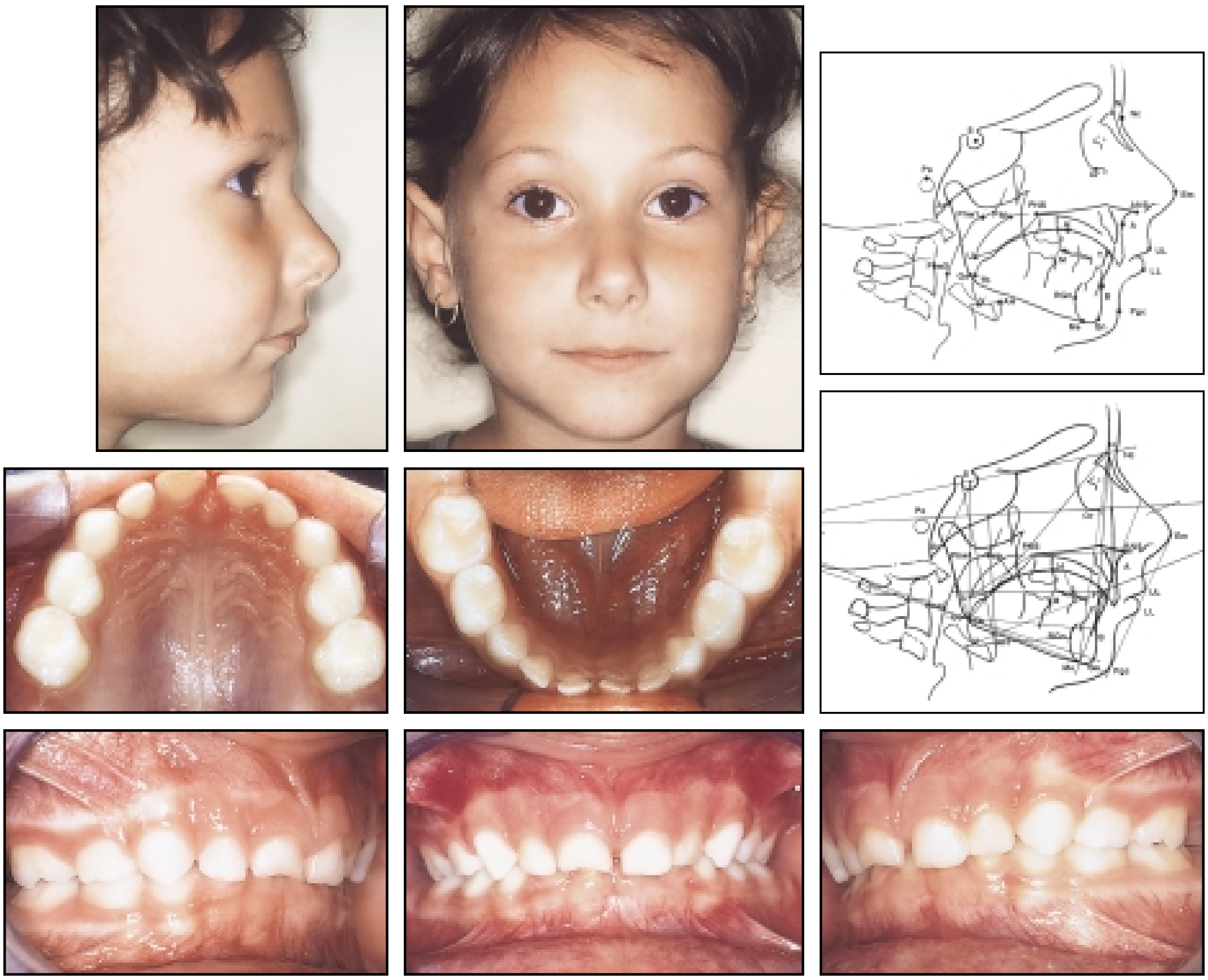

Fig. 1 4½-year-old female patient with Obstructive Sleep Apnea before treatment.

