# Effect of a Maxillary Mouthguard on the Parotid Flow Rate Response to Flavored Solutions (33718)

IRA L. SHANNON, JAMES M. TERRY, AND HOWARD H. CHAUNCEY

*Oral Physiology Research Laboratory, Veterans Administration Hospital, and The University of Texas Dental Branch, Houston, Texas; and Veterans Administration Central Office, Washington, D. C. 20420*

Several studies have pointed out that palatal coverage or palatal anesthesia is associated with a dimunition of taste perception (1–9). Others have found that denture insertion either exerted no effect (10–12) on taste perception or actually enhanced (13) this capacity.

The human parotid flow rate response has been suggested as a method by which gustatory sensation may be measured (14). We have recently reported (15, 16) that the presence of a flexible plastic maxillary mouthguard led to a significant decrease in the parotid flow rate response to four different flavored sour lozenges. It was suggested that this flow rate depression probably resulted from a deprivation of tactile sensation rather than from coverage of taste receptors by the mouthguard.

The present study details the effect of palatal coverage on the parotid flow rate response to aqueous solutions of sucrose, citric acid, sodium chloride, and quinine sulfate, employed to obviate the tactile stimulation provided by the flavored lozenges in the previous investigations (15, 16).

*Materials and Methods.* Subjects were healthy males between the ages of 17 and 22 years. Living conditions and environmental exposure were very similar for all participants. The marked homogeneity of this population has been previously documented (17–19). Experiments were undertaken at approximately 7:30 a.m. with subjects in the fasting state. No food intake was allowed until testing was completed. All samples were collected from the right parotid gland by means of a vacuum-maintained sampler (20).

The test solutions, all at 25° (±2), were applied in ascending concentrations in a timed procedure. Each subject was provided with a series of plastic cups, each containing 2.5 ml of test solution. After placing 2.5 ml of solution in his mouth, the subject held it therein for 0.5 min, expectorated, and sat quietly for an additional 0.5 min. Fresh solution was thus placed in the mouth at 1-min intervals and was held in place for 0.5 min. Each test sample was collected over a 10-min period. This was preceded by a 5-min accommodation period during which the gland was allowed to adapt to the stimulus. A 5-min rest period was allowed after each test collection, with subjects being given a drink of water during this interval. Parotid fluid was collected in graduated tubes and flow rate was calculated in ml/min.

Four groups of 10 subjects each were studied. The stimuli for the first group were aqueous solutions of sucrose (5, 10, 15, and 20%). After collection of control samples with each of the four concentrations of sucrose (no mouthguard), an individualized flexible plastic (Omnident, Omnidental Corporation, Harrisburg, Pa.) maxillary mouthguard was constructed for each subject. Particulars of mouthguard fabrication have been presented previously (15). The device was designed to cover areas generally included in maxillary full denture construction. Each subject wore the mouthguard for 1 hr prior to the collection of a second series of samples. This was done to allow the subjects to accommodate to the presence of the mouthguard. The 4 parotid fluid collections with sucrose stimulants were then repeated with the mouthguard in place.

The second group of 10 subjects was tested using citric acid solutions (0.2, 0.4, 0.8, and 1.6%); the third group used sodium chloride solutions (5, 10, 15, and 20%); and the fourth group used solutions of quinine sulfate (0.03, 0.06, 0.09, and 0.12%.) Solutions were

TABLE I. Effect of Palatal Coverage on Parotid Flow Rate Response to Aqueous Stimulants.

