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A Novel child-friendly approach to persistent digit sucking using a Digit-Light Glove and Modified Bluegrass Appliance: An innovative approach to habit interception-a case report

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Abstract
Background: Persistent digit-sucking habits can cause dentoalveolar changes such as anterior open bite, increased overjet, and altered palatal morphology. Successful habit interception depends on the child's motivation and compliance. This case describes a novel combination of a modified Bluegrass appliance with a digit-light hand glove.
Case Presentation: A 5-year-old boy presented with persistent digit sucking, occurring unconsciously for approximately seven to eight hours daily. Clinical examination revealed Stage II early childhood caries, high palatal vault, anterior open bite, 5-mm increased overjet, and callus formation on the involved digit. Following counseling and Mirror Dunlop's technique, a combined intervention using a digit-light hand glove and modified Bluegrass appliance was initiated. The glove-light provided a physical barrier and visual reminder, while the Bluegrass roller served as a non-punitive distraction mechanism. Monthly follow-ups were conducted to assess compliance and habit reduction.
Conclusion: The combined use of a digit-light hand glove and modified Bluegrass appliance may provide a simple, non-invasive, and child-friendly approach for managing persistent digit-sucking habits. Further studies are required to establish its effectiveness.

Keywords: Persistent digit sucking, Modified Bluegrass Appliance, Digit-light Glove, habit interception, habit cessation, visual distraction, behavioral modification, positive reinforcement, child-friendly intervention, early interceptive treatment

Introduction

Oral habits are a common component of normal childhood development and generally arise as learned patterns of muscle activity involving complex behavioral and psychological factors. Among these, sucking habits are the most frequently encountered oral habits in children. Sucking is an innate reflex that develops early in fetal life and has been demonstrated as early as the 29th week of intrauterine life. It continues during infancy as an important physiological mechanism for nutrition, comfort, and emotional security. Thumb, finger, and pacifier sucking are commonly observed during infancy and early childhood, particularly during periods of anxiety, fatigue, relaxation, separation, boredom, or immediately before sleep.

Sucking habits may be broadly classified into nutritive and non-nutritive sucking habits. Nutritive sucking includes breastfeeding and bottle-feeding, whereas non-nutritive sucking encompasses thumb sucking, finger sucking, pacifier sucking, and other digit-sucking habits. Digit sucking may further be classified according to the digit involved, such as thumb sucking, index-finger sucking, middle-finger sucking, or sucking involving multiple digits. Based on the nature of the habit, sucking may also be described as active or passive, depending on the degree of muscular activity and force exerted during sucking. The habit may additionally be characterized according to its frequency, duration, and intensity, which are important determinants of its potential effect on the developing dentition.

Non-nutritive sucking habits are generally considered normal during infancy and early childhood and are usually self-limiting, with spontaneous cessation commonly occurring between two and four years of age. However, persistence beyond the preschool period, particularly during the period of eruption and establishment of the permanent dentition, may result in adverse dentoalveolar and occlusal changes. The term persistence refers to the continuation or prolongation of a habit beyond the expected age of natural cessation, i.e., when a behavior that is normally temporary in early childhood continues beyond the typical developmental period (usually after 4–5 years of age) instead of stopping spontaneously. Importantly, persistence also implies a failure of natural habit extinction over time, where the behavior becomes reinforced and continues despite increasing age, social awareness, and potential dental consequences. The severity of these effects depends not only on the presence of the habit but also on its frequency, duration, intensity, and the position of the digit in the oral cavity, as well as the associated muscular forces and individual craniofacial growth pattern.

Persistent digit sucking has been associated with characteristic dental and skeletal alterations, including anterior open bite, increased overjet, proclination and labial inclination of the maxillary incisors, lingual inclination of the mandibular incisors, narrowing of the maxillary arch, posterior crossbite, increased overbite in some cases, and alteration of the normal eruption pattern. Continuous pressure from the digit against the palate and maxillary anterior region may interfere with normal eruption and contribute to increased overjet and anterior open bite, while altered buccal musculature and tongue posture may contribute to maxillary arch constriction and posterior crossbite. Prolonged and intense habits may also influence the surrounding soft tissues, swallowing pattern, speech, and overall orofacial muscle balance.

