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Management of skeletal open bite with repelling magnets: A review

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Abstract
The treatment of skeletal open bite poses significant challenges for orthodontists, traditionally managed through either anterior tooth extrusion or posterior teeth intrusion. This review evaluates the use of repelling magnets embedded in occlusal bite blocks as a non-surgical alternative for managing skeletal open bite. The case report of a 13-year-old female patient illustrates the effectiveness of this approach. Treatment involved the use of neodymium-iron-boron magnets within acrylic bite blocks to intrude posterior teeth, leading to autorotation of the mandible and closure of the anterior open bite. Over 4.5 months, the patient achieved 2.8 mm of bite closure and 1.6 mm intrusion of the posterior teeth, significantly improving occlusal and skeletal alignment. The results demonstrate that magnetic bite blocks can offer a rapid and effective non-invasive solution for skeletal open bite in growing patients. Long-term stability and potential for relapse remain areas for further research.

Keywords: Open bite, magnets, vertical malocclusion, bite blocks, molar intrusion

Introduction
The difficulties which arise during treatment of anterior open bites has challenged many orthodontists. Treatment of this malocclusion has been based on one of the following principles: extrusion of the anterior teeth, which is often unsatisfactory due to a poor aesthetic result; and intrusion of the posterior teeth, resulting in autorotation of the mandible anteriorly [1]. In anterior open bite cases, the most frequent attempts for correction have found to be extraction of posterior teeth and the use of vertical elastics. If the skeletal open bite or hyperdivergent type is to be successfully managed, one has to apply a muscle-like force to intrude the posterior teeth, preventing the descent of maxilla and moving it superiorly [2]. Sarver and Weissman [3] proposed some useful guidelines for the nonsurgical treatment of adult patients with open bite who have no potential for growth modification. It was emphasized that there were a limited number of open bites that are amenable to the treatment that included extraction and retraction and the patients who are candidates for this type of therapy should have proclined or procumbent maxillary or mandibular incisors, little or no gingival display on smile, normal craniofacial pattern, and with no more than 2 to 3 mm of upper incisor exposure at rest. The true skeletal open bite patient requires a coordinated orthodontic and orthognathic surgical approach to achieve a stable occlusion, acceptable esthetics, and improved function [4-6].
Use of occlusal bite blocks containing repelling magnets has been proposed as the treatment procedure for patients who have anterior open bites [11, 12] The repelling force of the opposing magnets is reported to cause intrusion of the posterior teeth, allowing the mandible to rotate upward and forward in much the same way that it would if the maxillae were surgically impacted [10]. Posterior bite blocks have been shown to be effective in producing condylar growth and forward rotation of the mandible. Bite blocks could be passive or made active by addition of active elements such as springs or magnets [8, 11-13]. Although the appliance has been used successfully in both children and adults, growing children experience more rapid results that adult patients. This appliance is a less invasive alternative to surgical correction of the skeletal open bite [7].

Case Report

A 13-year-old female reported to the Government Dental College and Hospital, Aurangabad with a chief complaint of space between the teeth while biting. The patient reported with no medical history or ongoing medications, and had no previous dental treatment undertaken. Upon intra oral examination, it was seen that the patient had an anterior open bite present which was measured to be 4.2 mm with the help of digital vernier callipers. with mild crowding in the upper teeth, and the open bite extended from 1st premolar on the right side to the 1st premolar on the left side with a single tooth crossbite on the right side upper and lower 1st molar region. Facial analysis revealed that the patient had incompetent lips, with a normal incisal display on smiling, with a flat smile arc and deficient chin with an acute nasolabial angle and a tendency towards vertical growth. (FIGURE 1)

The molar relationship was Class I on the left side while it could not be assessed on the right side due to the crossbite and there was an end-on canine relationship on both the sides. (Figure 2) Functional examination was done and no TMJ symptoms were present. While arriving onto the probable etiology for this malocclusion, the patient's parents informed that this problem was persisting since the time permanent teeth were erupted and because of the space between the upper and lower teeth, the patient was habituated to position her tongue forward during eating and speaking. She also suffered from repeated episodes of cold during the age of 7-8 years, because of which, the patient may have resorted to mouth breathing and enlarged adenoids leading to an unfavorable growth of the jaw bases.