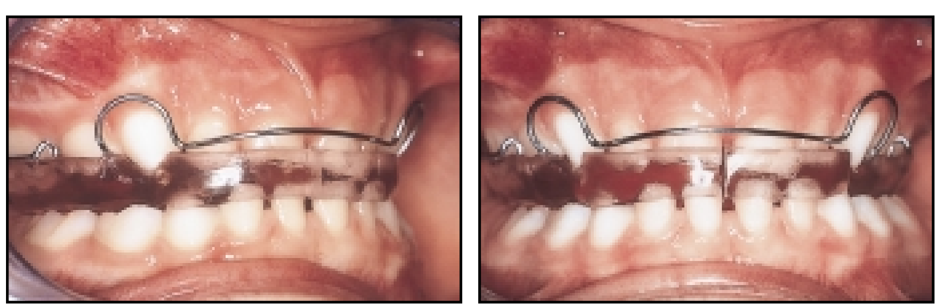

Fig. 2 Modified Monobloc appliance in place.

plications, and the etiology of the upper airway obstruction. It is directed primarily toward improving the airflow by various surgical and nonsurgical methods.[1,8] Nasal continuous positive air pressure (nCPAP) is the most common treatment technique, but some patients are unable or unwilling to tolerate it on a long-term basis.[1] Oral appliances have been recommended for patients with mild to moderate OSA who cannot tolerate or refuse treatment with nCPAP, and for patients who are not surgical candidates.[1] These modified functional appliances can be divided into two general categories: tongue retaining devices and mandibular advancing devices.[1,10]

The present article investigates the effects on craniofacial structures of a new orthodontic appliance, the Modified Monobloc, which incorporates features of both types of oral appliances, in a habitually snoring child with OSA.

Case Report

A 4½-year-old female was referred to the orthodontic department by her pediatrician. She presented with a polysomnographic diagnosis of moderate OSA (Table 1). Her chief complaints, as described by the child and her parents, were of loud snoring, disturbed sleep characterized by recurrent apneic periods (confirmed by polysomnographic studies), and pronounced daytime sleepiness. Her Body Mass Index (BMI) was $14kg/m^2$.

The patient's face was symmetrical, with a convex profile and a short lower anterior face (Fig. 1). The lips were competent, and the patient displayed good oral hygiene with no periodontal problems. She was in the deciduous dentition, with a Class II molar and canine relationship and excessive overbite and overjet. The panoramic radiograph demonstrated the presence of permanent dental successors.

Cephalometric analysis (Table 2) showed a Class II skeletal pattern with mandibular retrognathia (SNA = 82°, SNB = 75°, ANB = 7°) and excessive overbite (6mm) and overjet (4.5mm). The angles of skeletal divergence were slightly low (FMA = 22.5°, SN-GoGn = 30°). The position of the hyoid bone was superior and posterior (AH-FH = 53mm, AH-RGn = 31mm, AH-SN = 68mm).

TABLE 1
POLYSOMNOGRAPHIC REGISTRATIONS

	Pre-tmt.	9 Mos.	18 Mos.	24 Mos.
Apnea Index	4.6	0.7	0.3	0.0
Apnea-Hypopnea Index	6.3	1.8	1.4	0.6

A Modified Monobloc was designed like an activator to avoid undesirable anterior dental movements. It was fabricated from transparent acrylic resin, with full tooth coverage in both arches and a central screw (Fig. 2). The incisal edges and superior labial surfaces of the mandibular incisors were capped to prevent tipping. The construction bite positioned the mandible anteriorly into an edge-to-edge incisal relationship, 3mm short of maximum protrusion, with care taken to avoid lateral displacement. The bite opening exceeded the freeway space by 2-3mm.

The patient was instructed to wear the appliance full-time for the first week and then at night only. After a week of adjustment, the patient and her parents reported good compliance.

During treatment, contact was maintained between the appliance and the maxillary posterior teeth, and the screw was activated only enough to follow transverse maxillary growth. The mandibular posterior teeth were encouraged to erupt by trimming the acrylic occlusal and lingual to them.

