Skeletal class II malocclusion caused by mouth breathing in a pediatric patient undergoing treatment by interceptive guidance of occlusion

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Abstract
A 7-year 10-month-old boy was evaluated for mouth breathing and snoring habits. Examination revealed soft convex tissues, maxillary protrusion, mandibular retraction, and a class II sagittal osteofacial pattern. The patient failed a water holding test. He was clinically diagnosed with skeletal class II malocclusion caused by mouth breathing. Under interceptive guidance of occlusion (iGo), the malocclusion improved with fixed maxillary expansion using functional appliances and interventional treatment of mouth breathing by lip closure exercises. These treatments enabled the patient to gradually return to nasal breathing and guided him to develop physiological occlusion for a coordinated jaw-to-jaw relation. At the 5-year 2-month post-correction follow-up visit (at the age of 13 years), the patient had stable occlusion, a coordinated osteofacial pattern, and normal dentition, periodontium, and temporomandibular joints.

Keywords
Interceptive guidance of occlusion, mouth breathing, mixed dentition children, skeletal class II malocclusion, lip closure exercise, fixed maxillary expansion, early treatment appliance, case report

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**Introduction**

Long-term mouth breathing changes the temporomandibular joint structure and periarticular muscle groups, causing class II malocclusion and affecting the maxillofacial appearance and development. Interceptive guidance of occlusion (iGo) in pediatric patients allows for regular observation of the maxillofacial development and timely application of jaw correction, dental arch shaping, tooth alignment, and retention of eruption induction-based occlusion development based on the patients’ functional occlusion development. This treatment enables children to develop physiological occlusion by the age of 12 years and realize stable occlusion and a coordinated facial appearance. We herein report a case of skeletal class II malocclusion caused by mouth breathing in pediatric patient undergoing iGo with fixed maxillary expansion using an early treatment appliance (ETA) and lip closure exercises.

**Case report**

A 7-year 10-month-old boy of Han nationality visited the Department of Pediatric Dentistry, College of Stomatology of Guangxi Medical University on 3 December 2013 because of lip and teeth exposure that affected his facial appearance. His mother denied systemic diseases or a history of drug allergy, but she noted that he had mouth breathing and snoring habits. The patient had a mandibular deficiency similar to that of his father. Facial and temporomandibular joint examinations showed a bilaterally symmetrical raised face and normal temporomandibular joints. Oral examination showed the stage of dentition replacement, a molar distal relationship, deep overbite, deep overjet, 11 and 21 tipping, 0.5-mm spaces in 11 and 21, a narrow upper dental arch, a highly arched palatal cover, crowded lower front teeth, and 3-mm offsetting of the mandibular midline to the right (Figure 1(a)–(e)).

A preoperative panoramic radiograph (Figure 1(f)) on 6 December 2013 showed the stage of mixed dentition; a normal number of teeth; a normal order of replaced teeth; caries of dental crowns at 55, 54, 74, 84, and 85; periapical lesions of 74; and disappearance of the dental follicle and ectopic tooth germ of 34. Cephalometric analysis (Figure 1(g)) showed maxillary excess (SNA of 85.8°), normal mandibular development (SNB of 79°), skeletal class II (ANB of 6.3°), even angles, protrusion of the upper anterior teeth, and lingual inclination of the lower anterior teeth. The adenoid-nasopharyngeal ratio was 0.69, suggesting moderate adenoid hypertrophy. Estimation from Moyers’ table showed moderate upper dentition crowding (−6 mm) and mild lower dentition crowding (−2 mm). The patient failed a water holding test. He was diagnosed with mouth breathing and skeletal class II malocclusion.

**Treatment process**

1. **Odontotherapy**: Necrotic tissue was removed and a filling was placed at 54, and 74 was removed (before the correction).
2. A maxillary spiral expander (Figure 2(a)) was used to improve crowding (for 3 months from December 2013 to March 2014), and lip closure exercises were intensified (15 minutes every day until the end of the correction).
3. Fixed correction using a 2 × 4 appliance (Figure 2(b)–(f)) was performed to align the front teeth, and a transpalatal arch was used to maintain the gaps between the front teeth and the lower hyoid arch (for 3 months from April 2014 to July 2014).
4. The ETA was worn at night, and lip stickers were used to help intervene in
mouth breathing (for 6 months from August 2014 to January 2015).

5. Retaining stage: A Hawley retaining appliance (Figure 3(a), (b)) was worn in the daytime (for 6 months from February 2015 to September 2015), and the ETA (Figure 3(c), (d)) was worn during sleep at night to retain eruption induction-based occlusion development.

**Treatment outcome**

At the 5-year 2-month post-correction follow-up visit (when the patient was 13...
years old), the patient had stable occlusion, a coordinated osteofascial pattern, and normal tooth bodies, periodontium, and temporomandibular joints (Figure 4). The lateral cephalometric superimposition before and after the correction is shown in Figure 5.