Cephalometric analysis showed a skeletal Class I base and a vertical growth pattern with normal basal lengths and reduced ramal height along with increased lower anterior facial height. The upper incisors were proclined and the lower incisors were upright on the basal bone with increased dental heights of the upper and lower first molar teeth. (Figure 3) The composite analysis for the cephalometric tracings has been highlighted in Table 1.

Our treatment objectives were: correction of anterior open bite, correction of the tongue thrusting habit, achieving proper incisor inclination and angulation, correction of increased lower anterior facial height and achieving a good and esthetic facial profile.

Table 1: Pre-treatment cephalometric tracing of important parameters

SNA (Pre)	82°
SNB	81°
ANB	1°
SN-MP	39°
FH-MP	27°
FMA	30°
Ramal Length (Co-Go)	35 mm
Lower Anterior Facial Height (ANS-Me)	55 mm
Jarabak ratio	55.9
Upper Incisor to NA	41°
Upper Incisor to SN	114°
Lower Incisor to NB	24°
IMPA	91°
NASOLABIAL ANGLE	90°
S LINE TO UPPER LIP	+2.5 mm
S LINE TO LOWER LIP	+2 mm
H ANGLE	16 °

Fig 1: Pretreatment extra oral photographs

Fig 2: Pretreatment intra oral photographs

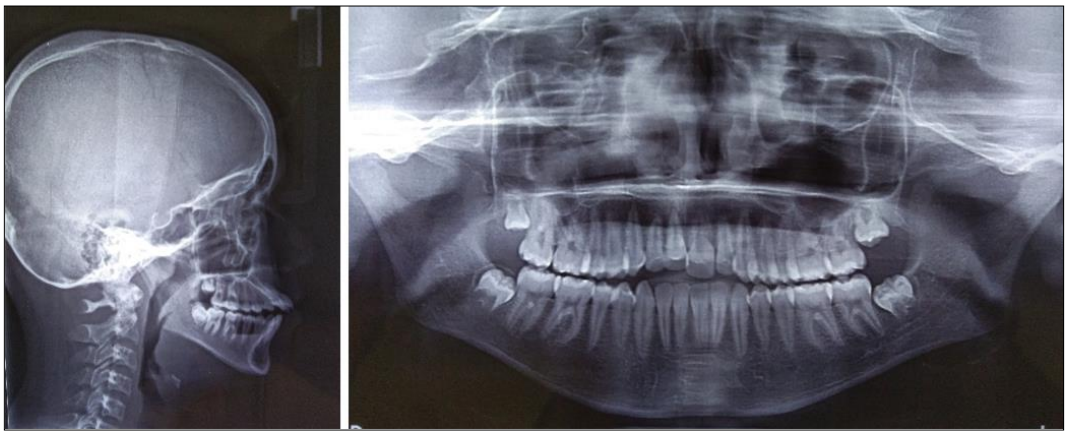

Fig 3: Pre-treatment lateral cephalogram and OPG

Treatment objectives

The patient was presented with three treatment plans: the first plan was extraction of upper and lower 1st premolars and closure of bite by retraction of incisors. The second plan given was to wait for the growth to cease and opt for surgical correction of open bite by posterior segmental impaction of maxilla and the third plan was to intrude the posterior teeth with the help of TADs or magnets achieve closure of bite by posterior intrusion and autorotation of mandible. Since, the patient did not want any invasive procedure like surgery or extractions or microimplants and wanted the treatment as conservatively as possible, the third option was chosen. The patient was explained about the treatment and that the skeletal discrepancy might require surgical correction later on after growth is completed if relapse occurs, which the patient accepted.

Treatment progress

The treatment was started with fixed mechanotherapy 0.022 slot and alignment and levelling to unravel and crowding to allow complete expression of the skeletal open bite. (Figure 4) The initial archwire was 0.014" NiTi followed by rectangular NiTi and 0.019 x 0.025 SS. Along with the fixed appliance, activated TPA was also inserted to correct the single tooth molar crossbite on the right side, which was also achieved within 4 months. After this, upper and lower impressions of the patients were taken and acrylic bite blocks with two repelling neodymium-iron-boron magnets (NdFeB) were fabricated. Care was taken to place the magnets exactly at the 1st molar region so as to allow the forces to act along the long axis of the first molars. (Figure 5) The dimensions of each magnet were 10 mm in diameter and 1.5 mm in height and the bite blocks on either side were connected with 1mm stainless steel wires, to allow stability and to counter the lateral effects which could be encountered due to the bite blocks and the magnets. (Figure 6)

These bite blocks were cemented in the patient after removal of the posterior brackets and the patient was recalled after 1 week to check for any sharp acrylic edges, any discomfort or for any dislodgment of the bite blocks.