A lingual arch was inserted for attachment of Class II elastics, which were worn only when necessary to prevent jaw opening and maintain the mandibular position (Fig. 3). A Tucat's Pearl, sliding on a wire in the anterior lingual portion of the appliance, was added as a reference point for the tongue. This device places the tip of the tongue against the palatal aspect of the alveolar process, behind the maxillary incisors, to improve muscle function and habitual tongue posi-

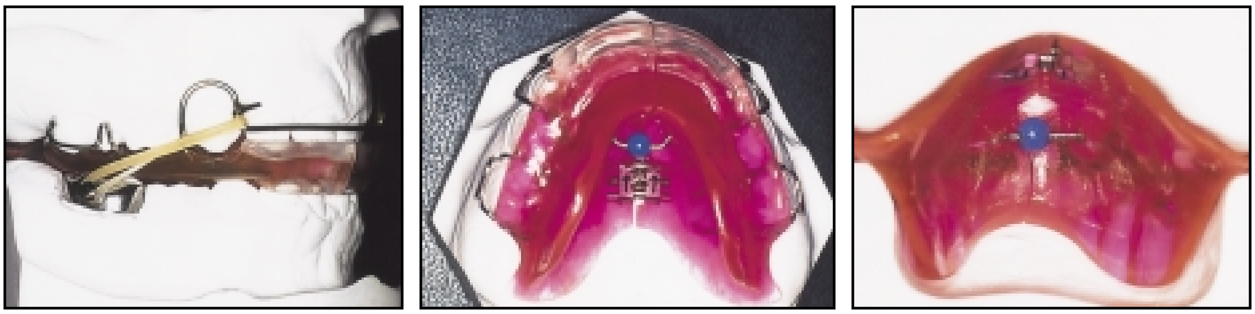

Fig. 3 Class II elastics and Tucat's Pearl added to appliance.

