

Clinicopathologic analysis of 493 cases of salivary gland tumors in a Southern Brazilian population

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Objective. The aim of this study was to determine the distribution and demographic features of salivary gland tumors (SGTs) in a large Brazilian population.

Study Design. A total of 493 cases of SGTs diagnosed between 2001 and 2011 from a general pathology laboratory and an oral pathology service were reviewed with respect to their clinicopathologic features.

Results. A total of 369 tumors were benign and 124 were malignant. The mean age of patients with benign tumors was 46.3 years and that of patients with malignancies was 54.0 years. The parotid gland was the most common location (42.3%). Pleomorphic adenoma (PA) and Warthin's tumor were the most common benign neoplasias, whereas mucoepidermoid carcinoma (MEC) and adenocarcinoma, not otherwise specified, were the most frequent malignancies.

Conclusions. The present data confirm that PA and MEC are the most common benign and malignant SGTs. However, it is important to consider that differences in tumor types may be influenced by whether a tumor derives from a medical or a dental service. (Oral Surg Oral Med Oral Pathol Oral Radiol 2012;114:230-239)

Salivary gland tumors (SGTs) consist of a group of heterogeneous lesions with complex clinicopathologic characteristics and distinct biological behavior that correspond to approximately 3% to 10% of the neoplasms of the head and neck region.¹⁻³ According to the World Health Organization (WHO), the global annual incidence, when all SGTs are considered, varies from 0.4 to 13.5 cases per 100 000 inhabitants, which accounts for only 0.3% of all malignancies in the United States.⁴ However, reports from numerous regions of the world have shown differences in the incidence and frequency of tumor types, indicating a geographic variation in the frequency of these neoplasias^{5,6} (Figure 1).

Although many retrospective studies regarding the incidence of salivary gland tumors have been reported, the epidemiology of these neoplasms is not well established because these studies are frequently restricted to a specific population,^{7,8} an anatomical location,⁹ or a specific tumor type.¹⁰ In addition, differences can be

found in the frequency of SGTs derived from surgical pathology centers and those from oral pathology laboratories. Therefore, the objective of the current study is to retrospectively review the characteristics of 493 SGTs retrieved from one general pathology service and one oral pathology laboratory, both located in the Southern Brazil, and to evaluate the clinicopathologic differences between these two samples.

MATERIAL AND METHODS

The files of a private general pathology service in Cascavel, Paraná State, and of the Department of Oral Pathology of the Piracicaba Dental School were retrospectively reviewed. During an 11-year period, between January 2001 and December 2011 (surgical pathology 2001-09 and oral pathology 2002-11), 493 cases of salivary gland tumors were retrieved from both archives. Clinical data concerning age, gender, and tumor location were obtained from clinical charts. Microscopic slides of all cases were reviewed by three

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Statement of Clinical Relevance

Numerous reports from different geographic regions have shown differences in the incidence and frequency of salivary gland tumors, and a better understanding of their demographic data is helpful for improving the comprehension of the clinicopathologic characteristics of these tumors.

