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Research paper

Orthopedic effects of splint high-pull headgear—A cephalometric appraisal

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ARTICLE INFO

Article history:
Received 27 July 2009
Received in revised form
4 February 2010
Accepted 9 March 2010
Published on line 20 April 2010

Keywords:
Maxillary splint
High-pull headgear
Class II
Vertical growth pattern (VGP)

ABSTRACT

Objective: The purpose of this study was to investigate the orthopedic effect of maxillary splint high-pull head gear appliance on maxillary complex.
Design: Retrospective study.
Settings: Patients under treatment in the Department of Orthodontics, Azad University, during one year period from November 2003 to March 2004.
Subjects: Lateral cephalometric radiograph of 26 patients (11 boys and 15 girls, with a mean age of 11.3 years) treated with splint high-pull headgear appliance was compared with a similar control group of 26 individuals (11 boys and 15 girls with a mean age of 12.6 years).
Main outcome measures: The result of the present study showed that the treated group more closely approximated Class I cephalometric values after treatment, whereas the control group with a Class II skeletal pattern did not necessarily become ''less Class II'' due to growth.
Results: Point A was held efficiently in the treated group (S–A = 0.4 mm) whereas in the control group it had relocated downward and forward 2.00 mm along sella–point A (S–A) line. Also, the relocation of the point A in the horizontal (X-axis) and vertical (Y-axis) planes confirmed these findings. No rotational changes of palatal plane were recorded in the treated group. Mandibular skeletal changes were similar to the control group. Maxillary dentition was relocated more posteriorly.
Conclusions: It was concluded that the maxillary splint with high-pull headgear in the present study held the maxilla in position without any rotational changes of the palatal plane. Therefore, a normal skeletal relationship was achieved in the treated group through a combination of maxillary basal bone and dentoalveolar growth inhibition and a normal expression of mandibular growth.

1. Introduction

Controversies surrounding the growth modulation effects of headgears have not been satisfactorily resolved even today, probably because of versatility of its use in orthodontics [1,2]. A great portion of this confusion has originated because headgears can be combined with a variety of intraoral appliances for orthopedic and orthodontic correction of Class

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1344-0241/$ – see front matter
doi:10.1016/j.odw.2010.03.001

II discrepancies [1–23]. Although a few clinicians deny their clinical efficacy for orthodontic purpose, proof of their growth-modifying (orthopedic) effect remains elusive.

In many studies, it was shown that Kloehn's cervical headgear significantly restrained maxillary forward growth [7,8]. However, with Kloehn's cervical headgear, many experienced the undesirable backward rotation of the palatal plane, the opening of the mandibular plane and maxillary molar extrusion [8–11].

The concept of full coverage maxillary splint with high-pull headgear was introduced by Raymond Thurow. He believed that heavy forces are needed to hold the maxilla in vertical plane while applying a distally directed force to the entire maxillary dentition and the hard palate for the correction of Class II malocclusion [12]. His appliance, therefore, consisted of a maxillary splint design that provided a much larger base area than merely maxillary first molars for the high-pull headgear force application.

Joffe and Jacobson [13], Caldwell et al. [14], Fotis et al. [15], Seckin and Surucu [16], Orton et al [17] and Uner and Yucel-Eroglu [18] have since then proposed their variation and evaluated the effects of their maxillary splint with high-pull headgear appliance design on the dentoskeletal complex.

With these few publications on the maxillary splint high-pull headgear (maxillary traction splint), it is not surprising to confront variations in the treatment results available in the literature. This is further complicated with variations in appliance design, clinical management and force direction and magnitude [18].

The differences in the effects of treatment on the dentoskeletal structure varies from those like Caldwell et al. [14], and Seckin and Surucu [16] who concluded that maxillary traction splint is an effective means of correcting dentoalveolar protrusion in growing patients to those like Joffe and Jacobson [13], Fotis et al. [15], Orton et al. [17] and Uner and Yucel-Eroglu [18] who concluded that a significant orthopedic as well as orthodontic effects on the growth pattern of the dentoskeletal structures were responsible for the Class II correction.

Considering the components of functional-headgear combined appliances with that of splint headgear appliances a similar orthopedic effect on the maxilla is expected. However, even the skeletal effects of these appliances have become a controversial issue. For example, the vertical skeletal control with functional-headgear combined appliances is claimed by some [3,19,20] but also rejected by others [21,22].

Therefore, the aim of this study was to investigate the skeletal effect of the acrylic maxillary splint covering full dentition with high-pull headgear on Class II skeletal pattern individuals, where the direction of the pull is upward and backward passing through or close to center of resistance of upper dentition and maxilla.

2. Materials and methods

2.1. *Splint high-pull headgear sample*

The cephalometric records of 26 patients (11 boys and 15 girls, with a mean age of 11.3 years) treated with splint high-pull headgear appliance, were collected from the records of the Department of Orthodontic, Dental College of Azad university.

2.2. *Control sample*

The evaluation of treatment effects of an orthopedic appliance is difficult, because the part of the effect could be contributed to normal growth. Therefore, on the basis of sex, chronological and skeletal age, and the dental and skeletal similarities (overjet, ANB and growth pattern) a matched comparable control group of 26 individuals (11 boys and 15 girls, with a mean age of 12.6 years) was selected from the observation files of the Department of Orthodontics (Table 1).

2.3. *Additional criteria for selection*

All subjects had Class II division 1 malocclusion based on dental overjet and molar relationship. As per cephalometric measurements, they all had Class II skeletal relationship with average growth pattern. The skeletal maturity age of all patients as with cervical vertebral maturation was either in stage 3 or stage 4, therefore, all patients were at or near the pubertal peak [23]. No patient was in stage of pubertal deceleration. All the subjects were observed for a period of 12 ± 2 months and none had any previous orthodontic treatment.

2.4. *Method of treatment*

The full coverage maxillary splint was fabricated such that it covered all the erupted teeth. The partially erupted second permanent molars if present were left to erupt and then included in the splint. The acrylic was adjusted occlusally to form a bite plane with even contacts on all occlusal surfaces of the lower teeth (Fig. 1). The bite height was kept within the limits of the freeway space unless the treatment plan required a bite opening, which was then permitted through free eruption of the molar and premolars of the lower jaw. Headgear tubes were planted into the acrylic 2 or 4 mm mesial to first permanent upper molars. The inner arms of the

Table 1 – Comparison of control and Treated group at T1.

Variables	Control ($n = 26$)		Treated ($n = 26$)		p-value	Significance
	Mean	SD	Mean	SD		
Overjet (mm)	5.3	2.3	5.9	3.1	0.40	Not significant
SN–MP (°)	33.05	6.70	37.60	4.50	0.20	Not significant
ANB (°)	7.72	2.29	7.00	1.96	0.35	Not significant