The clinical significance of a digit-sucking habit is therefore determined by the age of the child, type of digit involved, frequency, duration, intensity, and skeletal and dental maturity. In particular, a habit that occurs intermittently and primarily during sleep may exert a different influence from one that occurs continuously throughout the day. Nevertheless, persistent nocturnal digit sucking may continue to apply repetitive forces to the developing dentition and should be assessed when it persists beyond the expected age of spontaneous cessation.

The prevalence of digit sucking is highest during infancy and early childhood, with sucking behaviors reported in approximately 70–90% of newborns and infants. The prevalence gradually decreases during the preschool years to approximately 15–30% and falls further among older children, with persistent habits beyond eight years of age being relatively uncommon. Although spontaneous cessation is common, persistence may be associated with parental education, feeding practices, psychosocial stress, emotional insecurity, anxiety, behavioral characteristics, and environmental influences. In many cases, persistence is also linked to habit reinforcement mechanisms, where the child derives continued psychological comfort from the behavior, making discontinuation more difficult without intervention

In the present case, the child exhibited a persistent digit-sucking habit occurring predominantly at night, particularly during sleep. Although the habit was not reported as a continuous daytime behavior, its persistence beyond the normal period for spontaneous cessation warranted clinical evaluation because of the potential for continued dentoalveolar effects. The case therefore emphasizes the importance of identifying the pattern, timing, frequency, intensity, and persistence of digit sucking over time, rather than assessing the habit solely on the basis of its presence or absence. Appropriate habit interception should be individualized according to the child's age, dentofacial changes, behavioral characteristics, and level of cooperation

Removable habit-breaking appliances, such as conventional thumb guards and oral screens, are commonly employed because they are simple, economical, and relatively non-invasive. Nevertheless, their effectiveness is often dependent on the child's motivation and compliance and may lack the positive reinforcement and distraction offered by newer habit-interception strategies. The Bluegrass appliance, in comparison, incorporates a non-punitive roller mechanism that diverts the child's attention while providing neuromuscular stimulation, thereby facilitating better acceptance and compliance. However, to the best of our knowledge, only limited literature is available regarding the incorporation of a Modified Bluegrass appliance along with thumb light hand gloves.

Case Presentation

A 5-year-old boy was brought by his parents with a persistent digit-sucking habit since early childhood. The parents reported that the child engaged in digit sucking unconsciously, particularly during idle periods, averaging seven to eight hours per day. The child was medically healthy, with no history of systemic illness, developmental disorders, or psychological concerns. Prenatal, natal, and postnatal histories were non-contributory, and developmental milestones had been achieved appropriately for age. Dental history revealed no previous habit-interception or orthodontic treatment. The child belonged to a supportive family environment, and no significant psychosocial stressors or behavioral issues associated with persistence of the habit were identified.













Clinical examination revealed Stage II early childhood caries, a high palatal vault, anterior open bite, 5-mm increased overjet, and callus formation on the involved digit, consistent with a longstanding digit-sucking habit. No other significant dentofacial abnormalities, such as posterior crossbite or facial asymmetry, were observed. As this was an early interceptive case and objective measurements of palatal morphology were not recorded, qualitative clinical assessment was used to document the habit-related changes

At the initial visit, a comprehensive history of the digit-sucking habit was obtained, including the age of onset, duration, frequency, and circumstances associated with the habit. A clinical examination was performed to assess habit-related oral and dentofacial changes. The patient's medical, dental, developmental, and psychosocial histories were also reviewed and found to be non-contributory.

Following the diagnostic assessment, counseling was provided to the child and parents regarding the potential adverse effects of prolonged digit sucking on the developing dentition and the available habit-interception approaches. Mirror Dunlop's technique was employed to enhance motivation, wherein the child was encouraged to observe the habit in a mirror and reflect on whether he wished to discontinue it. The child expressed willingness to stop the habit, thereby enhancing motivation and cooperation.



