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ORIGINAL RESEARCH

Alteration in Taste Perception among Young Children during the use of Removable Orthodontic Appliance Therapy

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ABSTRACT

Background: The sense of smell is very influential in the taste of foods. If the smell pleases us, we anticipate the taste of the food with a great deal of relish. If our sense of smell is impaired, so is our taste. The effect of appliance on taste perceptions has always had a controversial subject.

Materials and methods: The present study was designed to analyze the change in taste perception in children using removable orthodontic appliances. All the selected volunteers were given different taste stimuli and were asked to score as per their perception. The verbal score was calculated based on the correct and incorrect taste stimuli given to them. Visual analog scale was used to assess intensity and hedonic (palatability) estimation of the volunteers.

Results: The volunteers from both study and control groups scored different values for taste stimuli. The majority of stimuli were estimated correctly by both groups. There was no statistically significant difference between the study and control groups.

Conclusion: In different testing sessions, the scoring of the volunteers was nearly constant, indicating that an appliance does not play a major role in the alteration of taste stimuli.

Clinical significance: The appliance brings about transient change in taste perception, we should educate the patient before delivering the appliance about the transient change in taste perception and encourage full-time wear of the appliance, including during meals, without fear of affecting taste sensations.

Keywords: Alter, Orthodontic appliance, Taste, Young children.

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INTRODUCTION

Taste refers to the sensation experienced during stimulation of oral chemoreceptors and will include stimulation of specialized receptor cells in the taste buds and free nerve endings in the oral cavity.[1] In relation to humans, the development of taste perception follows a well-defined pattern; the rejection response to bitter tastes and the acceptance of sweet foods appear to be inborn and not learned responses.[1] It has been demonstrated that newborn infants show preferences to sugar, aversions to acids, and bitter stimuli and are relatively indifferent to salt solutions.[1] This suggests that the sense of taste is to some degree functional at birth. At present, however, some broad generations about sensory development and food acceptance can be made. First sweet preference appears innate, second aversions to bitterness appear from a very early age, third saltiness may be aversive or neutral to infants, with adult patterns of salt preference not appearing until about age two.[2]

Research shows that taste sensitivity of 8- to 9-year-old child, although well developed, is not fully matured.[2] Pattern of distribution of taste buds is more extensive in

infants and young children. The sensory development in children is not so mature as compared with that of adults.[2] Hence, anything which brings about a change in taste is repulsive to children.

Children in the developing period develop various types of malocclusion and hence, undergo orthodontic therapy for its correction. However, there are various reasons for the failure of removable appliance therapies in children, such as disturbances in phonation, vocalization, and complaints related to oral handling of food and beverages and change in taste and smell perception.[3]

The effect of appliances on taste perceptions has always been a controversial subject.[4] Several investigators have indicated a loss of taste sensation associated with palatal coverage.[4] Others have found that appliance either exerted no effect on taste perception or actually enhanced this perception.[4] Clinical experience suggests that upper removable or removable prosthetic appliance might affect taste and smell by disturbing the natural airflow between the oral and nasal cavities.[3] In relation to children, not many studies have been done regarding change in taste and smell perception in spite of complaints and questions from patients and their parents regarding this function.[3] Hence, this study was designed to analyze the change in taste perception in children using removable orthodontics appliances.

This study was aimed to analyze the taste perception in young children undergoing upper removable orthodontic appliance therapy.

Objectives

- To check the accuracy of taste in young children undergoing upper removable orthodontic appliance therapy.
- To measure hedonic (palatability) estimation of the taste stimuli in young children undergoing upper removable orthodontic appliance therapy.
- To estimate the intensity of the taste stimuli in young children undergoing upper removable orthodontic appliance therapy.

Study Design

A total of 100 selected volunteers for the study were divided into two groups (groups I and II) of 50 children each as study and control groups between the age of 8 and 13 years from the Department of Pedodontics and Preventive Children Dentistry and Department of Orthodontics. The study group (I) was given upper removable orthodontic appliances as per individual treatment needs. Control group (II) consisted of children who did not require removable orthodontic appliances. All the selected volunteers were given different taste stimuli and were asked to score as per their perception. The verbal score was calculated based on the correct and incorrect taste stimuli given to them. Visual analog scale (VAS) was used to assess intensity and hedonic (palatability) estimation of the volunteers. Volunteers were instructed to make a single and decisive, clearly visible mark on each of the scales according to their best subjective judgment. The results obtained were subjected to statistical analysis.