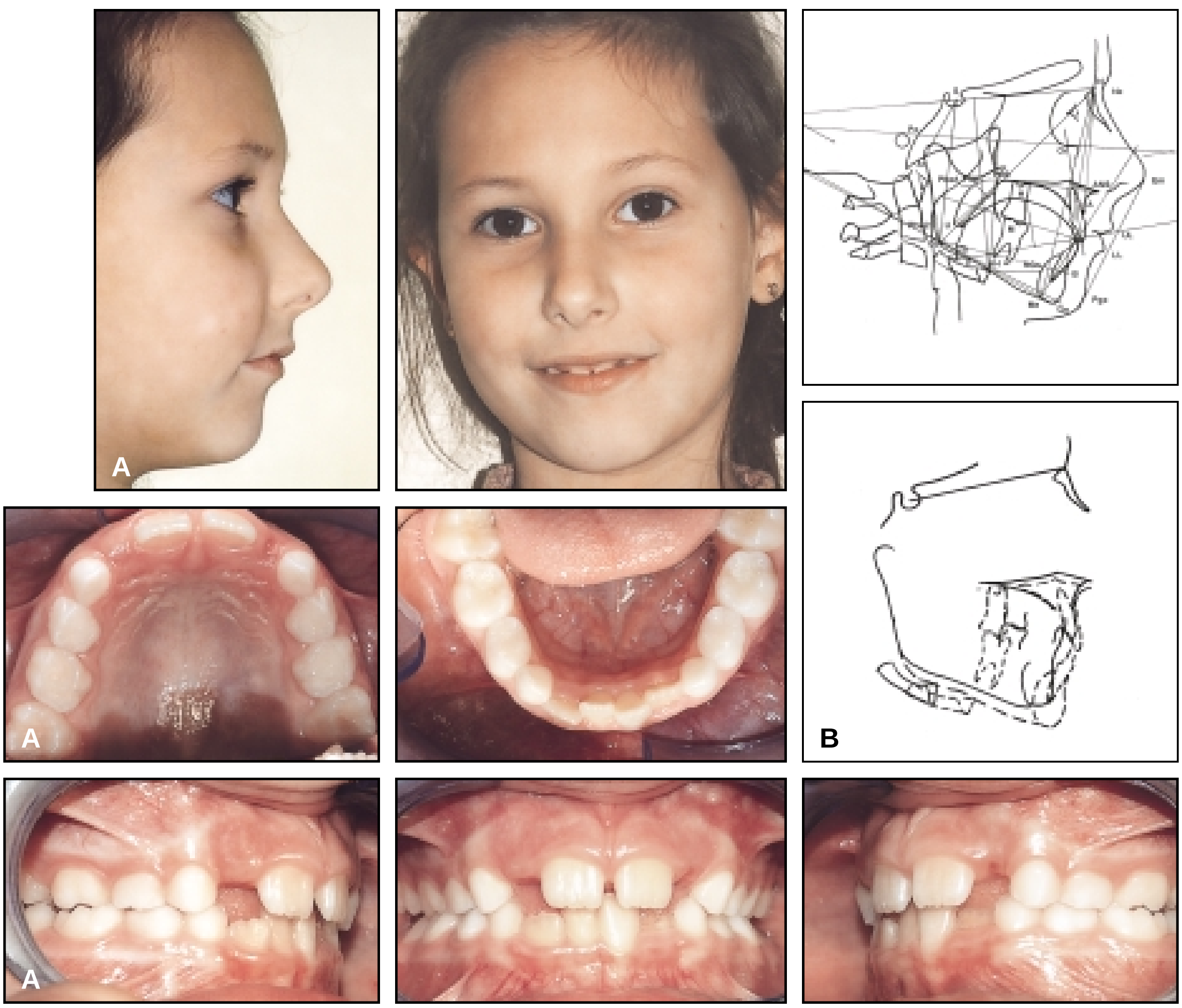

Fig. 4 A. Patient after 18 months of therapy with Modified Monobloc. B. Superimposition of cephalometric tracings before and after treatment.

tioning.[14]

Polysomnographic registrations were carried out nine, 18, and 24 months after appliance insertion. The Apnea-Hypopnea Index decreased from 6.3 to 1.8 after nine months, to 1.4 after 18 months, and to .6 after 24 months of therapy with the oral appliance (Table 1). The Apnea Index decreased from 4.6 to 0.7 after nine months, to .3 after 18 months, and to 0 after 24 months. After 18 months of treatment, the patient's BMI was 16kg/m^2.

Cephalometric analysis after 18 months of therapy (Table 2) showed a Class I skeletal relationship (SNA = 80°, SNB = 76°, ANB = 4°) and an ideal overbite and overjet (each 1mm). The skeletal divergence angles were normal (FMA = 25°, SN-GoGn = 32°). The hyoid bone was lower and more forward (AH-FH = 57mm, AH-RGn = 22mm, AH-SN = 75mm). Clinical examination after treatment confirmed a normal profile, overbite, and overjet (Figs. 4,5).

