

## Effects of maxillary expansion and placebo effect of appliances on nocturnal enuresis – preliminary results

Morteza Oshagh<sup>1</sup>, Fateme Bahramnia<sup>2</sup>, Ali Reza Aminsharifi<sup>3</sup>, Mohammad Hossein Fallahzadeh<sup>4</sup>, Parisa Ghodrati<sup>5</sup>

<sup>1</sup>Orthodontist, Private Practice, Shiraz, Iran

<sup>2</sup>Post Graduate Student of Orthodontics, Orthodontics Research Center, School of Dentistry, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>3</sup>Department of Urology, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>4</sup>Shiraz Nephrourology Research Center, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>5</sup>Dentist, Private Practice, Shiraz, Iran

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### Correspondence

Fateme Bahramnia

Department of Orthodontics

Faculty of Dentistry

Shiraz University of Medical Sciences

Ghasrodasht Avenue, Ghomabad

71345–1836 Shiraz, Iran

phone: +98 711 628 99 13

Fateme\_bahramnia@yahoo.com

**Introduction** Nocturnal enuresis has been found a common symptom among children with breathing problems and sleep apnea. The purpose of this study was to evaluate the therapeutic and placebo effects of slow maxillary expansion on nocturnal enuresis.

**Material and methods** Four children with enuresis aged 7–12 years were selected. Rigid acrylic expansion appliances were fabricated and delivered to them. Frequency of enuresis was recorded by the parents during three stages: 1) before appliance delivery; 2) after appliance insertion without expansion; and 3) during expansion and retention.

**Results** The frequency of wetting decreased significantly during the period of appliance use without expansion. During the expansion and retention phase, two patients became completely dry, and two patients improved significantly.

**Conclusions** Maxillary expansion can have a positive effect on the treatment of nocturnal enuresis. Also, the placebo effect of the expansion appliance has significant effects on enuresis.

**Key Words:** nocturnal enuresis ◊ frequency ◊ slow maxillary expansion

## INTRODUCTION

Nocturnal enuresis (NE) is not uncommon in children. Some children wet their beds every night and have never been dry up to their first years of school or even their teenage years. The term nocturnal enuresis is used for children over the age of 4–6 years [1]. 15% of boys and 10% of girls are enuretic at age 10, and by late adolescence, the number falls to 1–3% [2]. Clinical severity of enuresis is defined as: infrequent, one to two wetting episodes per week; moderate, three to five wetting episodes per week; and severe, six to seven wetting episodes per week [3, 4]. The etiology of NE in the majority of cases remains unclear. Most investigators consider it a multicausal disorder involving genetic, developmental, organic and psychosocial factors [5].

Uro–dynamic and sleep investigations have shown that enuretic children have no increase in antidiuretic hormone (ADH)/vasopressin at night. Children normally produce this hormone during the nighttime, which causes urine production to fall [6, 7, 8]. Medical treatments of enuresis include wetness alarms, biofeedback, arousal treatment, fluid restriction, medication with ADH, and desmopressin. Despite all these methods some patients are still resistant [9].

Upper airway obstruction as a factor in NE has also been discussed and several scientific articles mentioned NE as a common symptom among children with breathing problems and sleep apnea [10–13]. Otolaryngologists have demonstrated relief of these breathing problems by adenotonsillectomy, on the other hand, dealing with an anterior nasal obstruc-

tion surgically is not as easy as adenotonsillectomy therefore maxillary expansion may offer a better choice to relieve such constrictions [14].

The effects of maxillary expansion on NE have been discussed in several articles: in 1970, Freeman observed the effects of rapid maxillary expansion on cessation of NE in mentally retarded children. He related this beneficial effect to improved lymph circulation and an increased antidiuretic function of the pituitary gland due to maxillary expansion [15]. In a retrospective study on 10 children by Timms, NE ceased within a few months of maxillary expansion. He attributed this improvement to the positive effects of rapid maxillary expansion on the nasal airway resistance [16]. Also, in a prospective study by Kurok et al., immediate improvement was observed after rapid maxillary expansion in 10 children, of whom none had any ear, nose and throat problems or anatomic abnormalities of the urinary tract. Various mechanisms explaining these effects were discussed, including the reduction in nasal airway resistance [17].

