



# Evaluation of the efficacy of the modified bluegrass appliance in cessation of thumb-sucking habit: an in vivo study with 12 months follow-up

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## Abstract

**Background and aims.** Blue grass appliance, also known as habit correction roller has gained universal attention and acceptance to correct thumb sucking habit. The present study utilizes the modified bluegrass appliance that was fabricated with an inexpensive acrylic roller to lower the cost of treatment and make it more affordable for the patients in developing countries. The purpose of this study was to evaluate the efficacy of the modified bluegrass appliance in cessation of thumb-sucking habit.

**Methods.** Forty children aged 4-14 years visiting our department for the treatment of thumb sucking habit were selected. A modified bluegrass appliance having an acrylic roller was used along with the positive reinforcement. The patients were followed-up after two weeks of appliance placement and then monthly for twelve months. The various factors like need of reinsertion, discomfort caused due to improper placement or distortion, and/or breakages of the appliance following insertion were evaluated. The cessation of the thumb sucking habit was determined by the patient and/or parental/legal guardian confirmation and disappearance of the callous formation on the thumb. However, the total treatment time was determined when the appliance was removed.

**Results.** Of the total 33 patients included in the final analysis, the treatment was successful in 32 (97%) of the patients. The treatment time for the cessation of habit was  $\leq 4$  weeks in 13 (40.6 %) patients and 5-20 weeks in 50% of the subjects. Conversely, in 2 (6.3%) of the patients the habit ceased after 21-24 weeks and in 1 (3.1%) patients it took 25-28 weeks for the habit to cease. The appliance had to be reinserted during the treatment in 5 (15.7%) out of the total 32 patients. The total treatment time for the cessation of thumb-sucking habit with modified bluegrass appliance was  $\leq 24$  weeks in 17 (53.1%) patients, 25-36 weeks in 34.4% and 37-48 weeks for the 12.5% subjects.

**Conclusion.** The modified bluegrass appliance was found to be highly comfortable and cost saving for the patients and very much successful in eliminating the habit within a short period of time without any complications.

**Keywords:** modified blue grass appliance, habit, thumb sucking, reminder therapy

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## Background and aims

Habit is defined as a frequent or constant practice or acquired tendency, which has been fixed by frequent repetition of an act [1]. Thumb sucking or non nutritive sucking is a common childhood habit or behavior that is considered normal up to the age of 3 to 4 years [2]. Prevalence of thumb sucking habit was found to be 14% in six years-old children,

and 6% in children 11 years old [3]. Prolonged, chronic thumb sucking habit that continues in mixed and permanent dentition results in dento-alveolar changes like anterior open-bite, increased over-jet, lingual inclination of lower incisor, posterior cross-bite, spacing between teeth, atypical root resorption, mucosal trauma, affects the growth of maxilla and palate, causes constriction of skeletal structures

and abnormal facial growth [4-7]. The risks associated with thumb-sucking depend on the frequency and duration of the habit, the intensity of orofacial muscle contractions associated with the reduced intraoral pressure produced by sucking, and the position in which the fingers are placed in the mouth [8,9].

Efforts should be made for the treatment of thumb-sucking by the dentist if the problem is chronic, the child is older than four years of age as the retention of habit may adversely affect the growth and development of oral structures; the problems associated with thumb-sucking are incipient and/or the child has requested help in stopping the habit. Different approaches have been described in literature to correct thumb sucking habit ranging from operant procedures that include contingency reinforcement and reframing to sensory attenuation procedures designed to interrupt the sensory feedback experience with digit sucking habits either by appliance therapy or response prevention [2]. Reminder therapy and use of a reward system should be attempted prior to the placement of any dental appliance [10,11].

Palatal cribs, spurs, palatal bars, hay rakes and cage type appliances employ an aversive negative stimulus to cease the undesirable oral habits [12]. Emotional disturbances, difficulty with speech and eating, and iatrogenically “self-inflicted” wounds can occur with such appliances [13].