As part of the comprehensive dental management, the carious teeth were initially restored, followed by placement of stainless-steel crowns on the indicated posterior primary teeth to establish appropriate function and provide full-coverage protection. Management of the anterior carious teeth with crowns.

Following restorative management, a combined habit-interception approach using a modified Bluegrass appliance for the upper arch and a digit-light hand glove was planned. The Bluegrass appliance was fabricated and placed in the maxillary arch as a non-punitive intraoral distraction device. Its roller mechanism provided an alternative sensory stimulus and redirected the child's attention during episodes of the urge to suck the digit. The hand glove was used as a physical barrier to prevent direct contact of the involved digit with the oral cavity and to increase awareness of the habit. A digit light was incorporated as an additional visual cue and distraction whenever the child attempted to place the digit in the mouth.

The child and parents were instructed regarding the appropriate use of the digit-light hand glove and modified Bluegrass appliance. The child was encouraged to use the Bluegrass roller whenever the urge to suck the digit occurred, while the glove and digit light served as additional reminders to interrupt the habit. Positive reinforcement was emphasized throughout the intervention rather than punitive measures, thereby promoting cooperation and sustained motivation.

Monthly follow-ups were scheduled to assess habit frequency, appliance acceptance, compliance, and clinical progress. During subsequent visits, the condition of the restored teeth and crowns will be evaluated.

This case report highlights a comprehensive, child-friendly approach combining restorative dental care with habit interception, integrating caries management, stainless steel crowns, planned anterior crowns, a modified Bluegrass appliance, and a digit-light hand glove to address both the existing dental disease and the underlying persistent digit-sucking habit.

Discussion

Persistent digit sucking beyond the preschool period may adversely influence the developing dentoalveolar structures, with the severity of associated changes being influenced by the frequency, duration, and intensity of the habit. In the present case, the child demonstrated an unconscious digit-sucking habit for approximately 7–8 hours daily, indicating prolonged exposure to the habit. The presence of anterior open bite, 5-mm increased overjet, high palatal vault, and callus formation on the involved digit was consistent with the effects of a longstanding sucking habit. Maguire emphasized that management of oral habits should consider the duration, frequency, intensity, motivation, and associated dentofacial alterations rather than relying solely on mechanical intervention.

The dentofacial findings observed in the present case are consistent with those reported in the literature. Diwanji *et al*. reported that persistent thumb sucking may be associated with anterior open bite, increased overjet, proclination of maxillary incisors, lingual inclination of mandibular incisors, and alterations in palatal morphology. The authors also emphasized that the severity of these changes is related to the duration and frequency of the habit. In the present case, the prolonged daily duration of approximately 7–8 hours may have contributed to the development of the observed anterior open bite and increased overjet. The callus formation on the involved digit further supported the chronic nature of the habit.

Successful management of digit sucking depends not only on mechanical prevention but also on the child's motivation and cooperation. In the present case, Mirror Dunlop's technique was used to increase the child's awareness of the habit and encourage active participation in treatment. This was particularly relevant because the habit occurred unconsciously, especially during idle periods. The child's willingness to discontinue the habit following counseling provided a favorable behavioral foundation for subsequent appliance therapy. Maguire emphasized the importance of behavioral approaches and positive reinforcement in the management of oral habits.

The Bluegrass appliance, introduced by Haskell and Mink, represents a non-punitive approach to digit-sucking habit interception. Unlike conventional palatal cribs, rakes, or spurs that primarily prevent digit placement through mechanical obstruction or aversive stimulation, the Bluegrass appliance incorporates a roller that provides an

alternative sensory stimulus. Haskell and Mink proposed that the roller could divert the child's attention and provide a competing activity, thereby facilitating habit cessation without inducing fear or discomfort.

The effectiveness of the Bluegrass concept has been supported by subsequent clinical studies. Greenleaf and Mink reported successful cessation of thumb sucking in 28 of 30 children treated with the Bluegrass appliance. Similarly, Diwanji *et al*. described a modified Bluegrass appliance as a comfortable and non-punitive alternative for habit interception, emphasizing the role of positive reinforcement and patient cooperation. Chhabra and Chhabra also evaluated a modified Bluegrass appliance and reported a high rate of habit cessation, supporting its potential as a child-friendly approach for managing persistent digit sucking.