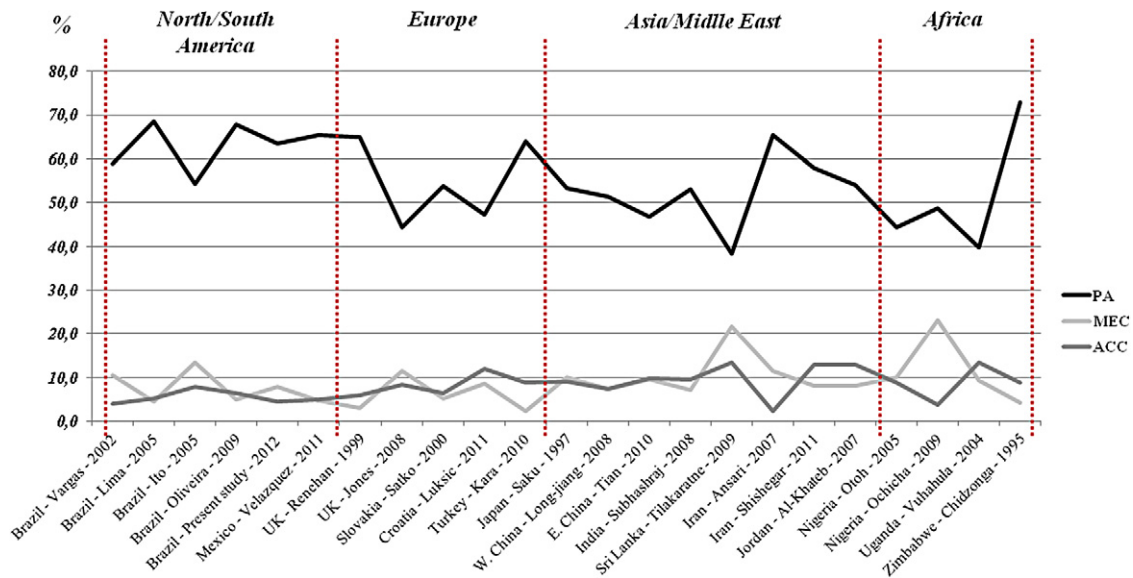


Fig. 1. Heterogeneous distribution of the most frequent salivary gland tumors (pleomorphic adenoma [PA], mucoepidermoid carcinoma [MEC], and adenoid cystic carcinoma [ACC]) among different geographic regions of the world.

Table I. Histologic and gender distribution of 493 salivary gland tumors

	n = 493	%	% in the group of benign or malignant tumors	Gender			
				Male		Female	
				n	%	n	%
Benign tumors							
Pleomorphic adenoma	314	63.6	85.0	123	24.9	191	38.7
Warthin's tumor	36	7.3	9.7	27	5.4	9	1.8
Canalicular adenoma	11	2.2	2.9	5	1.0	6	1.2
Cystadenoma	3	0.6	0.8	0	0.0	3	0.6
Myoepithelioma	3	0.6	0.8	0	0.0	3	0.6
Basal cell adenoma	1	0.2	0.2	0	0.0	1	0.2
Oncocytoma	1	0.2	0.2	1	0.2	0	0.0
Total	369	74.7	100	156	31.5	213	43.1
Malignant tumors							
Mucoepidermoid carcinoma	39	7.9	31.4	16	3.2	23	4.6
Adenocarcinoma, NOS	33	6.6	26.6	23	4.6	10	2.0
Adenoid cystic carcinoma	22	4.4	17.7	11	2.2	11	2.2
PLGA	14	2.8	11.2	5	1.0	9	1.8
CExAP	8	1.6	6.4	5	1.0	3	0.6
Acinic cell carcinoma	5	1.0	4.0	3	0.6	2	0.4
EMC	2	0.4	1.6	1	0.2	1	0.2
Myoepithelial carcinoma	1	0.2	0.8	0	0.0	1	0.2
Total	124	25.1	100	64	13.1	60	12.1

CExAP, carcinoma ex-adenoma pleomorphic; EMC, epithelial-myoepithelial carcinoma; NOS, not otherwise specified; PLGA, polymorphous low-grade adenocarcinoma.

independent oral pathologists and, if necessary, new sections were prepared and stained with hematoxylin and eosin, periodic acid-Schiff, or mucicarmine. All cases were classified according to the 2005 WHO Histologic Typing of Salivary Gland Tumors.⁴

The current study was approved by the Ethical Committee of the Piracicaba Dental School, State University of Campinas (Protocol 141/2011).

RESULTS

General overview

Of the total of 493 cases, 369 (74.8%) were benign and 124 (25.1%) malignant (a ratio of 2.9:1), distributed among 7 benign and 8 malignant histologic subtypes, accounting for 5.0% of all benign and malignant head and neck neoplasias detailed by both centers (Table I). The overall male-to-female ratio was 0.8:1 (220 male

Table II. Distribution of 493 benign and malignant salivary gland tumors according to age (years)