Blue grass appliance, also known as habit correction roller was introduced by Haskell and Mink in 1991, utilizing the principles of positive reinforcement [14]. This appliance has various advantages over other reminder appliances such as cribs or rakes. It has smooth rolling roller that can encourage the child to play with the roller rather than making the patient anxious. Blue grass appliance has gained universal attention and acceptance as it is non-destructive, user friendly, comfortable appliance that does not interfere in eating and presents minimum disturbance with speech [15]. The design consisted of hexagonal teflon roller on a cross-palatal wire [14]. In the present case the modified bluegrass appliance was fabricated with acrylic roller instead of the relatively expensive hexagonal teflon roller to lower the cost of treatment and make it more affordable for the patients in developing countries. Chhabra et al successfully utilized modified bluegrass appliance made with an acrylic roller for the cessation of thumb sucking habit within a short period of time in a patient and concluded that it was very comfortable for the patient [16].

The current study was conducted to evaluate the efficacy of the modified bluegrass appliance in the cessation of thumb-sucking habit. To our knowledge, this is the first study evaluating the use and efficacy of modified bluegrass appliance in cessation of thumb-sucking habit.

## Methods

### Study design and patients

Forty normal and healthy children in the age group of 4-14 years visiting our department for the treatment of thumb sucking habit were selected. Patient selection criteria for the appliance therapy were:

- age of the child equal or more than four-year
- history of chronic thumb sucking
- problems associated with thumb sucking were incipient
  - if the alternative reminder treatments (i.e. taste aversion, Band-Aid on the finger) or reward systems were unsuccessful
  - if the child was motivated and had requested to help in stopping the habit

#### *Exclusion criteria:*

- if the thumb sucking habit was meaningful. For example, if the child experienced a loss of a family member, was fearful.
- uncooperative child
- medically compromised child

All the parents were informed about the clinical procedure and safety. However, three subjects declined to participate in the study. The written parental consent was taken from the rest of 37 subjects, along with the ethical clearance obtained from the institutional review board to conduct the study. The procedures followed were in accordance with the ethical standards of the institutional or regional responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 1983.

### Treatment

During the initial appointment, behavior management was done. Then after using local anesthetic spray the bands were adapted to the permanent first molars using 0.006” x 0.018” band material (Rocky Mountain, Denver, Colorado) or the primary molars using 0.005” x 0.018” band material (Rocky Mountain, Denver, Colorado). Alginate impressions were made of the maxillary and mandibular arches; the bands were transferred to the impression and stabilized.

Casts were poured using dental stones, which were used to fabricate the appliance by adapting 0.9 mm stainless steel wire over the palate, extending from the permanent first molars or primary molars on either side. An acrylic button was made in our laboratory using clear self-cure acrylic resin monomer and polymer (DPI, India). It was then inserted into the 0.9 mm stainless steel wire and placed in the most superior aspect of the palate to avoid obstruction while eating and to present minimal disturbance to speech, unlike hay-rake and crib appliances [12]. The acrylic button did not contact the palatal tissue, so that the patients could roll it with their tongue. The wire was then soldered to the molar bands by protecting the bead (Figure 1).



Figure 1. Extra oral view of the Modified Bluegrass appliance.

During the second appointment, the appliance was cemented to the teeth using glass ionomer luting cement (GC-Fuji Type I) (Figure 2). The patients were instructed to “turn the acrylic roller” with their tongue instead of sucking their thumb.



Figure 2. Intra oral occlusal view of the cemented modified bluegrass appliance.

**Follow ups and evaluation**

The patients were recalled for a follow-up after two weeks of appliance placement to check for the patient tolerance and treatment progress. Subsequent follow-ups were scheduled monthly for 12 months, with total treatment time ranging from four to twelve months. Reminder was given and reinforcement of the patients for the follow-up was done by a telephone call.