In the present case, the modified Bluegrass appliance was selected because its roller mechanism provides a competing sensory stimulus rather than a punitive barrier. The child was encouraged to manipulate the roller whenever the urge to suck the digit occurred. This provided an alternative oral activity and potentially redirected attention away from the sucking behavior. Thus, the intervention was based on habit substitution and sensory distraction rather than punishment.

The novel component of the present intervention was the addition of a digit-light hand glove to the modified Bluegrass appliance. The glove acted as a physical barrier preventing direct contact between the digit and oral cavity, while the digit light served as a visual cue to increase awareness of the habit. This feature may be particularly useful when digit sucking occurs unconsciously. Thus, the glove and digit light addressed the habit externally, whereas the Bluegrass roller provided an intraoral competing stimulus. The combination incorporated physical interruption, visual awareness, and sensory distraction within a single intervention.

The use of positive reinforcement was another important component of the present treatment. Rather than associating habit cessation with punishment, the child was encouraged and reinforced for successful interruption of the habit. Diwanji *et al*. and Chhabra and Chhabra similarly emphasized the importance of positive reinforcement when using Bluegrass-type appliances. A supportive family environment may further contribute to compliance by allowing parents to provide consistent encouragement and monitor the child's use of the glove and appliance.

The present case is noteworthy because of the combined use of the digit-light hand glove and modified Bluegrass appliance. Although Bluegrass appliances have previously been described for habit interception, limited literature is available regarding their combination with an external visual cue such as a digit light. The multimodal nature of this intervention may be particularly advantageous when digit sucking occurs unconsciously, as it simultaneously interrupts the habit, increases awareness, and provides an alternative sensory response.

However, this case report has certain limitations. As this represents a single-patient clinical experience, the effectiveness of the combined approach cannot be generalized. The individual contribution of the glove, digit light, modified Bluegrass appliance, and behavioral counseling cannot be independently determined. Furthermore, palatal morphology and dentoalveolar changes were assessed clinically without standardized quantitative measurements. Therefore, the findings should be considered descriptive rather than definitive evidence of treatment efficacy.

Future studies should evaluate this approach using larger samples, standardized measures of habit frequency, objective assessment of overjet and open bite, and longer follow-up periods. Comparative studies evaluating the modified Bluegrass appliance alone versus the modified Bluegrass appliance combined with a digit-light glove would be particularly valuable in determining the additional benefit of the visual and physical cues. Overall, the present case suggests that combining behavioral motivation, a digit-light hand glove, and a modified Bluegrass appliance may provide a simple, non-invasive, non-punitive, and child-friendly approach for intercepting persistent digit-sucking habits.

Clinical Implications

The present case highlights a simple, non-invasive, and child-friendly approach for managing persistent digit-sucking habits. Combining a digit-light hand glove with a modified Bluegrass appliance may address different aspects of habit behavior by providing a physical barrier, increasing habit awareness through a visual cue, and offering an alternative sensory stimulus through the Bluegrass roller. The approach may be particularly useful for unconscious or frequent digit-sucking habits, where conventional counseling alone may be insufficient. Incorporating positive reinforcement and parental involvement can further support motivation and compliance. From a clinical perspective, this multimodal approach may provide an alternative to punitive habit-breaking methods while promoting a more comfortable and cooperative treatment experience. However, its clinical effectiveness should be validated through controlled studies with standardized outcome measures and longer follow-up.

Conclusion

The combined use of a digit-light hand glove and modified Bluegrass appliance provided a simple, non-invasive, non-punitive, and child-friendly approach for intercepting persistent digit-sucking habits. By integrating habit awareness, physical interruption, sensory distraction, and positive reinforcement, the approach may enhance child cooperation and facilitate habit cessation. Further clinical studies with standardized outcome measures and longer follow-up are required to establish its effectiveness and long-term benefits

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