	0-10		11-20		21-30		31-40		41-50		51-60		61-70		71-80		81-90		NS	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Benign tumors																				
Pleomorphic adenoma	3	0.6	20	4.0	49	9.9	74	15.0	55	11.1	47	9.5	40	8.1	15	3.0	5	1.0	6	1.2
Warthin's tumor	0	0.0	0	0.0	0	0.0	1	0.2	6	1.2	9	1.8	13	2.6	5	1.0	1	0.2	1	0.2
Canalicular adenoma	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	3	0.4	0	0.0	7	1.4	0	0.0	0	0.0
Basal cell adenoma	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.4	0	0.0	0	0.0	0	0.0	0	0.0
Cystadenoma	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2	0	0.0	1	0.2	0	0.0	0	0.0
Myoepithelioma	0	0.0	0	0.0	1	0.2	0	0.0	1	0.2	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
Oncocytoma	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
Subtotal	3	0.6	20	4.0	50	10.1	75	15.2	64	12.9	61	12.3	55	11.1	28	5.6	6	1.2	7	1.4
Malignant tumors																				
Mucoepidermoid carcinoma	0	0.0	2	0.4	4	0.8	7	1.4	11	2.2	3	0.6	6	1.2	6	1.2	0	0.0	0	0.0
Adenocarcinoma, NOS	0	0.0	0	0.0	1	0.2	3	0.6	2	0.4	9	1.8	7	1.4	5	1.0	3	0.6	3	0.6
Adenoid cystic carcinoma	0	0.0	0	0.0	0	0.0	6	1.2	2	0.4	2	0.4	7	1.4	3	0.6	1	0.2	1	0.2
PLGA	0	0.0	0	0.0	0	0.0	1	0.2	3	0.6	2	0.4	6	1.2	2	0.4	0	0.0	0	0.0
CExAP	0	0.0	0	0.0	0	0.0	0	0.0	2	0.4	1	0.2	5	1.0	0	0.0	0	0.0	0	0.0
Acinic cell carcinoma	0	0.0	0	0.0	0	0.0	3	0.6	1	0.2	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0
EMC	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
Myoepithelial carcinoma	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Subtotal	0	0.0	2	0.4	5	1.0	22	4.4	21	4.2	18	3.6	32	6.4	16	3.2	4	0.8	4	0.8
Total	3	0.6	22	4.4	55	11.1	97	19.6	85	17.2	79	16.0	87	17.6	44	8.9	10	2.0	11	2.2

CExPA, carcinoma ex-pleomorphic adenoma; EMC, epithelial-myoepithelial carcinoma; NS, not specified; PLGA, polymorphous low-grade adenocarcinoma.

vs 273 female), whereas in the benign cases this proportion was 0.7:1 (156 male vs 213 female) and in the malignant cases 1.1:1 (64 males vs 60 female; Table I). Most tumors occurred in patients 31 to 70 years old, with an average age of 48.2 years (range 8-88 years). The mean age of the patients with benign tumors was 46.3 years and that of those with malignancies was 54.0 years. The exact distribution of each SGT, according to the age of the patients, is depicted in Table II.

The parotid gland was the most commonly affected location, with a frequency of 42.3%, followed by the palate (19.2%), lips (7.7%), and the submandibular gland (6.8%). No tumors of the sublingual gland were found. Benign tumors predominated in the parotid glands, followed by the palate and lips, whereas malignancies were more frequent in the palate, parotid gland, cheek, and submandibular gland (Table III).

Among the 369 benign salivary gland tumors, 314 were pleomorphic adenomas (PA) (63.6% of the total or 85.0% of the benign) and 36 Warthin's tumors (7.3% of the total or 9.7% of the benign), and these represented the most common benign neoplasias. The most common malignant tumors were mucoepidermoid carcinomas (MEC; n = 39, 7.9% of the total or 31.4% of the malignant), followed by adenocarcinomas, not otherwise specified (NOS; n = 33, 6.6% of the total or 26.6% of the malignant), and adenoid cystic carcinomas (n = 22, 4.4% of the total or 17.7% of the malignant).

Dental hospital sample

In a 10-year period (2002 to 2011), there were 161 salivary gland tumors diagnosed at the oral pathology department of the Piracicaba Dental School, which corresponded to 6.4% of all head and neck tumors diagnosed by this department. Of these, 88 were benign (54.1%) and 73 (45.9%) were malignant, with a benign-to-malignant ratio of 1.2:1, representing four histopathological benign subtypes and seven malignant subtypes (Table IV).

