

# The Comparative Effectiveness of Two Digit-Sucking Deterrent Methods

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## ABSTRACT

*A study was conducted to compare the effectiveness of the crib and positive reinforcement in eliminating anterior open bites and increased overjets caused by digit-sucking. The overjet and overbite were measured using an overjet ruler at the start and end of the seventeen-week observation period. Forty patients consented to participate but measurements were only obtained for 11 subjects. The trend in this study is that the crib is more effective than positive reinforcement in preventing digit-sucking.*

## INTRODUCTION

Digit-sucking (*ie* thumb or other finger) and its sequelae are a highly common cause of concern of parents of patients who visit dentists. As many as 90% of children develop a digit-sucking habit (1). Although malocclusions are seen in the primary dentition due to persistence of digit-sucking (Fig. 1), many children give up the habit before the permanent teeth erupt (2) and the presence of features of malocclusion in the primary dentition stage caused by digit-sucking does not indicate the likelihood of developing the same features of malocclusion in the permanent dentition. About half of those who start a digit-sucking habit still do so at seven years of age (3). Persistence of the habit during the mixed dentition stage results in the deflection of the permanent incisors from their path of eruption. The resultant increase in overjet (OJ) (Fig. 2) can predispose the digit-sucking patient to traumatic injury to the incisors—fracture and avulsion are most common.

Cessation of the habit in most children is associated with social influence - peer pressure in playgroups or at school. Children who have crossed this hurdle for more than a year without breaking the habit on their own need some form of interceptive therapy. Although an increased overjet and reduced overbite can spontaneously improve if the



Fig. 1: Digit (thumb) sucking

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Fig. 2: Increased overjet

patient can be persuaded to discontinue the habit early in the mixed dentition, it rarely results in a complete resolution of the problem (4). Interceptive therapy can only be 100% successful for these patients when the problem is not severe and treatment is timed correctly.

For these reasons, the first line of therapy is positive reinforcement: the child is rewarded for making the effort to discontinue the habit. This line of therapy was found to be just as effective as negative reinforcement and treatment with appliances in a study reported by Larsson (5). His study placed 76 children (nine years of age) in four treatment groups (19 in each) and found no statistically significant differences between the active treatment groups; the small sample size in each group may have resulted in the results being skewed.

Negative reinforcement is often tried first by parents. This ranges from application of bitter flavouring agents to the digit to many forms of punishment of the child for continuing the habit. Other simple mechanical deterrent approaches described in the orthodontic literature include: alteration of the child's pyjamas so that the hand cannot be moved to the mouth and sucking is rendered impossible; tubes attached around the elbows or gloves around the wrist (6). Less dramatic procedures are currently recommended to avoid the risk of psychological trauma.

A gentle deterrent orthodontic appliance forms the second line of therapy. The pre-requisites for this are:

- The child should have demonstrated an understanding of the purpose of treatment and be motivated;
- Upper first permanent molars should be fully erupted or, less preferably, the upper second deciduous molars should not be mobile (to allow retention of the orthodontic appliance).

The level at which the clinician has been trained determines whether a removable appliance or a fixed appliance is provided. A removable appliance can be issued by a dentist with minimal orthodontic training and can be more easily altered in design to be retentive at an early stage of the mixed dentition. A crib in the form of an upper removable appliance is shown in Figures 3 and 4. Unfortunately, the fact that the patient can remove the appliance makes it fail to be effective in many cases; many children subconsciously remove them while sleeping. Fixed appliances are thus preferable when the clinician has the skills to use them (Fig. 5).