Discussion
Children are in the active growth and development stage; thus, their craniofacial bones, dental occlusions, and facial soft tissues are dynamically changing. Children with chronic rhinitis, adenoid hypertrophy, tonsil hypertrophy, and nasal septum deviation may develop mouth breathing because the upper airway is completely or partially obstructed, causing all or partial airflow to enter the lower airway through the mouth, oropharyngeal cavity, and laryngopharyngeal cavity rather than the nasal cavity. Mouth breathing changes the temporomandibular joint structure and periarticular muscle groups, resulting in regular mouth breathing. This causes malocclusion (often class II malocclusion) as well as changes in the maxillofacial soft and hard tissues, which in turn affects the maxillofacial appearance and development.3–6 The patient in the present case had mouth breathing and snoring habits, and examination showed soft convex tissues, a protruded maxilla, a retruded underjaw, and a class II sagittal osteofascial pattern; he was thus diagnosed with skeletal class II malocclusion caused by mouth breathing.

The available treatments for skeletal class II malocclusion caused by mouth breathing are early functional correction, camouflaged orthodontic treatment, and combined orthodontic and orthognathic treatment. Because of the growth potential in teenagers with skeletal class II diseases, the use of functional appliances can inhibit the growth of the maxilla and enhance the growth of the mandible.7,8 The patient in this case was 7 years 10 months old and at

Figure 3. Eruption induction-based occlusion development and mouth breathing intervention. (a) Hawley retaining appliance. (b) Hawley retaining appliance (centric occlusion). (c) Early treatment appliance. (d) Lip sticker.
Figure 4. Treatment outcome. (a–f) Intraoral photographs at the end of the correction (captured on 14 February 2019). (g, h) During the correction (captured on 5 April 2017) and intraoral photographs at the late stage (captured on 16 August 2018). (i) Lateral cephalogram after treatment (captured on 16 August 2018).

Figure 5. Lateral cephalometric superimposition before and after the correction (black: before the correction; red: after the correction).
the stage of mixed dentition; thus, his den-
tition disorder was treated in a timely
manner to lower the severity of malocclu-
sion. We use iGo for pediatric occlusion
induction to promptly intervene in oral
problems in children via jaw correction,
dental arch shaping, tooth alignment, and
eruption induction-based occlusion develop-
ment technologies from the time of pri-
mary occlusion (age of 3 years) to
permanent occlusion replacement (age of 6
years) and to primary development of per-
manent dentition (age of 12 years). This
intervention helps guide the development
of physiological occlusion and realize
stable occlusion and a coordinated facial
appearance.

The skeletal class II malocclusion in our
patient was mainly caused by changes in the
maxillofacial soft and hard tissues due to
long-term mouth breathing. Traditional
appliances to intervene in mouth breathing
are vestibular shields and lip bumpers. In
this case, lip stickers were used to intervene
in the patient’s habitual mouth breathing,
and a fixed maxillary expander was used to
improve crowding and broaden the dental
arch. The width of the nasopharynx cavity
subsequently increased, and the palatal
vault was lowered while the median palatine
suture was enlarged. This reduced the nasal
ventilation resistance, and the patient gradu-
ally returned to nasal breathing. In addi-
tion, functional appliances were used to
improve the malocclusion by guiding the
development of physiological occlusion,
which eventually realized jaw-to-jaw coor-
dination. Common functional appliances
include activators, the Twin Block, the
Bionator, the Herbst appliance, the Forsus
appliance, the Jasper Jumper, and muscle
function trainers.9

A muscle function trainer is a simple,
convenient, and comfortable device that
can effectively build oral muscle balance
and adduct the upper incisor teeth. This
appliance has been used to correct mouth
breathing and treat skeletal class II maloc-
clusion, and it has received widespread
attention in recent years.10–12 For our
patient, we used an ETA and lip closure
exercises to restore and reshape the
normal width of the upper and lower
dental arches, improve the deep cover of
the deep-overbite occlusion, and exercise
the perioral muscle functions while correct-
ing the jaw positions and abnormal tooth
relationships. These measures established a
balance between occlusal functions and
perioral neuromuscular functions to realize
respective physiological occlusion.

The success of such treatment is largely
determined by the clinician’s adoption of a
treatment regimen based on iGo according
to the patient’s dentition, jawbone charac-
teristics, facial soft tissue profile, and
growth potential.

At the 5-year 2-month follow-up visit
after the correction (when the patient was
13 years old), the patient had stable occlu-
sion, a coordinated osteofascial pattern,
and normal tooth bodies, periodontium,
and temporomandibular joints.

Research ethics and patient consent
The study was performed in accordance with the
World Medical Association Declaration of
Helsinki. This study was approved by the
Ethics Committee of College of Stomatology of
Guangxi Medical University (approval no.
20210148). Written informed consent was
obtained from the patient.

Data availability
The datasets used and analyzed during the cur-
rent study are available from the corresponding
author on reasonable request.

Declaration of conflicting interest
The authors declare that there is no conflict of
interest.
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