Most tumors occurred in patients 31 to 50 years old (mean age 48.9 years, range 8-88 years) and the male-to-female ratio was 0.7:1. The minor glands in the palate were the most common site (n = 86 or 53.4%), followed by the lips (n = 33 or 20.4%) and the cheek (n = 15 or 9.3%; Figure 2). Pleomorphic adenoma was the most frequent histologic type (n = 73 or 45.3%), followed by canalicular adenoma (n = 9 or 5.5%). The most common malignant tumor was MEC (n = 35 or 21.7%), followed by polymorphous low-grade adenocarcinomas (PLGA; n = 14 or 8.6%) and adenoid cystic carcinomas (n = 12 or 7.4%).

Private general pathology sample

In a 9-year period (2001 to 2009), 332 salivary gland tumors were found in a private general pathology center located in the city of Cascavel (Paraná State, Brazil), accounting for 4.6% of the head and neck neoplasias seen at this center. Of these, 281 were benign (84.6%)

Table III. Distribution of the 493 salivary gland tumors according to the location (major and minor salivary glands)

	Major salivary glands						Minor salivary glands											
	Parotid		Submandibular		Sublingual		Palate		Lips		Cheek mucosa		Tongue		Floor of the mouth		NS	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Benign tumors																		
Pleomorphic adenoma	153	31.0	24	4.8	0	0.0	54	10.9	20	4.0	7	1.4	0	0.0	0	0.0	56	11.3
Warthin's tumor	29	5.8	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	6	1.2
Canalicular adenoma	0	0.0	0	0.0	0	0.0	1	0.2	10	1.8	0	0.0	0	0.0	0	0.0	0	0.0
Cystadenoma	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2
Myoepithelioma	0	0.0	0	0.0	0	0.0	3	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Basal cell adenoma	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Oncocytoma	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Subtotal	184	37.3	25	5.0	0	0.0	59	11.9	30	6.0	7	1.4	0	0.0	1	0.0	63	12.7
Malignant tumors																		
Mucoepidermoid carcinoma	3	0.6	0	0.0	0	0.0	21	4.2	1	0.2	2	0.4	2	0.4	1	0.2	9	1.8
Adenocarcinoma, NOS	17	3.4	3	0.6	0	0.0	2	0.4	0	0.0	1	0.2	0	0.0	0	0.0	10	2.0
Adenoid cystic carcinoma	2	0.4	4	0.8	0	0.0	4	0.8	1	0.2	3	0.6	2	0.4	0	0.0	6	1.2
PLGA	0	0.0	0	0.0	0	0.0	7	1.4	4	0.8	2	0.4	0	0.0	0	0.0	1	0.2
CExAP	1	0.2	2	0.4	0	0.0	1	0.2	1	0.2	0	0.0	0	0.0	0	0.0	3	0.6
Acinic cell carcinoma	2	0.4	0	0.0	0	0.0	0	0.0	1	0.2	1	0.2	0	0.0	0	0.0	1	0.2
EMC	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
Myoepithelial carcinoma	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2
Subtotal	25	5.0	9	1.8	0	0.0	36	7.3	8	1.6	10	2.0	4	0.8	1	0.0	31	6.2
Total	209	42.3	34	6.8	0	0.0	95	19.2	38	7.7	17	3.4	4	0.8	2	0.4	94	19.0

CExPA, carcinoma ex-pleomorphic adenoma; EMC, epithelial-myoepithelial carcinoma; NS, not specified; PLGA, polymorphous low-grade adenocarcinoma.

Table IV. Histologic and gender distribution of 161 salivary gland tumors diagnosed at the Piracicaba Dental School, São Paulo State, Brazil

