A Comparison of the Effects of Bilateral Sections of the Chorda Tympani Nerve and Extirpation of the Submaxillary and Sublingual Salivary Glands on the Eating and Drinking Patterns of the Rat

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SMITH, J. C., I. J. MILLER, JR., R. F. KRIMM, M. S. NEJAD AND L. M. BEIDLER. A comparison of the effects of bilateral sections of the chorda tympani nerve and extirpation of the submaxillary and sublingual salivary glands on the eating and drinking patterns of the rat. PHYSIOL BEHAV 44(4/5) 435–444, 1988.—The chorda tympani nerve (CT) innervates the fungiform papillae on the tip of the tongue and has been considered an important nerve for the sense of taste. The CT also contains the parasympathetic supply to the submaxillary and sublingual salivary glands. Therefore, changes in taste or feeding behavior following bilateral sections of CT are caused by both degeneration of fungiform papillae and the inevitable partial desalivation of the rat. In the present experiments we compared the effects of bilateral chorda tympani nerve sections with extirpation of submaxillary and sublingual glands on daily home cage eating and drinking patterns in the rat. Before and after surgery we analyzed the daily eating and drinking patterns, including such measures as intake, bout number, bout length, interbout interval and rate of consumption during bouts. The results of desalivation and bilateral CT sections were indistinguishable. The most profound change was that eating bout duration was increased following surgery. Since food intake did not increase, the results indicate a marked loss in eating efficiency over the daily ingestion periods. Although the eating patterns of desalivated and chorda tympani sectioned rats are quite similar, the evidence is not compelling that they have the same physiological basis. A second experiment was designed to test the hypothesis that the atypical eating patterns observed following bilateral sectioning of CT were the direct result of partial desalivation resulting from the denervation of the salivary glands. In this experiment a unilateral section was made of one CT and it was shown that the eating behavior was not affected. Then the contralateral submaxillary and sublingual salivary glands were removed. This resulted in a six-fold increase in feeding bout length. In all cases a unilateral CT section combined with extirpation of the contralateral salivary glands resulted in rats whose eating behavior was indistinguishable from the earlier data following either the bilateral CT sections or bilateral desalivations. The conclusion is drawn that the eating irregularities noted following bilateral CT sections result from this partial desalivation. CT sections were verified by taste bud counts in the fungiform papillae and histological examinations were made of salivary glands in rats receiving CT sections.

Feeding Chorda tympani nerve Salivary glands Desalivation Feeding patterns Rats

THE chorda tympani nerve (CT) innervates taste buds in fungiform papillae of the anterior 2/3 of the tongue and has been considered an important nerve for taste. In fact, the majority of the electrophysiological evidence illustrating neural responses to a variety of compounds was collected from recordings from the CT [for examples, (6, 8, 19, 20)]. There have been several attempts to bilaterally section the CT and subsequently to study the taste mediated behavior of the rat (12, 13, 23, 27). The CT also contains the parasympathetic supply to the submaxillary and sublingual salivary glands (2,10). Therefore, behavioral measurements of ingestion following bilateral CT sections involve the effects of this partial desalivation as well as the loss of taste responses. Stricker (17) has shown that the removal of the submaxillary and sublingual salivary glands has a strong effect on the chow pellet eating patterns of rats in a single meal following a deprivation period. Although no prandial drinking was evident, this partially desalivated rat was less efficient in eating,

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taking longer than normal rats to consume either 1.75 g or a 4.5 g food pellet. Stricker also demonstrated a similar loss of eating efficiency in rats with bilateral sections of the CT. He assumed that this loss in innervation from the CT partially desalivated the rats, leaving them with disabled submaxillary and sublingual glands. No histology was performed to verify the sectioning of the CT or the subsequent degeneration of the submaxillary and sublingual glands. However, when he subsequently ligated the parotid ducts in either the partially desalivated or the CT sectioned rats, the rats became prandial drinkers.