The various factors determining the need of reinsertion for the modified bluegrass appliance such as discomfort caused due to improper placement or distortion, and/or breakage of the appliance following insertion were evaluated. The cessation of the thumb sucking habit was determined by the patient and/or parental/legal guardian confirmation and disappearance of the callous formation on the thumb. However, the total treatment time was determined when the appliance was removed.

The percentages of collected data for various factors was obtained for clear and objective understanding, to facilitate comparison with other published studies and reconciliation of the conflicting results. The data analysis

was conducted using SPSS for Windows, version 17.0 (SPSS Inc., Chicago, IL. USA).

**Results**

The initial selection included 40 patients for the study (age group 4 to 14 years). However, three subjects declined to participate. Among the remaining 37 patients in whom modified bluegrass appliance was inserted; four of them did not complete the follow-ups and were eliminated from the study. A total of 33 patients were included in the final analysis. One case of the purposeful destruction of this appliance was observed, the patient not willing further treatment, therefore this was considered a failure.

**Time period required for treatment of habit cessation**

The treatment time for the cessation of thumb-sucking habit with modified bluegrass appliance is depicted in Table I. It was four weeks or less in thirteen (40.6 %) patients. Seven (21.9%) subjects showed the habit cessation in 5-8 weeks, while in five (15.6%) patients it took 9-12 weeks. Three (9.4%) and one (3.1%) of the patients ceased their thumb sucking habit within 13-16 weeks and 17-20 weeks, respectively. However, in two (6.3%) of the patients the habit ceased after 21-24 weeks and one (3.1%) patient took 25-28 weeks for habit cessation.

Table I. Time period required for the treatment of habit cessation.

Time in weeks	Number of patients	Percentage (%) of patients
0-4	13	40.6
5-8	7	21.9
9-12	5	15.6
13-16	3	9.4
17-20	1	3.1
21-24	2	6.3
25-28	1	3.1

**Number of patients in which modified bluegrass appliance was reinserted**

Table II showed the distribution of patients in which modified bluegrass appliance was reinserted during the course of treatment. Out of the total 32 patients studied, the appliance had to be reinserted in five (15.7%) patients. The appliance breakage was noted in two (6.3%) patients, and the refabrication was done in these cases. The reinsertion of the appliance was required in three (9.4%) cases because of the improper placement and/ or distortion after initial insertion.

Table II. Number of patients in which modified bluegrass appliance was reinserted.

Reason for reinsertion of modified bluegrass appliance	No. of patients	Percentage (%)
Improper placement and/or distortion	3	9.4
Breakage of appliance	2	6.3
Total	5	15.7

### Total period of treatment time

The total treatment time for the cessation of thumb-sucking habit with modified bluegrass appliance is depicted in Table III. It was 24 weeks or less in seventeen (53.1%) patients and 25-28 weeks in five (15.6%) patients. Four (12.5%) patients completed treatment in 29-32 weeks and two (6.3%) in 33-36 weeks. The total treatment time was 37-40 weeks in two (6.3%) and 41-44 weeks in one (3.1%) cases. However, one (3.1%) patients took as long as 45-48 weeks for the total treatment.

**Table III.** Total period of treatment time.

Time in weeks	Number of patients	Percentage (%) of patients
0-24	17	53.1
25-28	5	15.6
29-32	4	12.5
33-36	2	6.3
37-40	2	6.3
41-44	1	3.1
45-48	1	3.1

The treatment with the modified bluegrass appliance was successful in thirty two (97%) patients with none of the patients requiring retreatment or reinsertion of the appliance once it was removed, and the completion of the treatment was attained.

### Discussion

Historically, correction of thumb sucking habit includes direct counselling of the child, encouragement to improve self-confidence by rewarding the child, appliance therapy, and in case of more complex dental changes, orthodontic therapy along with habit breaking appliances [17]. Palatal cribs, spurs, hay rakes and cage type appliances employ an aversive negative stimulus for cessation of the undesirable oral habits and thus may trigger unexpected behavior of the child sometimes in addition to causing difficulty in speech and eating. This type of appliance treatment tends to be regarded as a punitive rather than a supportive one [12].

