EFFECTS OF TWO TYPES OF APPLIANCES ON OROFACIAL DYSFUNCTIONS OF DISABLED CHILDREN

Alev Alacam and Nalan Kolcuoğlu

Introduction

The importance of preventive therapies in disabled patients have been understood in dentistry also as in every step of their medical therapies. Oral-health education of the family and the child, motivation and preventive applications starting from early ages, will probably solve most of the oro-dental health problems of this special group. Otherwise, periodontal problems, missing teeth due to caries, malocclusions and orofacial muscle dysfunctions of the patients will make the treatment more complicated.

Orofacial dysfunctions mostly seen in Down syndrome (DS) or Cerebral palsy (CP) cases create a social problem for children besides their physical problems. However these dysfunctions are not accepted as a serious or primary health problem by most physicians. The extra-oral appearance with an open mouth called “dull look” causes negative effects on the physiological development of children, affecting their social acceptance. Habitual mouthbreathing, feeding disorders, lack of mastication, protrusion of the tongue, lip incompetence, drooling, swallowing and speech disorders are the problems most often seen in this special group. Usually patients have mouthbreathing which causes upper respiratory system problems and xerostomia resulting in periodontal destruction and dental loss. All these problems need early stage orofacial muscle treatment.

It is known that lack of lip closure is not abnormal in children under 3½ years of age and normal tongue posture development takes place at approximately 4 years of age.
In DS, CP and motor-mental retardation cases (MMR), there will be lack or retardation of orofacial muscle development. As a close relation between oral structure and muscle tone was demonstrated by neuromuscular therapy, it is important to know the normal development and retardation due to disabilities (Carr, 1970; Limbrock et al., 1993; Hennequin et al., 1999). Oreland et al., (1989) showed a relationship between mental retardation and poor oral function in their study whereas Sipahier et al., (1992) stated that the effects of orofacial dysfunctions had an important role on malocclusions in mentally retarded groups compared with normal children.

In the 1970’s, a treatment method for orofacial muscle dysfunctions was proposed by Castillo-Morales et al., (1982) by the stimulation of tongue and the upper lip with a palatal plate combined with physiotherapeutic exercises. Today the Castillo-Morales palatal plate is a well-known appliance as a part of orofacial myofunctional therapy (Castillo-Morales et al., 1982; Chapman et al., 1983; Hoyer and Limbrock, 1990; Limbrock et al., 1990b; Carlsted et al., 2003). On the other hand vestibular screen therapies have the same indications of treating the abnormalities due to tongue and lip dysfunctions such as inciting nose-breathing, preventing external forces to teeth from cheeks and lips, activating the muscular tonus of lips (Hinz, 1986; Hinz, 1995). The aim of the screen is to improve the open mouth habit by establishing a rest position of the tongue behind the incisor.

In this study the effectiveness of the Castillo-Morales palatal plate and Dr. Hinz oral-screen appliances on orofacial muscle dysfunctions of disabled children was evaluated.

### Materials and Methods

Fifty children, ages 3-7, with orofacial muscle dysfunction diagnosis were included in the study with parental consent. Also study permission was obtained from Ethical Commitee of Gazi University Faculty of Medicine. Thirty-one of the children who participated the study had CP, 8 children had DS and 13 had MMR. All the children had special physiotherapy programme for orofacial stimulation in their institutions before and during the study.

Orofacial dysfunctions were evaluated according to the criteria of Oreland et al. (1989), were recorded and photographed, and 3-5 minute video-images were taken (TABLE I).

After giving a draught of water, the type of swallowing was assessed by examining the posture of the tongue when the lips were opened with a mouth mirror. If a tongue thrusting movement was displayed the score was infantile. The number of chewings before swallowing a piece of bread (1 cm²) was also counted. Healthy people chew a piece of bread more than 5 times.

The choice of habitual way of breathing was examined by use of a mirror. The lip seal was estimated by examining the lips at rest. The tongue posture at rest was observed by causally examining the patient seated in an upright position in chair. The posture was judged normal, if the tongue tip was behind the mandibular incisors; and interdental, if the tip was atop the lower incisors.