	n = 161	%	% in the group of benign or malignant tumors	Gender			
				Male		Female	
				n	%	n	%
Benign tumors							
Pleomorphic adenoma	73	45.3	82.9	33	20.5	40	24.8
Canalicular adenoma	9	5.5	10.2	4	2.5	5	3.1
Cistadenoma	3	1.8	3.4	0	0.0	3	1.9
Myoepithelioma	3	1.8	3.4	0	0.0	3	1.9
Total	88	54.6	100	37	23.0	51	31.7
Malignant tumors							
Mucoepidermoid carcinoma	35	21.7	47.9	15	9.3	20	12.4
PLGA	14	8.6	19.1	5	3.1	9	5.6
Adenoid cystic carcinoma	12	7.4	16.4	5	3.1	7	4.3
Adenocarcinoma, NOS	6	3.7	8.2	2	1.2	4	2.5
Acinic cell carcinoma	2	1.2	2.7	1	0.6	1	0.6
EMC	2	1.2	2.7	1	0.6	1	0.6
CExAP	2	1.2	2.7	2	1.2	0	0.0
Total	73	45.3	100	31	19.2	42	26.0

CExAP, carcinoma ex-adenoma pleomorphic; EMC, epithelial-myoepithelial carcinoma; NOS, not otherwise specified; PLGA, polymorphous low-grade adenocarcinoma.

and 51 (15.3%) were malignant, with a benign-to-malignant ratio of 5.5:1, distributed between five benign and six malignant subtypes (Table V).

Patients 31 to 70 years old were the most affected, with a mean age of 47.7 years (range 8-86 years) and a male-to-female ratio of 0.8:1. The parotid gland was by

far the most affected site (62.6%), followed by the submandibular gland (10.5%) and the minor glands in the palate (2.7%; Figure 3). Pleomorphic adenoma was the most frequent histologic type (n = 241 or 72.5%), followed by Warthin's tumor (n = 36 or 10.8%). Adenocarcinoma NOS was the most common malignant

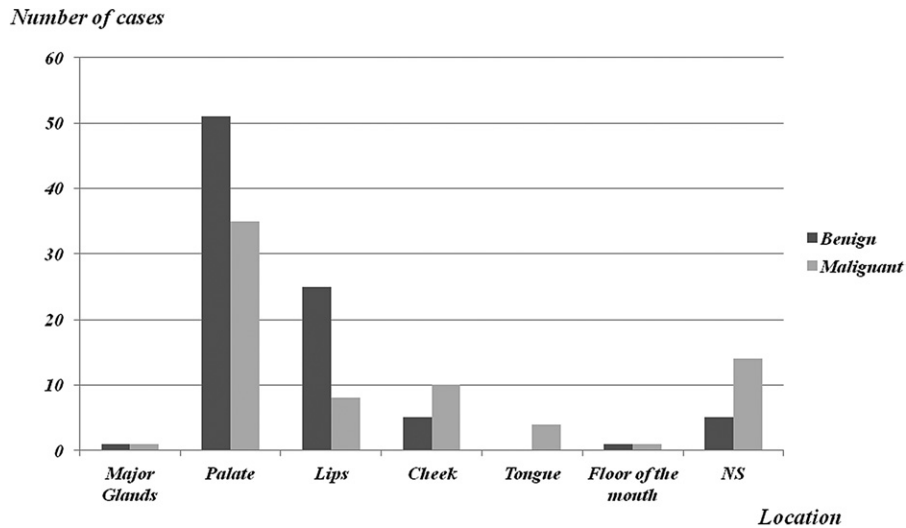


Fig. 2. Distribution of 161 salivary gland tumors diagnosed by the Department of Oral Pathology of the Piracicaba Dental School according to the primary site of involvement. NS, not specified.

Table V. Histologic and gender distribution of the 332 salivary gland tumors diagnosed at the Private Surgical Pathology Center, Cascavel, Paraná State, Brazil

	n = 332	%	% in the group of benign or malignant tumors	Gender			
				Male		Female	
	n	%		n	%	n	%
Benign tumors							
Pleomorphic adenoma	241	72.5	85.7	91	27.4	150	45.1
Warthin's tumor	36	10.8	12.8	27	8.1	9	2.7
Canalicular adenoma	2	0.6	0.7	0	0.0	2	0.6
Basal cell adenoma	1	0.3	0.3	0	0.0	1	0.3
Oncocytoma	1	0.3	0.3	1	0.3	0	0.0
Total	281	84.6	100.0	119	35.7	162	48.7
Malignant tumors							
Adenocarcinoma, NOS	27	8.1	52.9	21	6.3	6	1.8
Adenoid cystic carcinoma	10	3.0	19.6	6	1.8	4	1.2
CExAP	6	1.8	11.7	3	0.9	3	0.9
Mucoepidermoid carcinoma	4	1.2	7.8	1	0.3	3	0.9
Acinic cell carcinoma	3	0.9	5.8	2	0.6	1	0.3
Myoepithelial carcinoma	1	0.3	1.9	0	0.0	1	0.3
Total	51	15.3	100.0	33	9.9	18	5.4