We have developed several procedures for the study of taste in the rat following sectioning of various afferent nerves. One of these methods involves a detailed analysis of the rats' patterns of ingesting various taste compounds during a 23-hr period (14). In order to be able to study the effects of CT sections on taste measurements from this or any long-term ingestive procedure it is necessary to understand the effects of such nerve sections on the eating and drinking patterns of the rat over a daily testing session. The purpose of the present research was to study the effects of CT sections on daily eating and drinking in the rat and to determine if these effects were due to the loss of function of the submaxillary and sublingual salivary glands. This study would:

1) extend the results of Stricker's (17) work from a single meal in a deprived rat to the daily food intake of a normal rat;
2) note any effects of desalivation on the daily drinking patterns;
3) attempt to show conclusively that the bilateral sectioning of the CT results in behavioral changes in ingestion patterns because of the loss of function of the submaxillary and sublingual salivary glands. This will be done by a histological examination of the salivary glands following verified CT sections.

EXPERIMENT I

METHOD

Subjects

The subjects were 5 female and 17 male Sprague-Dawley laboratory rats weighing 250-300 g at the onset of the experiment.

Apparatus

The apparatus was similar to that described by Spector and Smith (16). Eight Hoeltje rat cages were modified to hold two drinking spouts on the rear of the cage and a feeding jar on the front. Photo transistors and IR LED sources were positioned in front of each lick spout and the food jar so that licking or eating by the rat interrupted the beam. Beam breaks were transmitted to a microprocessor. Each daily session was 23 hours in length with one hour for maintenance of the animals, cage cleaning and measurement of daily food and solution consumption. The number of licks on each of the two spouts and time spent feeding were recorded in each of the 13,800 consecutive 6-sec intervals over the daily test session. A daily strip chart was plotted for each animal, giving a graphic representation of the time spent eating and drinking in each of these six-sec time bins. An analysis program allowed for the establishment of a bout criterion for both eating and licking. Three licks within a six second bin initiated a drinking bout. The bout was considered as terminated if 300 sec elapsed with no licking. Bouts with less than thirty licks were discarded. When the rat's head was in the food jar for three seconds during a bin a food bout was initiated. These bouts were considered as terminated if there was no feeding activity for 300 seconds. Bouts with less than 30 seconds of activity were discarded. The analysis program provided quantification of the daily strip chart, reporting the total number of bouts, bout duration, licks per bout and interbout-interval.

Procedure

Each rat was allowed several weeks to accommodate to the laboratory environment before being placed in these special cages. They were run in squads of eight or less. Once placed in the special cage, the rats were allowed an additional few days to accommodate, learning to drink from either of the stainless steel spouts, which were recessed in slots on the back of the cage, and learning to eat powdered Purina Chow from the food jar on the cage front.

After several days of accommodation, the patterns of eating and drinking were observed for at least one week. Then the 22 rats were divided into three groups and treated as described below:

Group I. Four females and five males were subjected to surgery for bilateral resections of the chorda tympani nerves. The rats were anesthetized by IP injection of Chloropenet (Chloral hydrate-pentobarbital); a dosage of 2 ml/kg body weight. Each animal was secured with a head holder in a prone position. An access into the tympanic cavity was made through an incision medial to the pinna on the parietal aspect of the head above the ear. The bony portion of the meatus was exposed (6). The bony meatus was enlarged and the entire tympanum was removed. The malleus was separated from the tensor tympani muscle and a section was avulsed from the facial nerve to the point where the nerve leaves the tympanic cavity through the petro-tympanic fissure. In each animal the external auditory meatus and the skin were closed with surgical sutures.

Group II. Five male rats were subjected to surgery for removal of the submaxillary and sublingual salivary glands. The rats were anesthetized by IP injection of Chloropenet as described for Group I. A midline incision was made on the ventral side of the rat's neck. With blunt dissection the submaxillary and sublingual glands were exposed and lifted. A small length of suture was securely tied around the base of the gland and the gland was cut and removed. The skin was closed with surgical sutures. Verification of the removal of the pair of submaxillary and sublingual salivary glands was made by gross pathology at the end of the experiment.