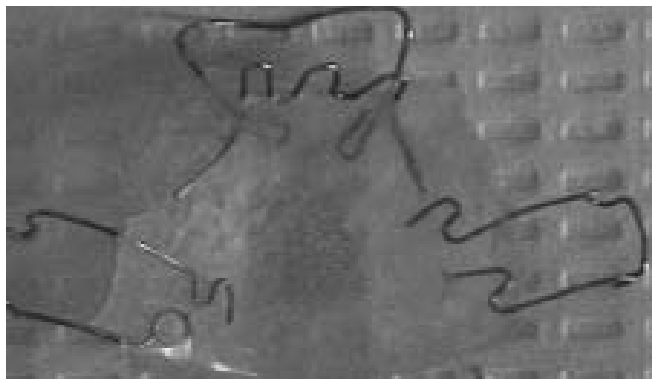


Fig. 3: Crib/upper removable appliance



Fig. 4: Upper removable appliance on the study model used for fabrication

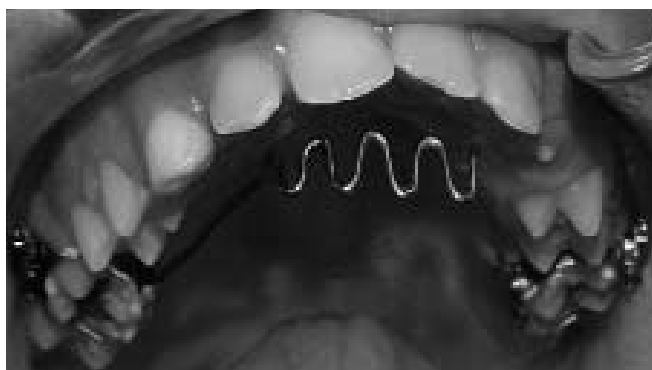


Fig. 5: Transpalatal archcrib

The fixed appliance used as a deterrent is most commonly a variation of a Transpalatal Arch (TPA) that impedes placing the digit in the mouth. It can be constructed with spurs or other auxiliaries to discourage the child from sucking the digit (due to discomfort) but this style is no longer popular. The deterrent appliance is referred to as a crib due to the simple design of the metal framework protectively enclosing the front area of the mouth.

The effectiveness of the crib needs to be compared to that of positive reinforcement using an adequate sample size. No publication of a well conducted scientific study on the effectiveness of the crib is available. Thus, the study presented here was conducted to compare the effectiveness of the crib and positive reinforcement in treating anterior open bites and increased OJ due to digit-sucking (Fig. 6).



Fig. 6: Anterior open bite

#### SUBJECTS AND METHOD

Forty digit-sucking patients of the Child Dental Health Clinic in the School of Dentistry of The University of The West Indies, St Augustine, Trinidad and Tobago, consented to participate in this study. Subjects invited to participate had to satisfy the following inclusion criteria:

- (i) Age seven or eight years.
- (ii) The child must be developmentally capable of the following skills:
  - Understanding of cause and effect relationships
  - Ability to grasp another person's point of view (peer/parent/professional)
  - Comprehension of the concepts of time in terms of past, present and future
  - An appreciation of intrinsic values (*eg* aesthetics)
  - Ability to discriminate between right and wrong
  - The capacity to practice some degree of self-control and self-denial.
- (iii) A current habit of sucking a digit while awake and asleep.
- (iv) An increased OJ of at least 6 mm and/or the presence of an anterior open bite.
- (v) The potential for the permanent central incisors to fully erupt as indicated by no more than 75% root formation.
- (vi) No craniofacial anomalies *eg* cleft lip and palate.

(vii) No learning disabilities.

Subjects were then randomly allocated to three groups: one group treated with positive reinforcement; another group treated with a crib; and a third (control) group that received no treatment for a similar period of time.

**Procedure**

Treatment with positive reinforcement involved three review visits around two, eight and sixteen weeks respectively after the initial visit. During the first visit for treatment, progress charts were provided for the parent/guardian to record the number of hours per day that digit-sucking is seen and/or reported to occur. A reward system was agreed on with the child and parent on this day as well. The OJ and overbite (OB) were measured at the start of the initial observation period and at the eight- and sixteen- week visits.

The OJ and anterior open bite or OB of patients treated with a crib were recorded using an overjet ruler at the start and end of the observation period (of 16 to 17 weeks). The observation period began after the TPA/crib was cemented in the mouth. To ensure that instructions were followed, a review visit two weeks after provision of the TPA/crib was arranged.

The sample studied reduced to eleven subjects treated with either a crib or positive reinforcement alone and three control subjects. After testing the results (*ie* reductions in OJ and increase in OB) for normality, two-sample *t*-tests were done using the statistical analysis software package, SPSS for Windows.

**RESULTS**

The initial OJ and OB mean and range for subjects treated with a crib or positive reinforcement are shown in Tables 1

and 2 respectively. Subjects in the control group experienced no change in OJ or OB. Statistical comparison of the results is shown in Tables 3 and 4.

**DISCUSSION**

Treatment with a crib or positive reinforcement improves the OJ and OB as seen by the results displayed in Table 2.