Exclusion Criteria

Those subjects with a history of systemic diseases, acute upper respiratory tract infection, or drug therapy were included in the study.

Those with a history of earlier orthodontic treatment were not taken into consideration.

Various Stimuli used in the Study

Taste stimuli – The various taste stimuli selected to assess the taste perception of the volunteers were divided into 10 different groups:

Group	*Stimuli*
I	Sucrose concentrated
II	Sucrose dilute
III	Citric acid concentrated
IV	Citric acid dilute
V	Saline concentrated
VI	Saline dilute
VII	Distilled water
VIII	Distilled water
IX	Mint
X	Strawberry

Method of Collection of Data

All selected volunteers' examination was performed on a dental chair. The samples were presented to the subjects in an individual, randomized sequence. The samples consisted of eight different taste stimuli in 5 mL samples representing tasteless, sweet, salty, and sour substances.[3] All intraoral stimuli were presented in disposable plastic cups at room temperature.

In each session, the participants were requested:

- To write down in their own words the description of the taste (verbal labeling)[3]
- To mark the hedonic estimation (palatability) of the taste stimulus on a VAS[3]
- To make the intensity estimation of the taste stimulus on a VAS[3]

The participants were asked to mark their answers on 100 mm VAS. The scales were horizontal lines with their end points marked by anchor statements. The statements were "most pleasant" (right-hand side) and "most

repulsive" (left-hand side). Visual analog scale was also used to record intensity estimate with the end points marked by anchor statements "strongest" on right-hand side and "weakest" on left-hand side.[3] The volunteers were instructed to make a single and decisive, clearly visible mark on each of the scales according to their best subjective judgment.[3-6]

Most repulsive |_____| Most pleasant

Weakest |_____| Strongest

The study groups were tested on three different sessions:

Session I: Ten days before removable orthodontic appliance therapy (T0)

Session II: On the day of removable orthodontic appliance delivery (T1)

Session III: One month after removable orthodontic appliance delivery (T2)

The control groups were tested on the first two different sessions:

Session I: Ten days before (T0′)

Session II: On the day (T1′)

Data Processing

- The verbal labeling was evaluated dichotomously as "correct" or "incorrect." The percentage of "correct" identifications for each taste stimulus was calculated.
- For the estimates, the distance between the left-hand side of the VAS and the subject's mark was measured in millimeters (to an accuracy of 0.5 mm). The individual measurements were charted. From the obtained individual semiquantitative estimates, means and standard deviations were calculated.
- The reliability of the subjects was established based on the identification of the two distilled water samples. They were considered consistent according to the following criteria: (1) the verbal labeling of the two distilled water samples (VII and VIII) was described as "tasteless", (2) the difference between the two values given for each of the requested estimates on the VAS did not exceed 7 mm. The results obtained were subjected to Chi-square test, Student's unpaired t-test, and analysis of variance test.

RESULTS

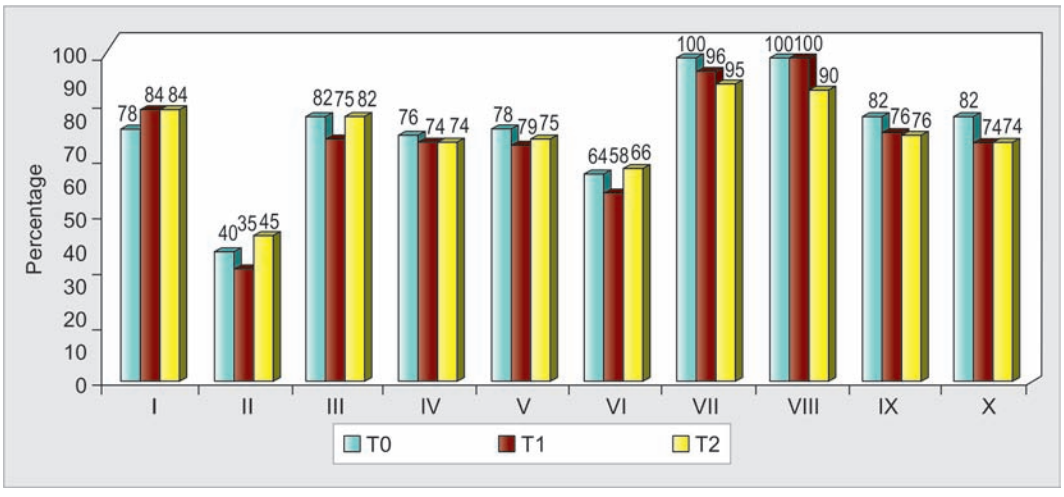
In this study the results of intensity and hedonic estimate among the patients with upper removable appliances was done by verbal estimation.