Occurance of drooling was observed without the patients’ awareness before and during the medical-functional examination. Documentation of pretreatment observations were given in TABLE II.

Initially, all the children used a Dr. Hinz oral-screen for a 2 week period. The type of appliance was the “Pearl Oral Screen” in
### TABLE I
Criteria for clinical examination of orofacial muscle dysfunctions (Oreland et al., 1989)

- **Swallowing:** normal, infantile, special feeding (have swallowing reflex), style feeding (impaired or no swallowing reflex)
- **Chewing:** 0 stroke; < 3 strokes; 3 < strokes < 5; 5 < strokes < 10; > 10 strokes; not cooperating
- **Mouthbreathing (habitual):** yes, no, undeterminable
- **Lip seal:** competent, incompetent, undeterminable
- **Tongue posture:** normal, interdental, various
- **Drooling:** yes, no, undeterminable

### TABLE II
Pretreatment examination results of orofacial functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Swallowing</strong></td>
<td></td>
</tr>
<tr>
<td>normal</td>
<td>20 children</td>
</tr>
<tr>
<td>infantile</td>
<td>30 children</td>
</tr>
<tr>
<td>special feeding</td>
<td>27 children</td>
</tr>
<tr>
<td>style feeding</td>
<td>3 children</td>
</tr>
<tr>
<td></td>
<td>have swallowing reflex (semi-solid foods)</td>
</tr>
<tr>
<td></td>
<td>impaired or no swallowing reflex (liquids only)</td>
</tr>
<tr>
<td><strong>Chewing</strong></td>
<td></td>
</tr>
<tr>
<td>0 strokes</td>
<td>16 children</td>
</tr>
<tr>
<td>3 &lt; strokes &lt; 5</td>
<td>32 children</td>
</tr>
<tr>
<td>5 &lt; strokes &lt; 1</td>
<td>2 children</td>
</tr>
<tr>
<td></td>
<td>41 children had chewing problems (eg. mashing on palate)</td>
</tr>
<tr>
<td><strong>Mouth Breathing</strong></td>
<td></td>
</tr>
<tr>
<td>nose breathing</td>
<td>29 children</td>
</tr>
<tr>
<td>mouth breathing</td>
<td>21 children</td>
</tr>
<tr>
<td><strong>Lip Seal</strong></td>
<td></td>
</tr>
<tr>
<td>incompetent</td>
<td>43 children</td>
</tr>
<tr>
<td>competent</td>
<td>7 children</td>
</tr>
<tr>
<td><strong>Tongue Posture</strong></td>
<td></td>
</tr>
<tr>
<td>interdental</td>
<td>34 children</td>
</tr>
<tr>
<td>extra-oral</td>
<td>8 children</td>
</tr>
<tr>
<td>normal</td>
<td>8 children</td>
</tr>
<tr>
<td><strong>Drooling</strong></td>
<td>All the patients had drooling in various degrees</td>
</tr>
</tbody>
</table>
the form of a pacifier with a rolling pearl part (PICTURE 1). Castillo-Morales palatal plate was applied to 23 children who refused to use a Dr.Hinz oral-screen (PICTURE 2). Castillo-Morales palatal plates were prepared at the laboratory from individual impressions. A therapeutic “button” stimulator with an external diameter of 7-8 mm and height of 4-8 mm was mounted on the palatal surface of each plate. In some cases, “dental retainers” were used for support; otherwise, plates were prepared like overdentures. If there was an incoordination of the appliance, the palatal plate renewed. Patients were motivated to use the appliances continuously for an hour per application. A total of 3-4 hours a day was recommended.

Parents recorded the daily usage time of the appliances and the improvements that they observed in children’s orofacial dysfunctions (chewing and feeding problems, drooling, lip seal, and tongue posture).

Patients were controlled clinically at 3-month intervals, for 12 months. At the end of 12 months, children stopped using the appliances and were evaluated for relapse for an additional 3 months. Treatment of 8 children had to be interrupted because of change of address, lack of compliance.
and loss of follow-up because of distance. Ultimately, 42 children were evaluated at the end of the original 12-month treatment period, while 36 were evaluated at the end of 3-month additional relapse period.

