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CIRCUMVALLATE PAPILLAE AND TASTE BUDS – A MICROSCOPIC STUDY OF HUMAN TONGUE

Anatomy

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ABSTRACT

Background: Taste buds, the chemoreceptors for the sense of taste (gustation) are in humans mainly located in the epithelium of the circumvallate papillae of the tongue.

Aims: To note the distribution and age changes in the circumvallate papillae and taste buds.

Materials and methods: The study was conducted in 41 specimens of tongue collected from the Department of Forensic Medicine and Labour Room, Govt Medical College, Kozhikode. Tissue bits from the region of circumvallate papilla were fixed, processed, stained and analysed under light microscope.

Results: In circumvallate papilla, the taste buds were located on the side wall. Taste buds on trench wall were found only in 24% of the specimens. Statistical analysis revealed no significant correlation between the number of taste buds and age. The number of connective tissue papillae also showed no significant change with age.

KEYWORDS

Circumvallate Papilla, Taste Buds, Human Tongue.

INTRODUCTION

Lingual papillae are projections of the mucosa covering the dorsal surface of the tongue[1]. Six to fourteen large circumvallate papillae form a row immediately anterior to the sulcus terminalis[2]. They are set into the tongue surface and encircled by a deep cleft[2]. The papilla is narrower at its base than its apex and the entire structure is generally covered with non keratinised stratified squamous epithelium[1]. Numerous taste buds are present on the walls of the papilla and the walls of the surrounding trench[3].

Each taste bud is a microscopic barrel shaped cluster of 50-150 fusiform cells which lies within an oral cavity in the epithelium and converges apically on a gustatory pore, a 2 micrometre wide opening on the mucosal surface[1]. There is considerable individual variation in the distribution of taste buds in humans[1].

The life span of each taste cell is about 10 days in lower mammals, but is unknown for humans[4]. Beyond the age of 45 years, many taste buds degenerate causing taste sensitivity to decrease in old age[4].

The connective tissue papillae are sometimes termed papillae simplices, and they are present beneath the entire tongue surface including the mucosal papillae and this arrangement serves to increase the anchorage of the epithelium to the underlying tissues[5].

AIMS AND OBJECTIVES

1. To note the distribution and age changes in circumvallate papillae and taste buds.

MATERIALS AND METHODS

41 specimens of tongue in the age group 0-80 years were collected. Autopsy specimens were collected from the Department of Forensic Medicine, Medical College, Kozhikode. Specimens of still born babies were taken from the Labour Room of Medical College, Kozhikode. Ethical Committee clearance was obtained for the same.

Exclusion Criteria:

1. Postmortem bodies of burns cases
2. Decomposed bodies
3. Bodies with severe maxillofacial injuries

Tissue bits were taken from the region of circumvallate papillae and fixed in Bouin's fluid overnight. They were then processed using ascending grades of alcohol, cleared in xylene and were embedded in paraffin wax. Sections with 6 microns thickness were taken and stained with haematoxylin and eosin. Ehrlich's haematoxylin was used since it could be kept for years after ripening and gave brilliant nuclear stain. Results of the microscopic study were analysed using Spearman's correlation.

RESULTS

See Table 1 & Fig: 1,2,3,4,5.

Fetal specimens

In the youngest fetus studied (13 weeks), 5 taste buds were seen on one circumvallate papilla. Out of 8 fetal specimens, taste buds were observed only in 2 cases. None of them had taste buds on trench wall.

Age group 1-80 years

Taste buds were observed in the side walls of the circumvallate papilla . They were identified in the trench wall only in 10 out of 33 specimens. Number of connective tissue papillae varied from 0-21. Many of them were minor.

TABLE 2

			Age
Spearman's rho	**Taste buds/ papilla**	**Correlation coefficient**	**-.109**
		Sig (2 tailed)	**.797**
		N	**8**
	CT Papillae/ Circumvallate papilla	**Correlation coefficient**	**.371**
		Sig (2 tailed)	**.365**
		N	**8**

Table 2 represents the statistical analysis of the data representing the circumvallate region of the tongue of fetal specimens. No significant correlation was observed between the taste buds/ papilla or CT papillae with age.

TABLE 3

			Age
Spearman's rho	**Taste buds/ papilla**	**Correlation coefficient**	**-.086**
		Sig (2 tailed)	**.635**
		N	**33**
	CT Papillae/ Circumvallate papilla	**Correlation coefficient**	**.099**
		Sig (2 tailed)	**.583**
		N	**33**

Table 3 represents the statistical analysis of the data representing the circumvallate region of the tongue (excluding fetal specimens). No significant correlation was observed between the taste buds/ papilla or CT papillae with age.

DISCUSSION

Earliest study on circumvallate papilla dates back to 1868, when Owen[6] described 3 vallate papillae in Callithrix personata.