CExAP, carcinoma ex-adenoma pleomorphic; NOS, not otherwise specified.

tumor (n = 27 or 8.1%), followed by adenoid cystic carcinoma (n = 10 or 3.0%) and carcinoma ex-pleomorphic adenoma (n = 6 or 1.8%).

Major versus minor salivary glands

Examination of the distribution of SGTs affecting major and minor salivary glands indicated that 243 neoplasias were located in the major glands and 156 in the minor glands (1.5:1 ratio; in 94 cases the location was not specified; Table III). There were only 2 cases affecting major glands in the sample derived from the oral pathology center (1.2%), both found in the parotid gland, whereas 86.9% of the tumors affected minor

glands, and in 11.8% of the cases the location was not specified. On the other hand, tumors of the major glands accounted for 72.5% of the neoplasias diagnosed in the general pathology center (62.3% affecting the parotid and 10.2% the submandibular glands), whereas 4.8% of the tumors affected minor glands and in 22.5% of the cases the location was unspecified. In major glands there was a significantly higher benign-to-malignant ratio than that observed in minor glands (6.1:1 vs 1.6:1, respectively).

Pleomorphic adenoma was the most common benign tumor in both major and minor glands (72.8% [177 of 243 cases] and 51.9% [81 of 156 cases], respectively),

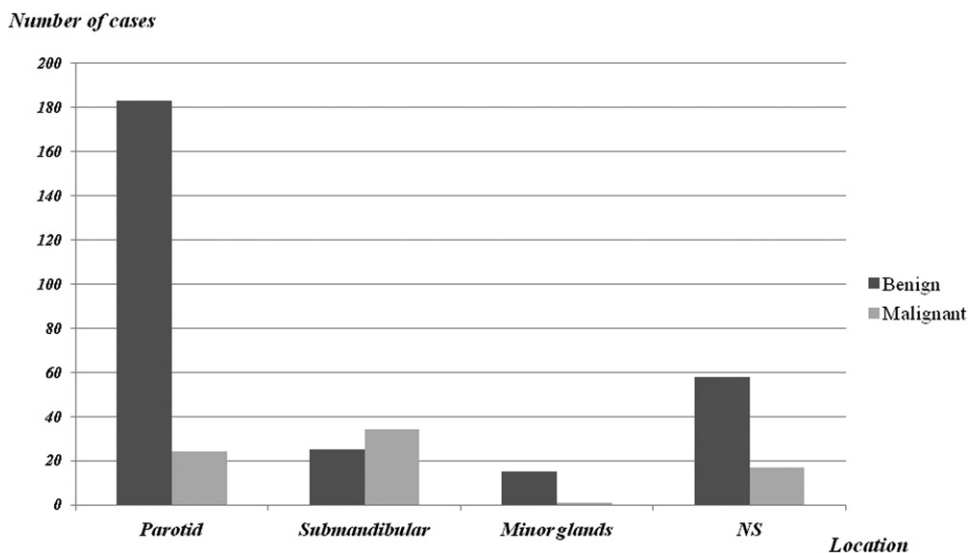


Fig. 3. Distribution of 332 salivary gland tumors diagnosed by a private surgical pathology center in Cascavel (Paraná State) according to the primary site of involvement. NS, not specified.

followed by Warthin's tumor in major glands (12.3% of the 243 major glands tumors) and canalicular adenoma in minor glands (7.0% of the 156 cases affecting minor glands). Regarding malignancies, adenocarcinoma NOS and adenoid cystic carcinoma were the most frequent neoplasias of the major glands (8.2% and 1.2%, respectively), whereas MEC and PLGA represented the most common malignancies in minor glands (17.3% and 8.3%, respectively).