Statistical analysis of the treatment results according to usage time and type of appliance was evaluated with a ‘sign test’. The differences between the two appliances according to orofacial functional development effectiveness were determined with a ‘proportion for difference-normal approximation’ test.

**Results**

Daily usage times of the appliances according to appliance type are given in TABLE III.

The results of the effects of the appliances on swallowing are presented in FIGURE 1, chewing (FIGURE 2), tongue posture and lip seal (FIGURE 3), and drooling (FIGURE 4).

The data revealed that Castillo-Morales palatal plates were significantly more efficient (p < 0.05) at improving swallowing

<table>
<thead>
<tr>
<th>Daily usage times</th>
<th>Dr. Hinz</th>
<th>Castillo-Morales</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 hour</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>1-2 hours</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>2-3 hours</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>3-4 hours</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

**FIGURE 1**
Effects of therapy on swallowing

- Castillo-Morales appliances
- Dr. Hinz appliances

<table>
<thead>
<tr>
<th>Percent of children</th>
<th>Castillo-Morales appliances</th>
<th>Dr. Hinz appliances</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>25%</td>
<td>14%</td>
</tr>
<tr>
<td>20%</td>
<td>33%</td>
<td>9%</td>
</tr>
<tr>
<td>40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80%</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td></td>
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</tr>
</tbody>
</table>
FIGURE 2
Effects of therapy on chewing

- Castillo-Morales appliances:
  - Transfer to chewing: 80%
  - Increasing in chewing stroke: 90%

- Dr. Hinz appliances:
  - Transfer to chewing: 33%
  - Increasing in chewing stroke: 71%

FIGURE 3
Effects of therapy on tongue posture and lip seal

- Castillo-Morales appliances:
  - Tongue transfer to interdental position: 100%
  - Tongue transfer to intra-oral position: 75%
  - Lip seal development: 83%
  - Lip seal competency: 53%

- Dr. Hinz appliances:
  - Tongue transfer to interdental position: 69%
  - Tongue transfer to intra-oral position: 67%
  - Lip seal development: 77%
  - Lip seal competency: 33%
after 2-3 hours and 3-4 hours usage times. However the number of chewing strokes was not affected by the appliance type used (p < 0.05).

The effects on tongue posture was important for the Castillo Morales palatal plate (p<0.05) according to daily usage times of 1-2 hours, but there was no difference between the appliances for 2-3 hours or 3-4 hours usage time schedules (p>0.05).

For lip seal competency, 1-2 hours and 2-3 hours usage of the appliances did not result in a statistically significant difference. Usage of Dr. Hinz oral-screen for 3-4 hours was effective after 3 months (p<0.05) whereas the Castillo-Morales palatal plate was found to be effective (p<0.05) after 12 month for the same usage time.

Drooling evaluations of 1-2 hours and 3-4 hours usage time of the Castillo-Morales palatal plate and their 12 month results were found to be important (p<0.05).

Thirty-six children returned for relapse evaluation at the end of a 3-month additional relapse period. The follow-up examination showed that 5 children (13.8%) who used the appliances less than 2 hours had a regression in orofacial functions. 15 children (41.6%) who used the appliances more than 2 hours continuously improved their orofacial functions and 16 children (44.6%) remained stable.

The improvement of the facial expression of the children who used the Castillo-Morales (PICTURES 3 and 4) and Dr Hinz appliances (PICTURES 5 and 6) were impressive.

Discussion

The most crucial point in this study was to improve the oral motor functions of this special group of children with two different palatal appliances and to evaluate their effects. The Castillo-Morales palatal plate has long been noted to have satisfactory results in improving oro-facial muscle dysfunctions especially in children with
PICTURE 3
Pre-treatment and post-treatment appearance of a 2 year old child with Down syndrome who used a Castillo-Morales appliance

PICTURE 4
Pre-treatment and post-treatment appearance of a 4 year old child with Down syndrome who used a Castillo-Morales appliance
PICTURE 5
Pre-treatment and post-treatment appearance of a 5 year old child with cerebral palsy who used a Dr. Hinz appliance