Bluegrass appliance introduced by Haskell and Mink (1991) works through the counter conditioning response to the original conditioned stimulus for thumb sucking [14]. The idea was drawn from the equine industry where a bit with copper rollers is used to distract the irritable horses. It has various advantages over the cribs or rakes such as lack of bulk, presents minimum disturbance with speech, is aesthetic, comfortable and encourages the child to play with the roller rather than making the patient anxious. The disadvantages of the bluegrass appliance are the expense of treatment, as well as eating and speech difficulties associated with initial placement of the appliance, which usually subside within two to three weeks [3]. However, in our study, the cost of treatment was quite low and affordable because the appliance was modified and

fabricated with an acrylic button instead of the relatively expensive hexagonal Teflon roller. The appliance resulted in positive reinforcement, and the child used his/her tongue to play with the acrylic bead. It also served as distraction therapy when the child was idle. The smaller size of the appliance made the appliance hardly visible from outside the patient's mouth. An additional advantage was that the roller acted as a neuromuscular stimulant for the tongue, which aided patients in speech therapy. However, it had few disadvantages like eating and speech difficulties initially after the placement of appliance, but it subsided within few days.

The treatment time for habit elimination varied from weeks to months. The cessation of the thumb sucking habit was determined by the patient and/or parental/legal guardian confirmation and disappearance of the callous formation on the thumb at the time of follow-up appointments. The follow-ups were scheduled monthly, with total treatment time ranging from four to twelve months except the first follow-up which was planned after two weeks of appliance placement to check for the patient tolerance and treatment progress.

The total treatment time with the bluegrass appliance is usually accepted to be 24 weeks. As recommended by Haskell and Mink the appliance should be left in place for four months even after correction of the habit to avoid reappearance [14]. Thus the period of complete treatment is dependent on the time the patient took to cease the habit. In this study, the total treatment time was 24 weeks or less in 53% of patients. This was in accordance with the study conducted by Greenleaf and Mink, who reported the mean treatment time with the bluegrass appliance to be  $30.2 \pm 17.7$  weeks [3].

One child removed the appliance intentionally within two weeks of placement and didn't report for his next follow ups until seven months after the placement of the appliance. He was not willing to undergo further treatment. Treatment was considered unsuccessful in this case and was not continued furthermore.

Greenleaf and Mink conducted a retrospective study on 30 subjects for the use of the Bluegrass appliance in the elimination of thumb habit, and the results showed that in 28 (93%) of the patients, the thumb habit was ceased after treatment with this appliance [3]. The cessation of habit in 97% patients in our study confirmed the findings of Greenleaf and Mink. However, 15.7% of children required reinsertion of the appliance either due to breakage or improper placement. The followings inferences were drawn from the study to rectify these problems: 1) the appliance should be fabricated with at least 0.036 gauge wire, 2) the bands of the appliance should not interfere with the occlusion, 3) the fit of the appliance should be evaluated and adequate clearance of the appliance from the palate and oral structures should be checked prior to bonding; 4) the excess cement should be removed to prevent any gingival

problems. Mink and Haskell in their study with bluegrass appliance, however, reported that all 24 patients (100%) gave successful results after treatment with bluegrass appliance, and no need of reinsertion was required in any of the cases [14].

Further in vivo research studies with larger sample sizes are essential to evaluate the efficiency of modified bluegrass appliance in the cessation of thumb sucking habit. The role of additional factors which influence the cessation of thumb sucking habit like the motivation of the child and positive reinforcement by parents should also be evaluated.

### Conclusion

The results of this study suggest that the modified blue grass appliance is a successful non-punitive treatment option in eliminating thumb sucking habit in a short period of time without any complications. It is comfortable, hygienic and virtually invisible appliance that not only stops the sucking habit but also retrains the tongue.

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