These bite blocks were kept in place for a period of 4.5 months and the pre-treatment and post-treatment results are show in Figure 7.

Fig 4: Full expression of skeletal open bite after initial levelling and alignment

Fig 5: Fabrication of magnetic bite blocks on the patient's case

Fig 6: Try-in of the magnetic bite blocks intraorally

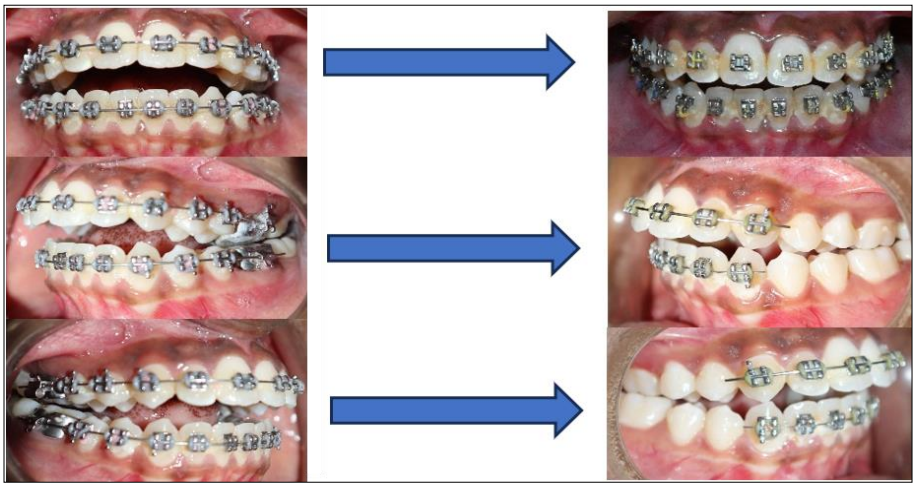

Fig 7: Comparison of the intra oral changes and bite closure after 4.5 months of magnetic bite block therapy.

Discussion

In our patient, the posterior bite blocks along with magnets were an effective modality for non-surgical management of the open bite, with intrusion of posterior teeth, mainly the first molars, opposite to which the magnets were installed in the posterior bite block. The results of the magnetic bite block therapy were quick in dental and skeletal vertical relationships. In a span of 4.5 months, around 2.8 mm of bite closure was achieved anteriorly. (Figure 8) This is in accordance to the study by Kiliaridis [1], improvement in vertical overbite in a range of 2.5mm to 4.5mm in less than 4 months. We achieved an intrusion of 1.6 mm in the region of first molar, with 1.4 mm of intrusion of maxillary first molar and 0.2 mm of intrusion in the mandibular first molar, causing autorotation of the mandible, which can be appreciated by the cephalometric values as highlighted in Table 2. Doshi et. al[11] reported 2 mm of bite closure in the molar region, with 1.5mm intrusion of maxillary molars and 0.5mm intrusion of mandibular molars, in a 8-month period.

Design of appliance

The repelling magnets on acrylic bite blocks were fabricated based on the principles of Active Vertical Corrector given by Dellinger (1986) [8]. The appliance consisted of a left and right acrylic bite block extending from the first premolar to the last erupted molar (2nd molar in this case) and both these blocks were connected by a rigid 1mm stainless steel bar. (Figure….). Additional Adams clasps were given in the region of 1st molar to enhance the retention of the appliance. The magnets were placed opposite to each other in the region of first molars.