The appliance had no adverse effects on the

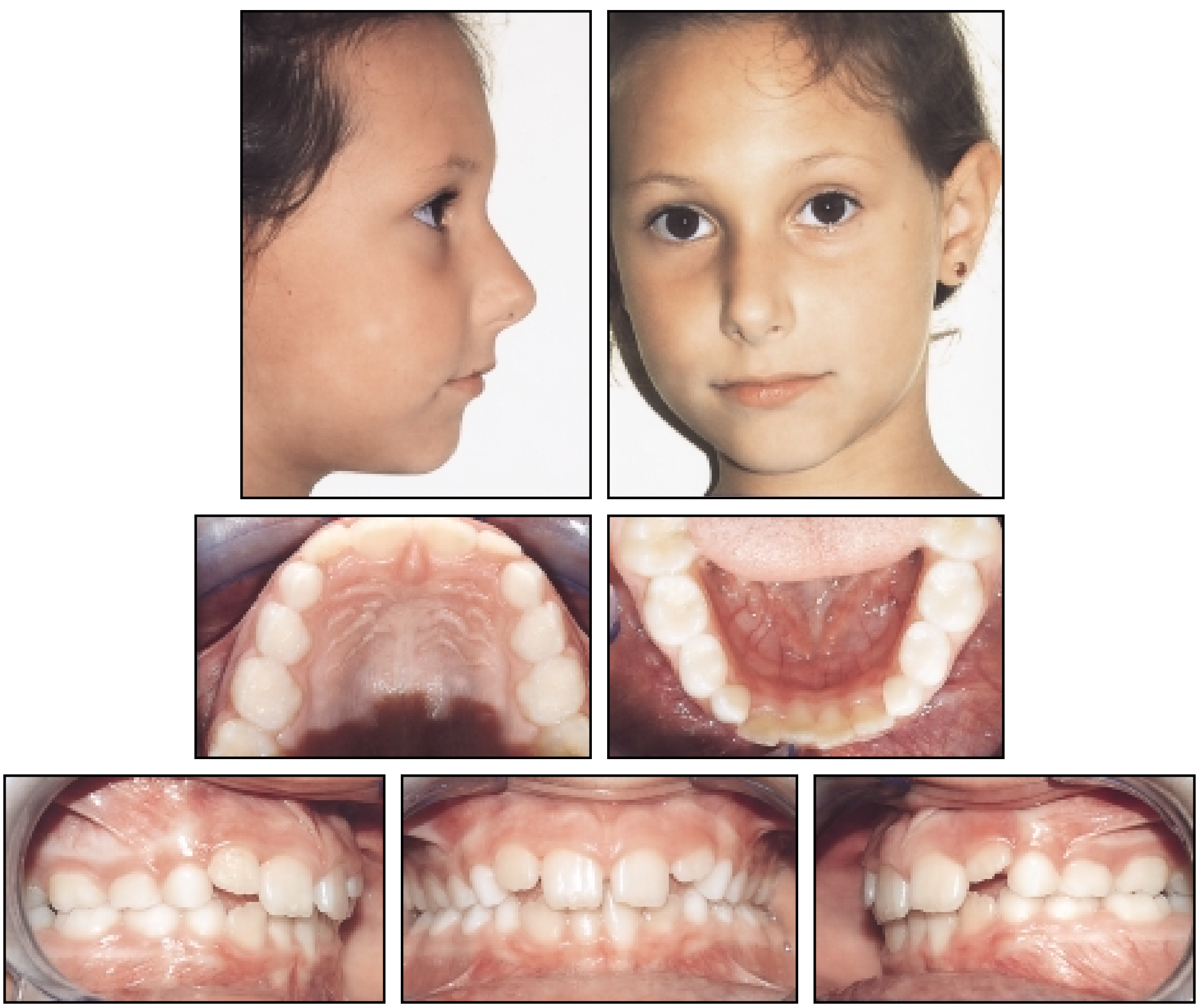

Fig. 5 Patient one year after treatment.

TABLE 2
CEPHALOMETRIC DATA

	Pre-treatment	Post-Treatment
Sagittal Analysis		
SNA	82.0°	80.0°
SNB	75.0°	76.0°
ANB	7.0°	4.0°
Go-Me	58.0mm	63.0mm
ANS-PNS	42.0mm	42.0mm
Vertical Analysis		
FMA	22.5°	25.0°
SN-GoGn	30.0°	32.0°
S-Go/N-Me	65.0%	65.0%
Dental Analysis		
IMPA	89.0°	94.0°
FMIA	68.5°	61.0°
1-FH	88.5°	110.0°
Overjet	4.5mm	1.0mm
Overbite	6.0mm	1.0mm
Esthetic Analysis		
E line-Upper lip	–0.5mm	–2.0mm
E line-Lower lip	1.0mm	–1.0mm
Growth Prediction		
NS-SAr	124.5°	123.5°
SAr-ArGo	139.0°	141.0°
ArGo-GoMe	130.0°	131.0°
ArGo-GoN	59.0°	56.0°
NGo-GoMe	71.0°	75.0°
Total	393.5°	394.5°
Hyoid Bone		
AH*-FH	53.0mm	57.0mm
AH-RGn	31.0mm	22.0mm
AH-SN	68.0mm	75.0mm
Tongue		
VT** distance	58.0mm	52.0mm
VT height	14.0mm	13.0mm
VT-FH	19.0°	20.0°
Soft Palate		
U***-PNS	31.0mm	28.0mm
SPT	9.0mm	8.0mm
CL	6.0mm	4.0mm
Pharynx		
Phw1-Psp†	9.0mm	8.0mm
Phw2-Tb‡	11.0mm	11.0mm
MPW††	9.0mm	8.0mm

teeth or gingivae. The parents reported that the patient was no longer sleepy during the day, and that her snoring and night-time arousals had disappeared.