According to Keith L Moore etal[7], vallate papillae are large and flat topped, lie directly anterior to the terminal sulcus and are arranged in a V shaped row. The present study agrees completely to the above. In

fact, they are so large that in majority of cases, only one circumvallate papilla is seen per low power field.

As per Gray,s Anatomy[1],each circumvallate papilla is surrounded by a slight circular mucosal elevation (vallum or wall), which is separated from the papilla by a circular sulcus. In the present study, well formed trench was seen associated with circumvallate papilla in all cases. The term "circumvallate", suits the papilla.

Haller[8] who studied the mammalian tongues histologically, described a double vallate papilla surrounded by a common trench in the higher primate and he termed the original papilla as the mother papilla and the other as daughter papilla. Kubota etal[9] described a double vallate papilla in the human and primate tongues. No such finding was observed in the present study.

The connective tissue papillae per circumvallate papilla were counted. They were observed from 25 week onwards and many of them were minor. This agrees with Kobayashi etal[10], who stated that vallate papillae had the connective tissue core of pine cone like structure with numerous small thorns (secondary connective tissue cores). Their appearance early in life might be to give stiffness to the papilla to expose the taste bud to the food particle for a better appreciation of taste.

The number of secondary papillae showed no significant relationship between the age and number. This disagrees with Kobayashi K etal[11],who reported that numerous small rod shaped secondary connective tissue cores were distributed under the epithelium of the vallate papillae in young subjects and decreased in number in old age. He also emphasized that there is a great deal of individual variation of human lingual papillae regardless of age.

The most important part of circumvallate papilla is the presence of taste buds. In addition to making eating a pleasant one, the sensation of taste has a protective role also.

According to Keith L Moore etal[12], lingual papillae appear towards the end of the 8th week and the vallate and foliate papillae appear first, close to the terminal branches of the glossopharyngeal nerve. Taste buds develop during 11-13 weeks by inductive interaction between the epithelial cells of the tongue and invading gustatory nerve cells. The present study agrees with the above as circumvallate papilla and taste buds were identified in the youngest fetus studied (13 weeks). Basal cells and cells with elongated nuclei and round nuclei were seen. All were crowded together. This is in agreement with Bradley etal[13], who stated that morphologically mature cells were recognizable at 13- 15 weeks.

As per Suzuki T[14], approximately 5000 taste buds cover the surface of human tongue with about 30% fungiform, 30% foliate and 40% circumvallate papillae. In the circumvallate papilla, taste buds were always present on the side wall. Papillae showing taste buds on the trench wall were few (24% cases). So the present study disagrees with Keith L Moore etal[7], who stated that the circumvallate papillae are surrounded by deep circular trenches, the side walls of which are studded with taste buds. Yoshimura K etal[15], also found that numerous taste buds were observable in the furrows of the vallate papilla. But Kinziro Kubota etal[16], reported that taste buds were limited to the side wall of the circumvallate papilla and no taste bud was seen on the adjoining trench wall. Richard O Davies etal[17],also reported no taste buds on the outer wall of the moat.

The number of taste buds per circumvallate papilla were counted. In adults, more number of taste buds are seen compared to the young. In the present study, taste buds were observed only in 2 of the fetal specimens. Bradley R M etal[18],observed that age did not affect the number of taste buds within the circumvallate papilla. The present study agrees with the same as statistical analysis revealed no significant correlation between the number of taste buds and age. For the same reason, this study disagrees with Arey etal[19] , who reported a decrease in the number of taste buds on the circumvallate papillae of the tongue of man with an increase in age. He observed an increase in taste buds per papillae until 4-20 years of age and then decreased to one third of the maximum at 74-85 years. Mochizuki[20],also stated that the investigation of human circumvallate and foliate papillae showed a reduction in the number of taste buds with old age.

Yamaguchi etal[21], conducted a study on common marmoset and reported that the effect of aging on taste bud numbers was different among individuals and did not simply depend on increasing age. Azzali G etal[22] also noted that age does not seem to influence taste perception in humans.

According to Farbman [23], cells of taste buds resembled those in adjacent epithelium in undergoing continual renewal. They had a limited life span and were regularly replaced by a proliferative basal cell population.

Ernest R Lalonde etal[24], stated a clustering effect on taste buds. According to him, the taste buds were grouped together. Arey L B etal[25] attributed the clustering effect to the innervations of taste buds and the formative influence that nerves had on taste bud development. No such clustering was seen in the present study.

CONCLUSIONS

Majority of the human circumvallate papillae contain taste buds in the side wall of the papilla. Taste buds were seen in trench wall only in 24 % of cases. Statistical analysis revealed no significant correlation between the number of taste buds and age. The number of connective tissue papillae also showed no significant change with age.