PICTURE 6
Pre-treatment and post-treatment appearance of a 3 year old child with cerebral palsy who used a Dr. Hinz appliance
DS (Castillo-Morales et al., 1982; Chapman et al., 1983; Hoyer and Limbrock, 1990; Limbrock et al., 1990a; Schuster and Giese, 2001; Backman et al., 2003; Carlsted et al., 2003). On the other hand, the oral screen appliances were suggested as good alternatives for lip exercises also. Between the four commercially available types of Dr. Hinz oral screen appliances, the “pearl-oral screen” which is in the form of a pacifier with a rolling pearl part, was selected for this study. The advantage of this appliance is that it is commercially available in two dimensions for primary and mixed dentition. The manufacturer stated that the rolling pearl improved the tongue position at rest, controlled drooling and prevented the position and strength of the lips. (Dr. Hinz Dental). Also, it is concluded that 3-8 years of age is ideal to begin the therapy with Dr. Hinz oral screen (Hinz, 1986).

The children attending a lasting physiotherapy programme for orofacial stimulation in their institutions with an age range between 3-7 years were randomly selected for this study. All the children who participated the study were guided to use a Dr. Hinz oral-screen for a 2 week period initially, but 23 children out of 50 refused it and were transferred to use the Castillo-Morales palatal plate. It became apparent that the physiological development of hand coordination of the older children was a disadvantage for the pacifier form of Dr. Hinz oral-screen usage since older children easily removed the appliance and it became harder to control the usage time. The advantage of the Castillo-Morales palatal plate was that it is an individual appliance that is harder to remove and the children showed better compliance, contrary to the findings of Castillo-Morales et al. (1982) who stated that in children above the age of 4 years of age the treatment would be unsuccessful because of rejection of the plate.

Most of the studies on orofacial regulation therapies demonstrated that the best results have followed very early intervention between 6 months and 4 years of age and stressed a dual concept of physiotherapeutic exercises for the oral region besides a stimulator plate. It is known that active prenatal development and orofacial influence starts with thumb-sucking at four to five months before birth. However, this habit seldom develops even after birth in Down syndrome cases (Carr, 1970; Fischer-Brandies et al., 1986). It is because of this that most of the studies on Castillo-Morales orofacial regulation therapy were started at a young age in children with Down syndrome (Limbrock et al., 1990a, 1991; Carlsted et al., 2003; Backmann et al., 2003; Hunn, 2000). On the other hand, Gerek and Çiyiltepe (2005) successfully treated 7 children with cerebral palsy, at ages between 8-17, with Castillo-Morales palatal plates whereas Limbrock et al., (1991) stated that there was no effect of age on results of the treatment in their Down syndrome study group of children aged 0-6. In our study 31 children had CP and the others had DS and MMR. Although the wide age range between 3-7 years did not affect the results, the importance of mental age in diagnosis and treatment planning rather than chronological age, must not be neglected.

The results of the study showed both of the appliances had similar improving effects on most of the parameters of orofacial dysfunctions at different time periods. The Castillo-Morales palatal plate was found significantly to be effective for only swallowing, lip seal and drooling parameters at 3-4 hours usage time at the end of a 12 month period. So the importance of daily usage times of the appliances rather than the appliance type became the most important criteria for success in the evaluation at the end of the study. Gerek and Çiyiltepe (2005) had followed a different schedule
starting with a 1 hour on, 10 minute off for 6 hours regime when awake at first week, 2 hours on, 10 min off for 8 hours in the second week, 4 hours on, 10 min off for 8 hours at the third week and all day when awake for 10-12 weeks. However there is the risk that the child may become accustomed to the appliances for all day usage for such a long time. On the other hand, the instructed usage time of at least one hour twice a day, by Carlsted et al. (2003) was thought to be in limits for success according to our results. Limbrock et al. (1991) preferred a schedule starting with one hour each day and quickly progressing to one hour three or four times a day which was similar to our study protocol. At the end of a 3 month relapse period without using the appliances, 44.6% of the children remained stable while 41.6% who used the appliances more than 2 hours had continued development in orofacial functions in this study. These results were in correlation with the study of Korbmacher et al. (2004) who stated that improved orofacial appearance resulting from the early treatment had remained stable after 12 years whereas initially slight improvements resulted in only slight improvements or unchanged findings in the longer term. The regression in orofacial functions of children who used the appliances less than 2 hours supported the idea of Hoyer and Limbrock (1990) who suggested that relapse would have happened if the usage of the appliance was neglected for a period of time in the early stages of the treatment.