Verbal Labeling of the Taste Stimuli

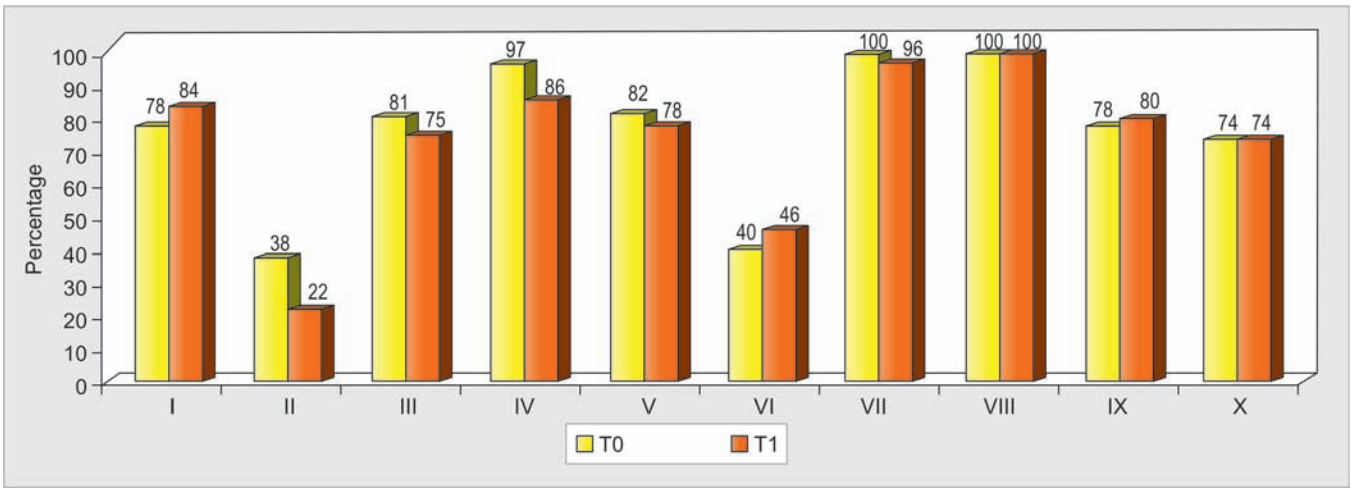
The result of taste stimuli obtained from all the volunteers of both study and control groups showed varied results in different testing sessions. The majority of stimuli were labeled correctly by both groups. The most accurate identification was for distilled water (groups G and H).There was no statistically significant difference between study and control group. The overall results were statistically not significant (Graphs 1 and 2).

Hedonic Estimates of the Taste Stimuli

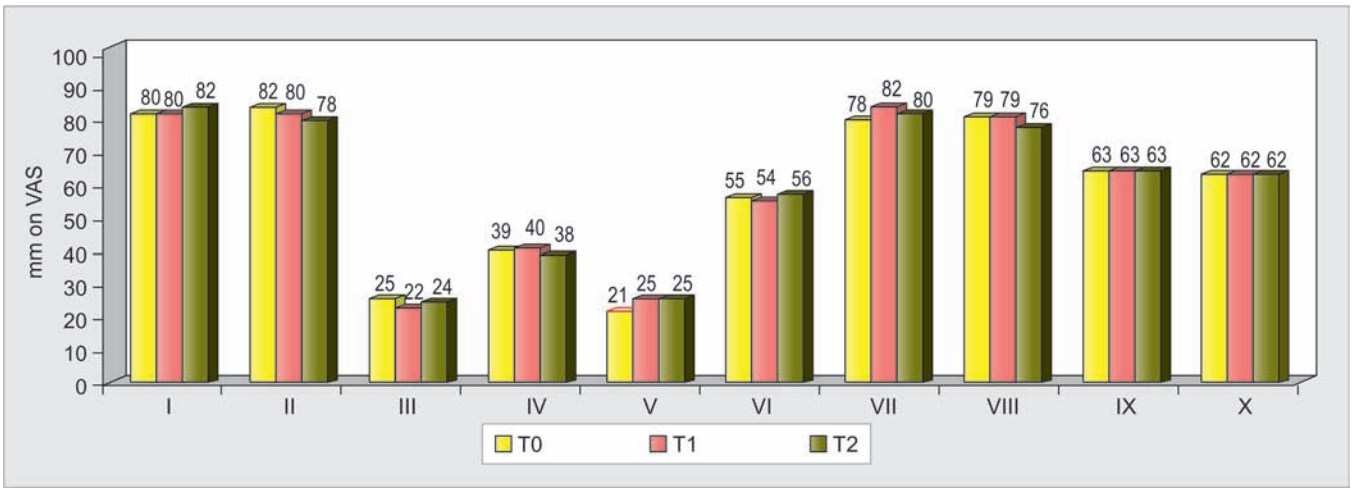
An individual variation was found for the hedonic (palatability) rating of taste stimuli. All the volunteers showed marked variation in the hedonic estimation of taste stimuli in different testing sessions irrespective of them belonging to either study or control group. However, there was no statistically significant difference found between the study and control groups. However, there was no marked difference among the various sessions between the study and control groups for taste stimuli and in intergroup comparison (Graphs 3 and 4).