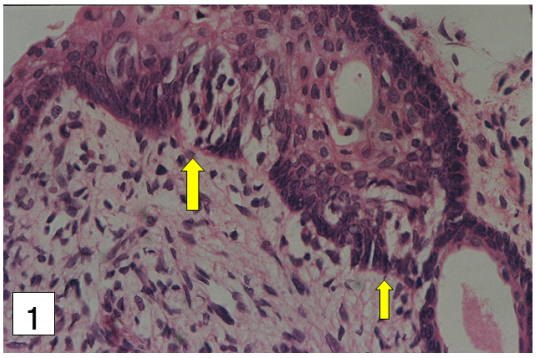

FIG:1-Section of the circumvallate region of tongue of 13 wk old fetus showing circumvallate papilla with taste buds (yellow arrow). Haematoxylin & Eosin staining. Magnification x 400.

FIG:2-Section of circumvallate region of tongue of 3 year old,showing 7 taste buds (yellow arrow). Haematoxylin & Eosin staining. Magnification x 400.

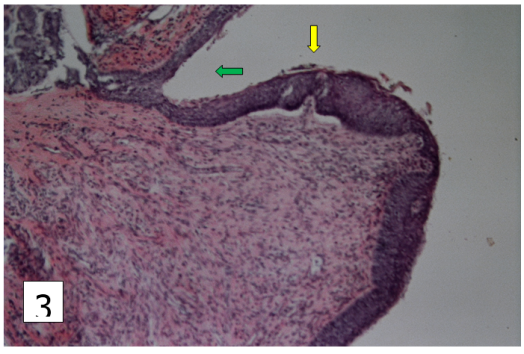

FIG:3-Section of circumvallate region of tongue of 5 year old, showing circumvallate papilla with taste buds(yellow arrow) and trench(green arrow). Haematoxylin and Eosin staining. Magnification x 100.

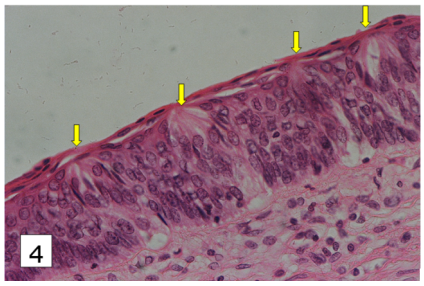

FIG:4-Section of circumvallate region of tongue of 10 year old, showing 4 taste buds(yellow arrow) on the side of the circumvallate papilla. Haematoxylin and Eosin staining. Magnification x 400.

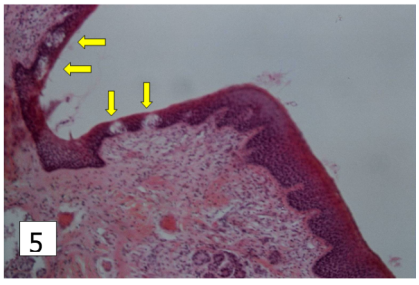

FIG:5-Section of circumvallate region of tongue of 43 year old, showing taste buds(yellow arrow) on the side of the circumvallate papilla and trench wall. Haematoxylin and Eosin staining. Magnification x 100.

TABLE 1

AGE	TB/Pap	TB-trench	CT Papilla	Trench
13wks	5	0	0	P
20wks	0	0	0	P
23wks	0	0	0	P
25wks	0	0	3*	P
27wks	0	0	0	P
28wks	0	0	2*	P
30wks	0	0	2	P
33wks	3	0	0	P
3yrs	7	0	2	P
5yrs	7(2,5)	0	8*	P
9yrs	0	0	3	P
10yrs	5(4,1)	1	15*	P
12yrs	8(6,2)	11(6,5)	8	P
14yrs	7(5,2)	3	6*	P
19yrs	1	0	3**	P
20yrs	5(4,1)	0	3*	P
24yrs	7(2,5)	0	4,1*	P
25yrs	15(6,9)	2	0	P
27yrs	5(4,1)	1	8*	P
34yrs	7	0	3**	P
36yrs	7	5(3,2)	6*	P
38yrs	6	0	4	P
40yrs	0	0	10	P
43yrs	2	2	6	P
45yrs	12(3,9)	0	6	P
46yrs	10(4,6)	0	5	P
47yrs	0	0	12*	P
48yrs	0	0	6	P
52yrs	4	0	2*	P
53yrs	22(14,8)	0	7*	P
56yrs	1	0	4	P
58yrs	11(7,4)	4(2,2)	10*	P
60yrs	0	0	7	P
61yrs	6	4	5	P
62yrs	9(6,3)	0	2,5*	P
64yrs	3	3	21*	P
66yrs	8(7,1)	0	8*	P
70yrs	9(3,6)	0	2*	P
73yrs	3	0	7*	P
75yrs	2	0	2	P
78yrs	1	0	3	P

TB/Pap- Tastebuds per papilla
TB-trench-Tastebuds on trench wall
CT Papilla- Connective tissue papilla
P- Present

*- Minor CT papilla
**- Very Minor CT papilla

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