A different investigation of stressful, psychosocial conditions at a government orphanage reported a 74% improvement of enuresis 8 months after rapid maxillary expansion [18].

In another study, the positive effects of RME were observed in nearly 50% of the 6–15 year old patients within 1 month of treatment, and these results were stable at the 10-year follow-up. However, no correlation was found between the success of treatment and improved airway, familial heritage, school performance, or other social factors [19].

Akhavan-Niakie et al., in a study of 6–9 year old patients, found that the average expansion level ranged between 4–7mm. In most cases mouth breathing was replaced by nose breathing, and therefore significant improvement was noticed in NE, so that 60% were completely treated and 20% showed a 50% improvement. The remaining 20% showed only a 10% improvement [20].

Considering the fact that some of NE patients are resistant to medical treatments (such as desmopressin), which in turn have side effects, conservative approaches like maxillary expansion would be advantageous. Most of these studies used rapid maxillary expansion. It must be stated that fabrication and delivery of removable slow expansion appliances is easier than with fixed rapid expansion appliances. One reason for the decrease of NE by expansion might be the placebo effect associated with the insertion of an orthodontic appliance in the mouth. To our knowledge, until now the placebo effect has not been evaluated. The purpose of this study was to evaluate the effect of slow maxillary expansion on NE and the placebo effect of the removable appliances.

## MATERIAL AND METHODS

The sample consists of four 7–12 year old children with primary nocturnal enuresis referred by the nephrology department.

### Including criteria

Except for their primary nocturnal enuresis (NE), they were otherwise healthy and there was no bladder or sphincter function pathology or abnormality. The patients that were included had received at least 2 antidiuretic drugs for 2 weeks or more with no complete response. All attended the otolaryngologic clinic for nasal obstruction and an ENT specialist clinically examined and determined any airway obstruction. Patients without nasal obstruction were referred to the orthodontic department. The type of occlusion and the skeletal growth pattern were not taken into consideration in the study design.

Particular attention was paid to the frequency of NE. Ethical approval was obtained from the Medical Research Ethics Committee of Shiraz Medical University. After taking informed consent, the interview and clinical exam were performed, and records were taken containing lateral cephalograms and the study models. After alginate impression (IRALGIN, made in Iran), the study models were poured by orthodontic plaster (Hinridur S, made in Germany). The pre-treatment study models were used for classification of the occlusion according to Angle and for appliance construction. Lateral cephalograms were taken in the natural head position for cephalometric diagnosis and assessment of pharyngeal airways related to age was made according to the McNamara analysis. The cephalograms were hand-traced by one orthodontic postgraduate student and were confirmed by one expert orthodontist. Measurements were performed twice by the same person and the mean of them was recorded. The measurements taken included A point–Nasion–B point (ANB), Wit's appraisal for sagittal skeletal classification, Gonion–Gnathion–Sella–Nasion (Go–Gn–S–N) and Jarabak index for vertical skeletal classification.

One NE frequency questionnaire was prepared and completed three times by the parents: before appliance delivery, after appliance insertion (without expansion) and during expansion and retention. The parents recorded the children's number of wet nights on this form. We divided our study design into three stages:

1. After initial appointment at the orthodontic department and initial data collection, the first NE frequency questionnaire was given to parents for daily reports of nocturnal enuresis frequency.
2. After 1 month, these completed forms were returned and then the orthodontic appliance was deliv-

**Table 1.** Characteristics of the patients (age, sex, dental and skeletal classifications) and the frequencies of nocturnal enuresis in three stages: before appliance delivery, after appliance insertion without expansion, during expansion and retention