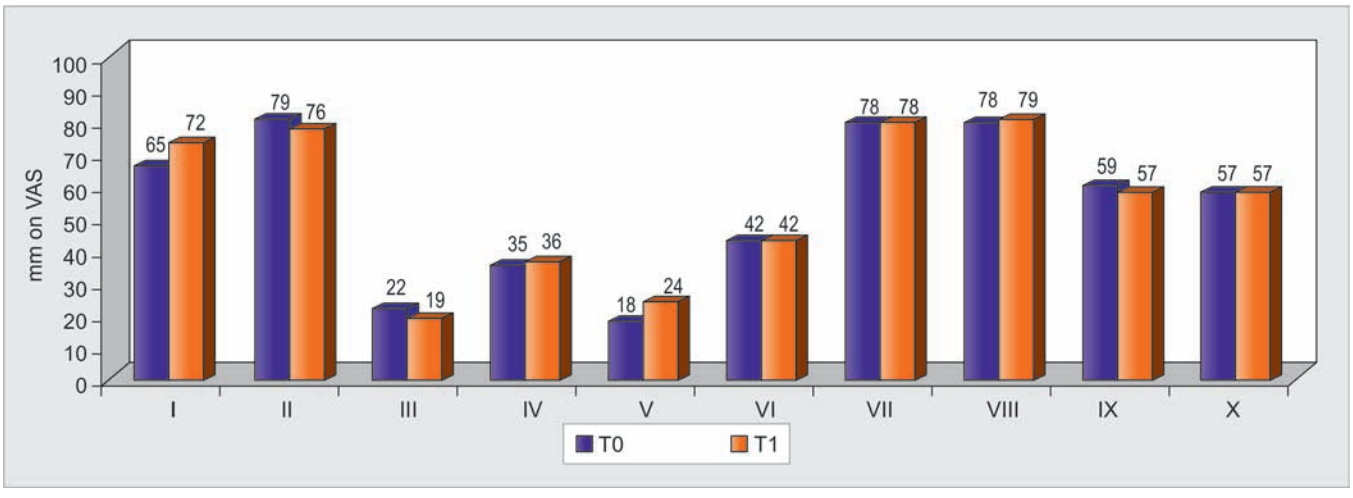
Graph 1: Mean percentage of correct verbal labeling for the various taste stimuli (A–H, I–J) in the study group for the three different testing sessions