Discussion

During sleep, when the masticatory muscles are physiologically relaxed, the mandibular complex can move backward and close the airflow in the upper airway space.[8] In such situations, the Modified Monobloc may be more effective than a passive functional appliance, because it prevents closing by providing continuous mandibular advancement and holding the tongue in an anterior position.

In this case, the monobloc also produced a long-term improvement in the positions of the bones and tongue. It increased the intermaxillary space in which the tongue rests, brought the tongue upward and forward, and brought the hyoid bone downward and forward, resolving the skeletal Class II malocclusion.

*AH = the most anterior and superior point on the body of the hyoid bone, representing the inferior part of the tongue.

**V = the intersection of the epiglottis and the base of the tongue; T = the tip of the tongue.

***U = the tip of the uvula.

†Phw1-Psp = superior posterior airway space, measured along a line parallel to BGo.

‡Phw2-Tb = inferior airway space, measured along BGo between the posterior pharyngeal wall and the dorsum of the tongue.

††MPW = middle pharyngeal wall, the intersection of a perpendicular from U to the posterior pharyngeal wall.[11-13]

REFERENCES

1. Lowe, A.A.; Sjöholm, T.T.; Ryan, C.F.; Fleetham, J.A.; Ferguson, K.A.; and Remmers, J.E.: Treatment, airway and compliance effects of a titratable oral appliance, Sleep 23:172S-178S, 2000.
2. Tangugsorn, V.; Krogstad, O.; Espeland, L.; and Lyberg, T.: Obstructive sleep apnea: A canonical correlation of cephalometric and selected demographic variables in obese and nonobese patients, Angle Orthod. 71:23-35, 2001.
3. Rosen, C.L.: Obstructive sleep apnea syndrome (OSAS) in children: Diagnostic challenges, Sleep 19:274S-277S, 1996.
4. Rosen, C.L.; D'Andrea, L.; and Haddad, G.G.: Adult criteria for obstructive sleep apnea do not identify children with serious obstruction, Am. Rev. Respir. Dis. 146:1231-1234, 1992.
5. Carroll, J.L.; McColley, S.A.; Marcus, C.L.; Curtis, S.; Loughlin, G.M.: Inability of clinical history to distinguish primary snoring from obstructive sleep apnea syndrome in children, Chest 108:610-618, 1995.
6. Marcus, C.L.: Obstructive sleep apnea syndrome: Differences between children and adults, Sleep 23:140S-141S, 2000.
7. Brouillette, R.T.; Fernbach, S.K.; and Hunt, C.E.: Obstructive sleep apnea in infants and children, J. Pediat. 100:31-40, 1982.
8. Bernhold, M. and Bondemark, L.: A magnetic appliance for treatment of snoring patients with and without obstructive sleep apnea, Am. J. Orthod. 113:144-155, 1998.
9. Cozza, P.; Polimeni, A.; and Ballanti, F.: A modified monobloc for the treatment of obstructive sleep apnoea in paediatric patients, Eur. J. Orthod., in press.
10. Rose, E.; Staats, R.; Virchow, C.; and Jonas, I.E.: A comparative study of two mandibular advancement appliances for the treatment of obstructive sleep apnoea, Eur. J. Orthod. 24:191-198, 2002.
11. Pracharktam, N.; Hans, M.G.; Strohl, K.P.; and Redline, S.: Upright and supine cephalometric evaluation of obstructive sleep apnea syndrome and snoring subjects, Angle Orthod. 64:63-74, 1994.
12. Tangugsorn, V.; Skatvedt, O.; Krogstad, O.; and Lyberg, T.: Obstructive sleep apnoea: A cephalometric study, Part I: Cervico-craniofacial skeletal morphology, Eur. J. Orthod. 17:45-56, 1995.
13. Tangugsorn, V.; Skatvedt, O.; Krogstad, O.; and Lyberg, T.: Obstructive sleep apnoea: A cephalometric study, Part II: Uvulo-glossopharyngeal morphology, Eur. J. Orthod. 17:57-67, 1995.
14. Cozza, P.; Polimeni, A.; and De Toffol, L.: *Manuale di Terapia Miofunzionale*, Masson, Milan, Italy, 2002.