Table 1: Results for subjects treated with a crib

Subjects	OJ (mm)	OB (mm)	Reduction in OJ (mm)	Increase in OB (mm)
1	10.0	-3.0	2.5	2.5
2	6.0	-4.5	1.0	3.0
3	5.5	-4.0	3.0	3.5
4	6.5	-3.0	-0.5 (↑)	3.5
5	2.0	-4.5	0.0	2.0
6	5.0	3.0	4.0	1.0
μ	5.83	-2.6	1.67	2.58
<b>Range</b>	<b>2 - 10</b>	<b>-4.5 - 3</b>	<b>-0.5</b>	<b>1-3.5</b>

Table 2: Results for subjects treated with positive reinforcement

Subjects	OJ (mm)	OB (mm)	Reduction in OJ	Increase in OB
7	5.0	-1.0	1.0	3.5
8	8.0	-1.5	0.0	-0.5 (↑)
9	2.0	-4.5	0.0	2.0
10	8.5	1.0	1.0	2.5
11	6.0	1.5	-0.5 (↑)	-0.5 (↑)
μ	5.9	-0.9	0.3	1.4
<b>Range</b>	<b>2 - 8.5</b>	<b>-4.5 - 1.5</b>	<b>-0.5-1</b>	<b>-0.5-3.5</b>

Table 3: Analysis of OJ reduction results using t-test

Treatment	n	Mean (mm)	Standard deviation (mm)	Standard error of the mean	<i>p</i> value (equal variances assumed)	95% Confidence interval (lower limit)	95% Confidence interval (upper limit)
Crib	6	1.67	1.78	0.726	0.141	-0.201	3.534
PR	5	0.30	0.67	0.300	-	-0.533	1.133

Table 4: Analysis of OB increase results using t-test

Treatment	n	Mean	Standard deviation (mm)	Standard error of the mean (mm)	<i>p</i> value (equal variances assumed)	95% Confidence interval (lower limit)	95% Confidence interval (upper limit)
Crib	6	2.583	.970	.396	.185	1.565	3.602
PR	5	1.40	1.817	0.812	-	-0.856	3.656

Comparison of the means clearly indicates that the crib is more effective than positive reinforcement for reduction of an increased OJ and increase of a reduced OB. However, the difference in the mean and the standard error of the mean (SEM) reduction in OJ for subjects treated with a crib ( $n = 6$ ;  $1.833 \pm 0.641$ ) and subjects treated with positive reinforcement ( $n = 5$ ;  $0.500 \pm 0.224$ ) does not appear to be statistically significant due to the 95% confidence interval of the difference containing zero. Similarly, the difference in the mean (and the SEM) results for OB increase for subjects treated with a crib ( $n = 6$ ;  $2.583 \pm 0.396$ ) and subjects treated with positive reinforcement ( $n = 5$ ;  $1.600 \pm 0.714$ ) does not appear to be statistically significant.

Larsson's study (5) is not appropriate for comparison as the appliances used in his study were probably designed for active movement of teeth with wire components unlike the cribs used in this study. However, as Larsson's conclusion (that the effect on the OJ and OB is likely to be the same regardless of the treatment modality that is used) agrees with the statistical analytical conclusion of this study, two important weaknesses of Larsson's study that unfavourably influenced the inference must be considered here. A sample size of 19 in each subgroup is too small to be representative of an entire population. Also, the age of the patients in his study indicates that the incisors were likely to have developed fully and consequently, the incisors could not erupt further to affect the OJ and OB significantly.

The results of the study presented here are also useful despite the limitation of the sample which needs to be increased. Attrition of the sample occurred mainly due to one of the following reasons. One was the fact that a large number of patients failed to return for follow-up appointments after the digit-sucking habit was broken – the treatment was effective in eliminating the cause but we do not know how great an effect it had on the symptoms. Another reason was the failure of a few patients and/or their parents to use the positive reinforcement system to get any success (*ie* the child continued to suck a digit whether a reward was given or not). A third major factor was the limitation of members of the research team involved in data collection. Several academic staff members of the Child

Dental Health Unit of the School of Dentistry examined patients at their initial visit but were unable to do follow-up examinations due to: being part-time; other commitments being overwhelming; an unexpected resignation and inability to notice the need for reminder calls due to the preceding reasons.

Methodology implemented in this study will be improved on when the study is continued. A much greater effort will be made to ensure that follow-up appointments are attended. This will involve more emphasis, to the parents, of the importance of the follow-up visits and the members of the research team involved in data collection. The latter will only participate if their involvement in the Child Dental Health Clinic (where subjects are recruited) includes at least two whole days of teaching and a half-day of administration per week. Manpower problems for the study will be largely irrelevant after manpower problems for the Child Dental Health Unit of the School of Dentistry are reduced. Although some attrition of the sample will be expected, less attrition should occur as continuation /repetition of the data collection stage will only be possible with the addition of at least two more academic staff members.

## CONCLUSIONS

The trend in this study is that the crib has an advantage over positive reinforcement alone but this was not supported by statistical analysis. This study needs to be continued to increase the sample size and consequently increase the power of the study.

## REFERENCES

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