Case	Age	Sex	Angel classification and transverse relationship	Enuretic frequency				Skeletal classification	Face type
				Before appliance delivery (times per month)	After appliance insertion without expansion (times per month)	During expansion and retention			
MA	7 years	F	Class I, no cross bite	2	Dry	Dry within 2 month	CI I	Long face tendency	
MZ	12 years	F	Class I, Bilateral cross bite	18	9	7 times per month	CI III	Long face	
ZK	12 years	F	Class I, no cross bite	25	18	Once per month	CI I	Normal	
SSH	9 years	F	Class I, no cross bite	8	6	Dry within 4 month	CI I	Long face	

ered to the patient. it was a rigid acrylic removable expansion appliance with a midpalatal expansion screw and Adams clasps on molars and premolars. If the premolars had not yet erupted, the primary molars were used. The patients were instructed to use this appliance full-time except when maintaining oral hygiene and during main meals and contact sports. During this period, a second NE frequency questionnaire was completed by the parents. The patient used the appliance without the activation of the expansion screw to record the placebo effect of the appliance.

3. After one month, instructions were given to parents to activate the expansion screw by turning it 90° degrees (0.25 mm) twice a week and the third NE frequency questionnaire was delivered to them. Despite a possible posterior crossbite initially, the expansion was continued as far as the posterior occlusion allowed and until the upper palatal cusps articulated with the lower buccal cusps. After expansion, the appliance was kept in place for 2 months before removal and the recurrence of nocturnal enuresis was observed. The patients were then considered for more conventional orthodontic therapy. The recorded frequencies of NE were evaluated in these three stages for each patient.

## RESULTS

One of the four enuretic children had a bilateral cross-bite. Three children showed normal transverse occlusion. Two children had a long face tendency, one of them had a long face.

The ENT examination showed no abnormal condition. One of the children had undergone tonsillectomy (MZ). The posterior airway measured on cephalograms, before treatment, showed normal variations according to normal standards for age.

Before the study, three children were wetting their beds at least once a night; one child wetted the bed twice a night.

The frequency of bed-wetting in patients decreased significantly during the period of appliance use without expansion.

The range of maxillary appliance expansion was 4 to 10 mm with a mean expansion of 6 mm. Two patients became completely dry. One patient improved significantly (1 episode per month) and another one improved (7 episodes per month). Improvement occurred more often in subjects younger than 12 years. Two patients, who were older than 12 years, showed improvements, but did not become dry (Table 1).

Two patients were followed up for almost 3 months after finishing the treatment. They showed complete dryness. We were unable to track the other two patients to perform treatment follow-up.

## DISCUSSION

Unlike previous studies, we used slow maxillary expansion, which can be a better option, since the use of rapid maxillary expansion carries a risk of distortion of facial structures in young children [21].

Only one of our patients had a bilateral crossbite; the other three had normal transverse occlusion. So the purpose of expansion was merely curing nocturnal enuresis. However, the patients relapsed to normal occlusion after the appliances were removed, except for the patient with the bilateral crossbite. Therefore, normal transverse occlusion does not seem to be a contraindication for 5–8 mm transverse maxillary expansion, in an attempt to cure NE in children [19].

It is very encouraging that all of our patients showed improvements, but to this day, no certain mechanism has been introduced to explain the effect of expansion appliances. One theory is that the widening of nasal structures due to the expansion, leads to better breathing and higher oxygen saturation of blood. This can cause the patient to have shorter periods of deep sleep. In this way, children are awoken more easily by a full bladder [19].

The placebo effect should also be taken into consideration. However, the orthodontist is usually the last referral and such a placebo effect should have expressed itself earlier when previous treatment alternatives were introduced [18]. To evaluate the placebo effect of the orthodontic appliance, in this study the patients were instructed to use the appliances without activation of the expansion screws. The patients showed significant improvements by just using the removable appliances without expansion. This could be as a result of the irritation induced by a solid orthodontic appliance which leads to more wakefulness during sleep [17].