Table 2: Cephalometric tracing post removal of the magnetic bite blocks

SNA (Post)	81°
SNB	80°
ANB	1°
SN-MP	36°
FH-MP	25°
FMA	27°
Ramal Length (Co-Go)	37 mm
Lower Anterior Facial Height (ANS-Me)	53 mm
Jarabak ratio	56.7
Upper Incisor to NA	37°
Upper Incisor to SN	108°
Lower Incisor to NB	26°
IMPA	92°
Nasolabial Angle	91°
S Line to Upper lip	+2 mm
S Line to Lower lip	+3 mm
H Angle	13 °

Fig 8: Closure of bite after complete bonding and removal of magnetic bite blocks

Dentoalveolar and skeletal changes by magnetic bite block therapy

A total intrusion of 1.6 mm in the molar region and 2.8mm bite closure in anterior region was seen. There have been reports regarding the lateral forces of this appliance along with vertical forces [1, 9, 11, 12] In our study, we reported no such lateral side effects or crossbite or scissor bite on either side, since both the block on either side of the arch were connected by rigid stainless-steel bar. Barbre and Sinclair[14] in their study on the Active Vertical Corrector reported the changes brought by the appliance was contributed not only by restriction of normal eruption of molars as the principal effect, but also by changes in angulation and eruption of the upper incisors [1, 11, 12, 15, 16]. Dental heights of the patients decreased with respect to the upper molars and increased with respect to upper and lower incisors. The dental heights decreased in the upper molar region from 23 mm (pre-treatment) to 21.5 mm (post magnetic bite blocks), and the mandible auto rotated around 3 degrees after the magnetic bite block therapy. The upper incisors extruded from 21 mm (pre-treatment) to 21.5 mm (post magnetic bite block therapy) and the lower incisors extruded from 32 mm to 33 mm after the bite block therapy but the smile arc of the patient was maintained and there was no clinically appreciable over-extrusion of the incisors. (Figure 9). The radiographs of the patient before and after magnetic bite block therapy can be seen in Figure 10.

Fig 9: Improvement and preservation of the smile arc and incisal display of the patient after the posterior magnetic bite block therapy

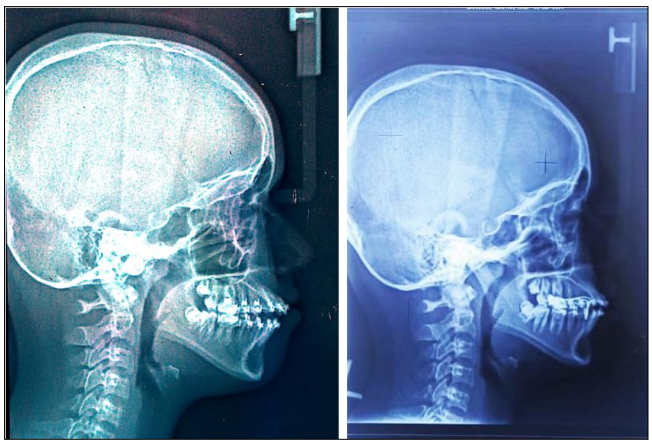

Fig 10: Lateral cephalogram before and after magnetic bite block therapy.

Relapse after magnetic bite blocks

It has been reported that the treatment effect with magnetic bite blocks decreases with time, possibly due to a decrease in the force applied to the antagonist teeth by the elevator muscles of the jaw [1]. Dellinger *et al*. [8] reported that a 3 year follow up after AVC treatment showed little tendency for re-eruption and both intrusion of teeth and autorotation of mandible were stable. Similar effects of stable autorotation were also concluded by the study of Kalra *et al*. [9].

Baek *et al*. [15] reported that most of the relapse in molar intrusion occurs within the first year after treatment and hence a posterior bite block as a retention is necessary for the maintenance of the results.

Further research on the long-term stability and better understanding of the biomechanics of magnetic bite blocks with long term follow up can be undertaken and will be welcomed.

Conclusion

The case highlighted in this article shows positive results of the repelling magnets on the posterior intrusion of teeth and closure of open bite, although further research on relapse and long term follow up is necessary for even more conclusive results.

1. The active bite blocks using repelling magnets is an efficient treatment modality to manage skeletal open bite malocclusion non-surgically especially in growing patients
2. The bite closure is through molar intrusion by the forces applied by repelling bite blocks, in a short period of time
3. Increased inter-occlusal space due to the bite blocks stimulates muscle forces and stretching of muscles which is favourable in vertical growers.
4. Passive bite blocks in the retention phase are necessary to prevent any chances of relapse of the molar intrusion achieved with the bite blocks.

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The authors report no commercial, proprietary, or financial interest in the products or companies described in this article

Conflict of interest

The authors declare that they have no competing interests.

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