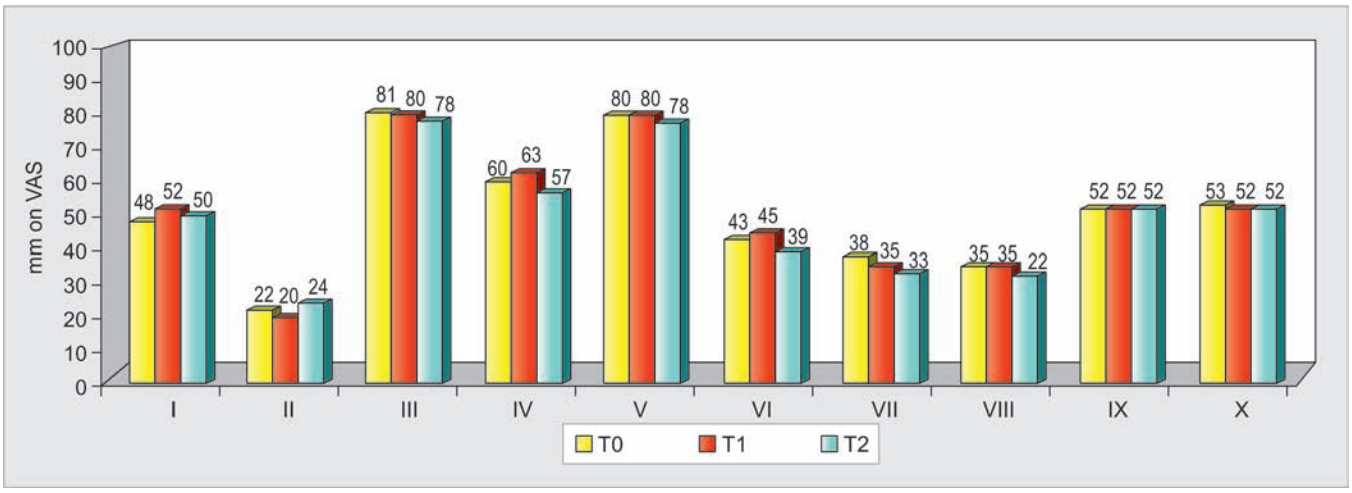
Graph 2: Mean percentage of correct verbal labeling for the various taste stimuli (I–VII, VIII–X) in the control group for the two different testing sessions



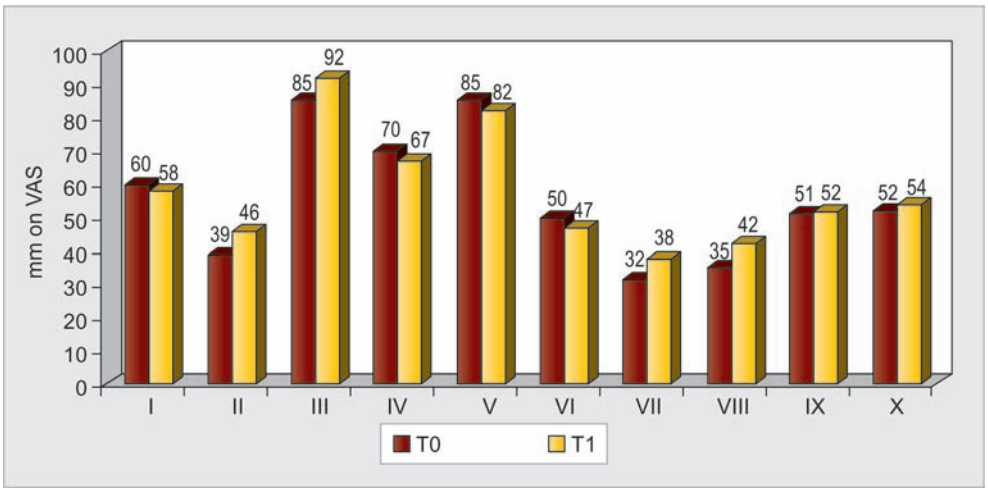
Graph 3: Mean hedonic (palatability) estimate (mm) on a VAS for the various taste stimuli (I–VII, VIII–X) in the study group for three different testing sessions



Graph 4: Mean hedonic (palatability) estimate (mm) on a VAS for the various taste stimuli (I–VII, VII–X) in the control group for the two different testing sessions



Graph 5: Mean intensity estimate (mm) on VAS for the various taste stimuli (I–VII, VIII–X) in the study group for three different testing sessions



Graph 6: Mean intensity estimate (mm) on VAS for the various taste stimuli (I–VII, VIII–X) in the control group for two different testing sessions

Intensity Estimates of the Taste Stimuli

The volunteers from both study and control groups scored different values for intensity estimation of taste stimuli. The majority of stimuli were estimated correctly by both groups. There was no statistically significant difference between study and control groups (Graphs 5 and 6).

DISCUSSION

The reactions to taste stimuli can be determined objectively, using physiological indicators, such as heart rate, blood pressure, saliva secretion, or the "gustofacial reflex."[7,8] A different approach is the subjective psychophysical evaluation based on verbal description and semiquantitative rating of the hedonics and intensity of the stimuli. Since the principal requirements in the design of this study were sessions of short duration and simplicity of instructions appropriate to the situation of young patients, the latter approach was applied. The actual tool used in this study was the VAS, which has been used previously under similar circumstances.[7-10] The results indicate that the reactions elicited by similar stimuli were congruous for the majority of the subjects in both the groups.