Group III. Eight rats (seven male and one female) were subjected to sham surgery similar to the procedure for those rats in Group I. They were anesthetized as described above and an incision was made medial to the pinna. The bony portion of the meatus was exposed and enlarged. The entire tympanum was removed. Care was taken so that the CT nerve remained intact. In each animal the external auditory meatus and the skin were closed with surgical sutures. No rats were given a sham surgical treatment similar to the animals described in Group II.

Following each of the surgeries the rats were allowed one week for recovery in the special cages. During this time, the regular dry Purina Chow was supplemented by powdered chow mixed into a paste with water. This wet chow was preferred by the rats during this time and subjectively seemed to hasten the postsurgery recovery. Following the
recovery period the rats were once again given only the powdered Purina Chow. Water was always available. Food and water intake patterns were described as noted above for at least four days.

Historical Methods

At the conclusion of the behavioral experiments, the animals were anesthetized with a 0.3 ml dose of sodium pentobarbital and perfused intravascularly with 10% formalin. The heads and submaxillary and sublingual salivary glands were removed and placed in formalin. The specimens were shipped to the Department of Anatomy, Bowman Gray School of Medicine for microscopic examination. Specimens were coded by number, and the anatomical study was conducted by one of us (I.J.M.) without knowledge of the surgical procedure or behavioral history for each rat.

Tongues were removed from the heads, and a 0.5 cm length of the anterior portion of the tongue, excluding the most rostral 1.0 mm of the tip, was selected for study. The sampled region contained about 40-50 fungiform papillae on each lateral side (7). A topographical examination of the specimen was made to identify fungiform papillae and to survey taste pores. Specimens were prepared for embedding in paraffin, and serial sections were cut at 10 μm in thickness, mounted on glass slides and stained with hematoxylin and eosin. Each section was examined for the presence of fungiform papillae. The number of papillae and taste pores were counted.

Submaxillary and major sublingual salivary glands were prepared for microscopic examination using paraffin sections with H and E staining. They were evaluated by qualitative criteria.

RESULTS

Behavioral Results

An analysis was made of the feeding and drinking patterns for all rats before and after surgery. No sex differences were noted at any time, so the sexes were combined for all analyses. Prior to surgery, the eating and drinking patterns were noted to be relatively stable for each rat. The average chow consumption for all twenty-two of the rats was 24 grams. The food was ingested in a mean number of 13.5 feeding bouts which averaged 8.2 minutes in length. The females ate slightly less total food than the males. Their bout frequency was not different, but the bout duration was somewhat shorter. The mean water consumption was 34.2 ml, taken in an average of 22 bouts of approximately 2.2 minutes duration. Males and females were not different in water consumption.

Results for Group I. Intake, number of bouts and bout length for both food and water before and after bilateral sectioning of the chorda tympani nerve are plotted in Fig. 1. The statistical significance of each of these differences was tested with a matched t-test. It can be seen in the lower panel that sectioning the chorda tympani nerves has no effect on the amount of food and water consumed (t values of 0.41 and 0.24). As can be seen in the middle panel, the number of eating and drinking bouts does not differ before and after the surgery (t values of 0.92 and 0.07). In the upper panel it can be seen that the length of the water bouts does not differ between the pre- and postsurgery measurements (t value of 1.6). In contrast, the mean feeding bout length triples in size after the chorda tympani nerves are cut, t(8) = 5.27, p<0.01.

Since the rat is spending more time with its head in the food jar, yet not increasing food intake, the rate of food consumption dropped significantly.

A pair of strip chart feeding records of a typical rat from this group is seen in Fig. 2. In the upper panel the number of seconds spent eating during each six second bin is plotted over the 23 hour period (13,800 six second bins) for a single day prior to surgery. In the lower panel the postsurgery data are shown. The average length of the feeding bouts increased from 5.2 minutes before surgery to 34.1 minutes following the CT sections. In addition to the lengthening of the food bouts, the pattern of eating within a bout changed. As can be seen the vertical deflections of the strip chart during the meals are higher in the upper panel than in the lower one. This indicates that prior to surgery, when the rat eats it generally puts its head into the food jar and stays there. This rat's head was in the food jar an average of 4.7 seconds out of each 6 second bin. After bilateral chorda tympani nerve sections (bottom panel) the average time during each of the six second bins when the rat's head was in the food jar dropped.
to 2.1 seconds. The rat's head was "in and out" of the food jar many more times during a meal.