| Stimulant and conc (%) | Parotid flow rate (ml/min) | | | |
|---|---|---|---|---|
| | Without mouthguard | | With mouthguard | |
| | Mean | SD | Mean | SD |
| Sucrose | | | | |
| 5 | 0.093 | 0.058 | 0.090 | 0.043 |
| 10 | 0.109 | 0.047 | 0.123 | 0.067 |
| 15 | 0.124 | 0.059 | 0.138 | 0.067 |
| 20 | 0.155 | 0.063 | 0.149 | 0.068 |
| Citric acid | | | | |
| 0.2 | 0.407 | 0.199 | 0.369 | 0.192 |
| 0.4 | 0.503 | 0.251 | 0.476 | 0.253 |
| 0.8 | 0.644 | 0.355 | 0.609 | 0.346 |
| 1.6 | 0.823 | 0.436 | 0.799 | 0.401 |
| Sodium chloride | | | | |
| 5 | 0.171 | 0.105 | 0.170 | 0.171 |
| 10 | 0.209 | 0.101 | 0.205 | 0.209 |
| 15 | 0.251 | 0.138 | 0.263 | 0.251 |
| 20 | 0.331 | 0.176 | 0.325 | 0.331 |
| Quinine sulfate | | | | |
| 0.03 | 0.141 | 0.078 | 0.140 | 0.103 |
| 0.06 | 0.160 | 0.105 | 0.163 | 0.120 |
| 0.09 | 0.176 | 0.105 | 0.168 | 0.117 |
| 0.12 | 0.202 | 0.115 | 0.192 | 0.127 |

always applied in ascending order of concentration.

Statistical analyses were undertaken to ascertain the effect of the mouthguard on parotid flow response with each stimulus.

*Results.* In the first group, subjects applying sucrose in ascending concentration, the flow rate means, without the mouthguard, increased from 0.093 to 0.155 ml/min (Table I), with the increasing solution concentrations. With the mouthguard in place the flow rate means ranged from 0.090 to 0.149 ml/min with the same increasing concentrations of sucrose. The presence of the mouthguard did not exert a significant effect on rate of flow.

In the second group, testing ascending concentrations of citric acid, without the mouthguard, flow rate means increased from 0.407 to 0.823 ml/min (Table I). When the mouthguard was inserted the comparable flow means were from 0.369 to 0.799 ml/min. At no concentration level was there a significant effect due to the mouthguard.

When the concentration of sodium chloride solution was increased, without the mouthguard, flow rate means increased from 0.171 to 0.331 ml/min. After mouthguard insertion the mean ranged from 0.170 to 0.325 ml/min (Table I). Mouthguard insertion had no significant effect on the generation of parotid flow by sodium chloride solutions.

In the fourth group, parotid flow means resulting from stimulation with quinine sulfate solutions were not significantly altered by mouthguard placement. Without the mouthguard, the means ranged from 0.141 to 0.202 ml/min. When the mouthguard was worn the mean flow rates increased from 0.140 to 0.192 ml/min (Table I).

*Discussion.* The results of the present study reject the hypothesis that palatal coverage reduces gustatory reception and thereby produces a decrease in salivary flow rates. The secretory rate increased with increasing concentrations of the four stimuli, both with and without the mouthguard. Flow rate was not significantly altered by mouthguard insertion, regardless of the stimulus employed.

Kapur *et al.* (13) found that the presence of an upper denture significantly raised parotid flow rates when either sucrose, citric acid, sodium chloride, or quinine was used. The higher flow rate noted with dentures was believed to result from the confinement of the test solution to lingual taste receptor areas; this confinement prevented a rapid spread and dilution of the stimulating solution. The results of the present study are not directly comparable since our subjects were younger, the subjects were not edentulous, different concentrations of stimulants were employed, and the eliciting agents were applied by a distinctly different method.

In previous publications (15, 16) we reported a significant decrease in flow associated with wearing the mouthguard when sour candy lozenges were utilized as the stimulus. The results of the present study would appear to support the contention (16) that the perception of gustatory stimuli is not altered

by palatal coverage if the stimulus is in solution, but that a decreased response is observed when the gustatory stimulus is presented as a solid form.

*Summary.* Flexible plastic maxillary mouthguards were prepared for 180 subjects and the effect of such palatal coverage on the parotid fluid flow rate response to various stimulating solutions was determined. The presence of the mouthguard did not significantly affect secretory rate when four concentrations of aqueous solutions of sucrose, citric acid, sodium chloride, and quinine sulfate were tested. The secretory response to palatal coverage appears to vary with the physical nature of the eliciting agent. If tactile stimulation is a factor, as with sour candy lozenges, palatal coverage significantly decreases the flow rate response. When aqueous solutions are employed this depressant effect is not present.

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Received Nov. 11, 1968. P.S.E.B.M., 1969, Vol. 130.