The method of error was established based on the study by Raben et al[11] who found an 8 mm error in the scoring of various variables (among them one was palatability too) regarding food samples. In the present investigation, children for whom the intensity and palatability of identical stimuli differed by more than 7 mm were considered inconsistent and were not included in the study.

Verbal Labeling of Taste Stimuli

Removable orthodontic appliances represent foreign objects inserted in a physically and psychologically sensitive area of the body. That they are being worn is often obvious to others and it is possible that susceptible children may be self-conscious about wearing such devices. Pediatric patients, in particular, may be object to social

ridicule from their peers.[12] Probably, to avoid this social ridicule, children may falsely complain of alteration in taste perception during appliance therapy in an effort to terminate it. A varied type of response was observed even in the present study when the children were made to label taste with and without appliances in their oral cavity.

The results obtained for the study group showed that there was a transient alteration in taste stimuli that could possibly be related to the late release of the self-curing acrylic monomer, which can affect the sensations directly.[13] However, patients undergoing removable appliance therapy often complain of alteration in taste perception, which could possibly be related to various other factors.[13-15] A possible factor could be the entrapment of a part of the given testing sample between the plate and the palate. This phenomenon can have an enhancing effect on the relevant senses.[11,16] These smell and taste sensations can also be modulated by coexistent somatomotor stimulation from the oral cavity. The appliance can also compromise the sensory input from the oral cavity through the trigeminal nerve. If an appliance is overextended onto the soft palate, it can interfere in taste perception due to the pressure or pain; hence, the extension of the appliance should be taken care of during design.[17]

Taste buds are confined to the taste areas of the tongue but may be extended to the anterior surface of the soft palate, uvula, tonsils, beginning of the gullet, region of the arytenoid cartilage within the larynx, posterior wall of the pharynx, and epiglottis.[18] The absence of taste buds in the appliance bearing areas shows that removable appliances do not significantly alter taste perception.

In the present study, volunteers of both the groups did not show marked difference in labeling taste stimuli. In different testing sessions, the scoring of the volunteers was nearly constant, indicating that an appliance does not play a major role in the alteration of taste stimuli.

Hedonic Estimation of Taste Stimuli

Hedonic estimation represents the palatability of the taste stimuli. In the present study, marked variation was obtained from both the groups scored for taste stimuli but was not statistically significant. Minimal alteration seen after appliance delivery could be attributed to the fact that the appliance acts as foreign body in the oral cavity; hence, there is an increase in salivation for few weeks to months following the insertion of the appliance, which may dilute the taste stimuli.[12] Distilled water was scored within the range of 70 to 80 mm on the VAS, by both groups. The sucrose solutions in both concentrations (I and II) were considered pleasant within the range of 60 to 80 mm on the VAS, whereas the other taste samples (III, IV, V, and VI) scored lower on the VAS within the range of 18 to 40 mm on the VAS, and were considered repulsive. A similar distribution of these scores for the taste stimuli was obtained in previous studies on adults[19,20] and in children.[3] In the present study, both the study and control groups showed nearly similar values for hedonic estimation, reflecting the fact that the appliance has minimal role in alteration of taste. However, the hedonic evaluation of the water samples was unexpectedly high (around 75 mm on the VAS) and this could be because the young subjects found it difficult to relate to water as a "neutral" stimulus and found it rather refreshing and thus awarded it higher scores.

Intensity Estimation of Taste Stimuli

A wide individual variation was found regarding the reported intensity of the taste stimuli. However, the majority of participants in both groups were able to differentiate between the low and high concentrations of three taste stimuli – sucrose, citric acid, and saline. The distilled water samples were scored as low intensity within the range of 30 to 40 mm on VAS. A possible comparison can be made with the work of Shannon et al[21] who examined saliva flow from the parotid gland as an objective marker of the response to different liquid taste stimuli in patients wearing a night guard which also covered the hard palate. The solutions used were of similar composition and concentration; the fact that the salivary flow was not affected correlates with the present study which found that the intraoral appliance did not affect the response to taste stimuli. These findings support the present results, indicating a lack of influence of the upper removable appliance on taste.

Hence, it is concluded that the treatment effects of removable appliance irrespective of their particular individual therapeutic intention and mode of action depends on the patient's cooperation.[4] Hence, we concluded from our study that since the appliance brings about transient change in taste perception, which could be found both in children with or without appliance, we should educate the patient before delivering the appliance about the transient change in taste perception and encourage full-time wear of the appliance, including during meals, without fear of affecting taste sensations.

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