The solid horizontal bars indicate the "lights-off" period of the daily run. As can be seen, most of the eating occurs during the dark both before and after the CT sections. These changes in eating bouts occur in all rats following chorda tympani sections, but prandial drinking does not occur. An enlargement of a 230 minute segment (time from bin 5100 to bin 7400) of drinking and eating for a single rat from this group is seen in Fig. 3. There are five of the typical long eating bouts shown in this segment. They range in time from about 25 to 70 minutes, separated by periods of 5 to 20 minutes. As can be seen, all of the drinking occurs between the feeding bouts.

Results for Group II. The food and water intake, the number and length of bouts for both before and after desalivation surgery are plotted in Fig. 4. The results are strikingly similar to those seen for the chorda tympani sectioned rats. The amount of food and water ingested during the 23 hour period does not change after desalivation (t values of 0.55 and 1.19). The number of both drinking and eating bouts also does not change (t values of 1.44 and 0.92). The water bout length does not change following the desalivation (t value of 1.81). As with the CT sections, the food bout length increases about three-fold (t=6.09). The strip charts showing the detailed study of the eating and drinking patterns for these desalivated rats reveals data that cannot be discriminated from that of the chorda tympani group.

Results for Group III. The data for the rats that underwent sham surgery are illustrated in Fig. 5. The mean intake of food and water did not change following sham surgery (t values of 0.99 and 1.05). The number and duration of eating
and drinking bouts did not change following the sham surgery (t values of 0.78, 1.96, 0.33 and 0.67).

**Histological Results**

Microscopic examination of the tongues yielded consistent results within experimental groups. In Group I (bilateral CT-transected), tissue was prepared for 2 males and 3 females, and their fungiform papillae contained no taste pores. The males survived 44 days after CT transection, and there were cell collections in the apical regions of fungiform papillae formerly occupied by taste buds. While the shape of these cell collections vaguely resemble taste buds, they differ from normal taste buds by two important features: 1) they do not appear as pseudostratified columnar cells, and 2) they do not project apical processes into a taste pore in the lingual surface. The females survived for 13 days after CT transection. Their fungiform papillae contained no taste pores, and in the apical region of the papillae there were degenerated taste buds. These structures resemble taste buds in shape, but their ovoid cell masses contain few columnar cells and regions of extracellular space uncommon in normal taste buds. A total of 407 fungiform papillae were identified bilaterally in 5 animals, and none of them contained a normal appearing taste bud with a taste pore.

Both pairs of sublingual and submandibular salivary glands were removed from the female rats at the time of sacrifice and 3 of them were prepared for histological examination. The findings in them will be presented later.

Sample regions of 3 sham-operated rats (Group III) were prepared for microscopic study. A total of 234 fungiform papillae were identified bilaterally, and normal taste buds containing pores were found in a total of 220 (94%) of them. The remaining 6% did not seem to be degenerated; but because of lost or folded sections or unfavorable orientations, a pore could not be confirmed.

**EXPERIMENT 2**

Although the eating patterns of desalivated and chorda tympani sectioned rats are quite similar, the evidence is not compelling that they have the same physiological basis. Ex-
Experiment 2 was designed to test the hypothesis that the atypical eating patterns observed following bilateral sectioning of the chorda tympani nerves were the direct result of partial desalivation resulting from the parasympathetic denervation of both the submaxillary and sublingual salivary glands. In this experiment a unilateral section was made of one chorda tympani nerve and 12 days later the contralateral submaxillary and sublingual salivary glands were removed. The rats were tested before and after the nerve was sectioned and again after the contralateral glands were removed. A second group of rats were subjected to the same surgical manipulations, but had the submaxillary and sublingual glands removed first and the contralateral CT nerve was sectioned 12 days later in the second surgery. In addition to ingestion tests with the powdered food, these rats were given a three day test before any surgery and after the second surgery with a moistened food.