Just the presence of such an appliance might change the pattern of the tongue, and perhaps also induce irritation [17]. This promising pilot study indicates that the placebo effect of a removable expansion appliance has a significant effect on the treatment of enuresis.

Early use of expansion appliance can be more effective. Two of our patients who were 7 and 9 years old became completely dry, but two of them who were 12 years old only showed improvement without resolution. It may be attributed to the fact that enuresis becomes more established with time, and in another study, age 10 was introduced as a breakpoint for success regarding RME treatment and cure of NE [19]. It can be concluded that the expansion is less effective in older patients. It is not abnormal for preschool children to wet the bed occasionally. Children often reach the age of 5 to 6 years before they can withhold urination with any degree of bladder distention. Girls achieve control of urination earlier than boys do. Therefore the diagnosis of enuresis should be reserved for older children beyond the age of 5 years for girls and 6 for boys [17]. Different studies have reported the spontaneous cure rate of about 15% per year for age groups 5–9, 10–14 and 15–19 years [19]. Kurol et al. explain their success rate of 70% after RME (in comparison to spontaneous recovery rate of 15% per year) can be attributed to the appliance treatment [17].

The frequency of enuresis decreased significantly by slow maxillary expansion. This is in agreement with the result of Akhavan Niaki and Farbod's study. But in their study, expansion was started at the first

week of appliance insertion and the rate of expansion seems to vary in different weeks [20]. The rate of expansion in our study was 0.5 mm per week, but in their study, the rate was 2.5–3.4 mm per week. The mean amount of maxillary expansion was 6mm and was more than Usumez et al.'s study (3.9 mm) [18]. This might be attributed to the fact that the rate of expansion is not an important factor in the treatment of enuresis.

Also in Kurol et al.'s study, the RME caused significant reduction in enuresis. But the frequency of enuresis in their study was more than in our patients. Their patients wet their bed almost every night [17]. One of the patients (MZ) had undergone tonsillectomy. After maxillary expansion the enuresis improved significantly. Several studies have shown that NE is markedly improved or resolved after an adenoidectomy or a tonsillectomy [19].

Schutz–Fransson and Kurol believe that the first choice of treatment in cases of enuresis is an examination of urinary function and medication. The next choice would be an evaluation of indication for adenoidectomy or tonsillectomy. The third choice of treatment is orthodontic expansion [19].

The long–term effect of RME has been questioned, and reports in the literature are sparse [19]. A 4–year–follow–up revealed that the positive effect of RME on NE was stable. All reports on long–term effect should involve at least a 1–year–follow–up as relapse is possible [19].

Orthodontic expansion is a noninvasive, routine and rather quick treatment and it has no negative side effects or complications [19].

Timms showed that RME caused significant improvements in transnasal airflow [16]. Tests limited to airflow only are equivocal. The ducts within the anterior nasal airway are very narrow; consequently, the small increases affected by RME may represent a large percentage increase. Bearing in mind the inherent difficulties in surgical relief of anterior nasal stenosis in the growing child, RME offers a simple therapy which might (otherwise) be denied to many children [16].

The nasopharyngeal airway dimensions increased in Usumez et al.'s study, but the changes were not statistically significant, probably because of the limited number of cases [18]. It seems that the nasopharyngeal airway problem is not the only etiological factor responsible, but the disorder is probably multicausal and may include strong psychological emotions and tensions [18].

Although our cases are fewer in number than previous studies, the results are in agreement. However, one should be cautious about the meaning of these findings.

## CONCLUSIONS

This study shows that maxillary expansion can have a positive effect on the treatment of nocturnal enuresis. Also, the placebo effect of the expansion appliance has a significant effect on the treatment of

enuresis. It can be concluded that expansion is less effective in older patients.

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