The most impressive results of this study were the improvement in the feeding style and the development of facial expression. Positive effects of therapy on swallowing and the increase in the number of chewing strokes were found to directly influence feeding types. 80 % of children in Castillo-Morales group were transferred from special to normal feeding and 90 % of the same group increased their chewing stroke number. The ability to advance from mashing the food on palate to a more normal feeding was very pleasing for the families of the children. On the other hand, development of facial expression is closely connected with the total (motor, cognitive and social) development of the child and it is known that children with Down syndrome have a slower than normal motor development during the first 2 years, related to general hypotonia including the orofacial muscles (Carr, 1970; Limbrock et al., 1990a, Limbrock et al., 1991, Limbrock et al., 1993; Carlsted et al., 1996). Pre-treatment and post-treatment photographs and video registrations of all of the children that participated in the study showed a significant difference in orofacial development on a 12 month follow-up period. However the lack of a control group limited our ability to evaluate the effect of the appliances independently from normal development. In such functional therapies, the lack of a control group raises the same ethical problems as dismissing the control group from treatment. According to our results, it is thought that the children who used their appliances less than 1 hour could be controls in future studies.

The results of the study showed vast improvement in the quality of the children’s orofacial functions, instilled happiness in their families and made their lives more enjoyable in this respect. It is clear that supporting the physiotherapy programmes with a regularly applied prostho-odontical appliance for a sufficiently long lasting treatment period (at least 3-4 hrs/day for one year) will achieve the desired permanent results in addition to a conscientious and wishful family.
Conclusions

• Both appliances had positive effects on the development of oral functions.
• Appliance effectiveness was directly related to the length of daily usage period.
• There was no improvement in oral functions in children who used the appliances less than an hour in both groups.
• The Castillo-Morales palatal plate was more effective in the swallowing, lip seal and drooling parameters, with 3-4 hours of daily use throughout the 12-month evaluation period.
• Relapse evaluations showed that the usage time was effective on the functional regression whereas 44.6% of the patients showed stability in their acquired functions in this study.

Summary

Habitual mouth-breathing, feeding disorders, lack of mastication, protrusion of the tongue, lip incompetence, drooling as well as swallowing and speech disorders are the problems most often seen in disabled children with orofacial muscle dysfunction. The aim of this study was to improve these functional problems by using either the Castillo-Morales palatal plate or the Dr. Hinz oral screen and evaluate their effects on this special group.

Thirty one children with cerebral palsy, 6 children with Down syndrome and 13 children with mental motor retardation, at ages between 3-7, participated to this study. The Dr. Hinz oral screen and Castillo-Morales palatal plate were used by the children for 12 months. Photographs and video images were taken at the beginning and at the end of the study. The changes in oral functions were recorded on standardized forms by the parents and the doctor. At the end of the therapy period, relapse was evaluated without the appliances for 3 months more.

Statistical analysis of oral functions were calculated using the 'sign test' and 'proportion for difference'. Both of the appliances were observed to efficiently aid the development of oral functions. However patients who used the appliances 3-4 hrs/day were found to have a more favorable outcome than patients using the appliances for 1-2 hrs/day. Also the Castillo-Morales palatal plate was found to be more effective and easily accepted in this study group. Relapse results showed that in 44.6% of the children there was stability in the acquired oral functions. 13.8% of the children who used the appliances less than 2 hours in the study period showed a regression in their acquired oral functions.

In this study, both of the appliances were found to have a positive role on the improvement of orofacial dysfunctions which affects the social acceptance of this special group negatively. Conscientiousness of the family and daily usage times were found important factors on the success.

References


Dr. Hinz Dental. [http://www.dr-hinz-dental.de/Cataloge](http://www.dr-hinz-dental.de/Cataloge)