Subjects

The subjects were six male Sprague-Dawley rats weighing between 350 and 450 grams at the outset of the experiment.

Apparatus

The same special testing cages described in Experiment 1 above were used in this experiment.

Procedure

The six rats were allowed to live in the special cages for several days before data collection was initiated. When they were accommodated, data collection was initiated. For four days the rats were given ad lib access to powdered food and water. Total intake and detailed patterns of ingestion were measured. For an additional three days the powdered Purina Chow was replaced by a paste made with chow and vegetable oil (Wesson).

The rats were then divided into two groups of three each. One group was subjected to unilateral removal of the submaxillary and sublingual salivary glands. The second group had a unilateral section made of the chorda tympani nerve. Following four days of recovery from the surgery, the food and water ingestion patterns of the rats were again measured for four days. The rats were then subjected to a second surgery. The group that received the unilateral salivary gland
extirpation then had the contralateral chorda tympani nerve cut and the group that had the CT sectioned had the contralateral salivary glands removed. Again, a four day period was allowed for recovery from surgery. After recovery, the rats were given four days on powdered food and water followed by three days on the moistened food. The ingestion patterns were observed throughout all of the ingestion test periods.

RESULTS

Behavioral Results

Analyses were performed using data from the last of the test days before the first surgery, after the first surgery and after the second surgery. The order of the two surgeries had no effect on any of the variables tested, so the two groups of rats were combined into one group of six rats for all subsequent analyses. Repeated sampling of the same subjects analyses of variance were run across these three testing days for water consumption, number of water bouts and water bout length. None of these analyses were significant and all \( p \) values were greater than 0.05. Similar analyses were performed for the dry powdered and the moistened food consumption and also found to be nonsignificant with all \( p \) values greater than 0.05.

As was found in Experiment 1, the main effect of these surgeries was on the dry food bout length. This is illustrated in Fig. 6. Unilateral sections of either the CT or the submaxillary and sublingual glands had no effect on dry food bout length. However, when the contralateral gland or nerve was removed, the dry food bout length was increased by a factor of four, \( F(2,10) = 20.71, p < 0.01 \). A subsequent orthogonal comparison showed that there was no difference between the presurgery dry food bout lengths and those following unilateral operations on either the glands or the CT nerve. All of the variability was accounted for by the second surgery where the contralateral extirpation or sectioning was performed, \( F(1,10) = 41.0, p < 0.01 \).

The moment-by-moment records for a single rat are presented in Figs. 7 and 8. The presurgical strip chart record for this rat is seen in Fig. 7. On this day the rat drank 21 ml of water in 22 drinking bouts and ate 15 g of food in 9 discrete meals. The feeding bouts averaged 8.0 minutes in length. The left salivary glands were then removed and the rat was tested again. There was no significant change in the rat's eating behavior. The number of water bouts was 21 and there were 9 food bouts. Also, the mean length of the food and water bouts did not change. In the second surgery for this rat the right chorda tympani nerve was sectioned. The strip chart following recovery from this second surgery is seen in Fig. 8. Again there was no significant change in the number of drinking or feeding bouts (twenty-one and six respectively) or the amount of water (16 ml) or food (13 g) consumed. The significant finding was that the mean length of the feeding bouts was 43.8 minutes, a five-fold increase. During each of the six second bins the rat's head was in the food jar an average of 5.4 seconds prior to surgery and 2.9 seconds after the second surgery.

In contrast, bout length with the moistened food did not increase following the second surgery. The mean bout length before surgery was 12.1 min, and following the second surgery was 10.5 min. This difference was not significant, \( t(5) = 0.41, p < 0.05 \).

Histological Results

Samples of the anterior portions of 4 tongues equivalent to those in Experiment 1 were studied along with the submandibular and sublingual glands from the right sides with unilateral CT transections. Since the salivary glands from the contralateral (CT intact) left sides had been removed surgically, normal glands from 2 control rats were prepared for comparison. The 6 rats in this experiment comprised two groups. In 3 rats, the chorda tympani nerves were transected 22 days prior to sacrifice. In 3 rats, the animals were sacrificed 11 days after CT transection. The time at which the innervated salivary glands were removed surgically differed between the two groups (see procedure above). The quantitative effects of nerve transection on taste pores were consistent among both subgroups. A total of 126 fungiform papil-
lae with 121 taste pores (96%) were found in rats on the side with the CT intact. On the contralateral sides with the CT transected, 132 fungiform papillae were counted and none contained taste pores. Taste buds on the CT intact sides were similar in appearance to those in sham-operated rats (Experiment 1, Group III), while the papillae on the CT transected sides contained remnants of taste buds without pores which were similar to those in the bilateral, CT-transected animals (Experiment 1, Group I).

The qualitative appearances of the submaxillary and sublingual salivary glands from 5 different groups of rats were compared: 1) normal controls, 2) sham-operated (Experiment 1, Group III), bilateral CT-transsections (Experiment 1, Group I, 13 day postsurgery), unilateral CT-transsection (Experiment 2, 11 day postsurgery) and unilateral CT-transsection (Experiment 2, 22 day postsurgery). Sections were made of the entire cross-section of the submaxillary salivary gland which was sampled to include a cross-section of the sublingual salivary gland in the same section. The submaxillary gland is a mixed serous and mucus gland, while the sublingual gland is entirely a mucus gland. The histological appearance of them is distinctly different. The effects of CT nerve transections are most apparent in acini (secretory portions), ductal elements and parasympathetic ganglion cells which are present in the gland.

Glands from female rats in Experiment 1, Group I (13 days postsurgery) showed: shrinkage in the width of acini and ducts, more extracellular space than controls, less eosinophilia in the cytoplasm of ductal and acinar cells than controls, and clumping of nuclei substance in ganglion cells ("chromatolysis" or a cell body response) which are characteristics of preganglionic parasympathetic denervation. The submaxillary gland showed more alteration than the sublingual gland following CT transection.

The submaxillary salivary glands from unilateral CT-transsection (Experiment 2, 13 days postsurgery) were similar in appearance to those from Experiment 1, Group I. However, the glands from the same experiment which were removed after 22 days of postsurgical survival showed a greater degree of degenerative change than the shorter durations. Cellular debris and leukocytes were present in the secretory ducts. Serous acini were reduced in size, and the intralobular duct cells were shorter in height with fewer cytoplasmic granules. Ganglion cells in the center of the gland showed a fine, granular nissl substance with swollen nuclei. The effects of denervation were less severe in the sublingual gland than in the submaxillary gland in all cases.

By these criteria, the submaxillary salivary glands appeared to be dystrophic and dysfunctional following CT-transsection.

GENERAL DISCUSSION

With the resolution used in these measurements, the eating and drinking patterns of a rat following chorda tympani nerve sections cannot be distinguished from the patterns of a rat whose submaxillary and sublingual salivary glands have been removed. As was seen in short term tests by Stricker (17) it took the rats longer to ingest their food, but they did not become prandial drinkers. It is concluded that the alteration in eating behavior following bilateral CT-transsection is the result of the loss of function of the submaxillary and sublingual salivary glands.

The data for both groups of rats following the second surgery in Experiment 2 are indistinguishable from the data following either the bilateral chorda tympani cuts or bilateral desalivations seen in Experiment I. These data give further evidence to the hypothesis that the eating irregularities noted following bilateral chorda tympani nerve sections result from the fact that the rat is partially desalivated. A more detailed analysis of the eating behavior following either CT sections or removal of the submaxillary and sublingual salivary glands revealed two distinct eating patterns among the operated rats. Both groups showed the marked increase in food bout length as described above, but they differed in the total time the food IR beam was broken during each of the six second bins. An "eating efficiency score" was calculated which gave the mean proportion of time during each bin that the beam was broken. For example, a rat with an efficiency
score of 0.5 broke the beam an average of 3 sec out of each six sec bin, indicating a rapid insertion and withdrawal of the head from the food jar. We found that the efficiency score for most normal rats was between 0.85 and 0.95, indicating that during a meal the rat entered the food jar and stayed there for the duration of the meal. About half of the operated rats in these present experiments gave low efficiency scores (0.5 and less) and the other half showed normal efficiency scores.

With the use of a video camera in dim red light we were able to observe the eating behavior of a normal rat and two CT sectioned animals. The normal rat had an efficiency score of 0.92, one of the CT rats showed an efficiency score of 0.41 and the other a score of 0.95. The observed behavior was quite clear. The normal rat put its head into the food jar and ingested the powdered food with a rapid licking movement of the tongue. The two CT rats lifted small portions of the powdered food to the mouth with a scooping movement of a front paw. The difference in the two efficiency scores for these CT rats was the result of how far into the food jar the rat placed its head. One (0.95 rat) held its head low in the jar, continuously breaking the beam, while the second rat (0.41) held its head high and the leg broke the beam as it scooped the food. The two CT rats had equivalent extended food bout lengths. It is not clear how this ingestion of powdered food relates to the ingestion of food pellets, but the comparison of the extended eating time in this study with that described by Stricker for food pellets is quite good (17).

Moistening the powdered food with cooking oil results in a decrease in food bout lengths to normal durations. This suggests that the oil compensates for the lost saliva and permits a more normal ingestion pattern.

It seems probable that in the earlier studies on the effects of chorda tympani nerve sections on "taste" (12, 13, 21, 22) these investigators were working with rats which did not have functioning submaxillary and sublingual salivary glands. The eating patterns of these rats were probably altered, but unobserved by the investigators, since it was unlikely that there was a change in the quantity of food or water ingested. The marked change in eating strategy by the rat could lead to false inferences about taste in long term taste tests. For example, we have found in recent tests that rats with either chorda tympani sections or desalivation take higher quantities of low sucrose concentrations when compared to sham operated rats. They probably do this because the sucrose is a source of calories that is easier to obtain than the calories from the dry food. Our recent report (4) and corroborative electrophysiological studies (8,19) demonstrate that the greater superficial petrosal nerve in the rat, rather than the chorda tympani nerve, is probably the more important sensory source of taste-mediated responses to sucrose.

Jaccquin (3) observed reduced responsiveness to food and water after bilateral sections were made of the CT, the glossopharyngeal and the pharyngeal branch of the vagus nerves. He found increased palatability when he offered the rats wet food, indicating that the desalivated state of his animals probably contributed to the observed eating disorders. Stricker and Hainsworth (18) have noted that bilateral sectioning of CT impairs the rat's tolerance of high ambient temperatures because of the loss of salivary function of the submaxillary and sublingual glands.

Weinjen (24) has noted some small changes in the rat's licking response following CT sections such as contact duration, interlick-intervals and mean volume per lick. The six second resolution of measurement in the present study limits any comparison with Weinjen's research. No changes were observed in the present studies in lick volume, bout number or interbout-intervals.

Transection of the chorda tympani nerve in the middle ears of humans produces two symptoms: alteration of taste sensation and dryness of the mouth (1). The taste alteration includes paraguesia, i.e., a persistent "metallic" taste in the absence of stimulation, and aguesia, the inability to detect chemical stimuli placed on the anterior portion of the tongue, ipsilateral to the nerve which is cut. These effects are more complex and they complicate the simple assumption that transection of a gustatory nerve eliminates taste responses alone.

An impairment in taste perception and a loss of salivary secretion would be consistent with the anatomical findings after chorda tympani transection in the rat. The loss of all taste pores in ipsilateral fungiform papillae which were observed in the present experiments corroborates the findings of others (9,26). As in the hamster, remnants of taste buds persist after CT denervation (25). Likewise, following CT transection, there have been reported progressive dystrophic changes in the submaxillary and major sublingual salivary glands (11,15) which are similar to those reported here.

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