DISCUSSION

Salivary gland tumors are a large and diverse group of lesions, characterized by morphologic heterogeneity. There are numerous epidemiologic studies of SGTs in different countries, with varied results likely representing differences in the origin of the study (medical or dental centers), divergences in the histologic classification, restriction to a specific population, anatomical location, or tumor type^{6,7,11-34} (Tables VI and VII). Herein, we assessed 493 cases of SGTs from one medical and one oral pathology laboratory located in southern Brazil with the aims of investigating the distribution and clinicopathologic features of these neoplasias. Although there was some variability, particularly regarding the palate as the most affected site by malignancies, the results obtained revealed that the tumor types and their demographic features are in agreement with numerous reports, including those previously reported in Brazil.^{1,3,5,35}

According to the WHO, female patients are slightly more affected than males, although some variation can be found when analyzing specific tumor types.⁴ In the current study the male-to-female ratio was 0.8:1, which

is in accordance with the majority of studies, including Brazilian reports,^{1,3,5,12,14,24,27,35} although several reports have shown an increased frequency in male patients.^{15,36-38} It should be considered that benign tumors presented a male-to-female ratio of 0.7:1, whereas malignant neoplasias demonstrated a ratio of 1.1:1, indicating that benign tumors were slightly more common in females, whereas malignancies more often occurred in males, in accordance with previous studies.^{3,5,14,26} However, this is in contrast to results previously reported in Mexico,²¹ where female patients were more frequently affected by malignancies than male patients.

The age distribution in the present survey varied from 8 to 88 years old, with a mean age of 48.2 years, similar to other studies.^{3,12,21} As reported previously,^{3,15} the mean age of patients with malignant neoplasias is about a decade higher than that for benign tumors. However, Jansisyanont et al. (2002) reported that patients affected by malignant tumors were on average 6 years younger than those affected by benign neoplasias.²⁵

In the majority of studies, and in those derived from medical centers, the parotid gland is by far the most commonly affected location, with 64% to 80% of all primary SGTs occurring at this site, more specifically in the superficial lobe.^{38,39} In the present study the parotid gland was also the most commonly affected site (42.3%), followed by minor glands of the palate, lips, and the submandibular gland, which is in accordance with the observations of previous studies.^{6,37,38} The parotid gland was the most common location for benign tumors, whereas the palate was the most common site for malignancies. Although some studies conclude that

Table VI. Incidence of major and minor salivary gland tumors in different continents

Authors	Country	n	Benign tumors				Malignant tumors						
			Pleomorphic adenoma	Warthin's tumor	Canalicular adenoma	Basal cell adenoma	MEC	ACC	PLGA	AcCC	CExPA	Adenoc. NOS	EMC
Present study, 2012	Brazil	493	63.6	7.3	2.2	0.2	7.9	4.4	2.8	1.0	1.6	6.6	0.4
Velázquez et al. 2012 ²¹	Mexico	360	65.5	5.5	0.2	2.2	4.7	5.0	0.5	2.5	1.9	0.0	0.0
Luksic et al. 2012 ⁶	Croatia	779	47.2	11.1	0.0	0.7	8.6	12.0	0.5	3.0	4.2	2.1	0.0
Shishegar et al. 2011 ²⁰	Iran	392	58.0	6.0	0.0	0.7	8.0	13.0	0.6	1.5	0.6	1.0	1.0
Tian et al. 2010 ³⁷	East China	6982	46.9	13.8	0.04	3.7	9.6	9.8	0.4	2.5	2.6	1.9	0.5
Kara et al. 2010 ¹⁵	Turkey	125	64.0	4.8	0.0	0.8	2.4	8.8	0.8	0.8	1.6	4.0	0.0
Tilakaratne et al. 2009 ⁴²	Sri Lanka	713	38.4	4.1	0.3	1.4	21.6	13.5	4.2	2.5	3.2	3.6	0.6
Ochicha et al. 2009 ¹⁷	Nigeria	78	48.7	0.0	0.0	2.0	23.1	3.8	5.1	1.3	0.0	0.0	0.0
Oliveira et al. 2009 ³	Brazil	599	67.8	6.3	0.0	0.0	5.0	6.5	0.0	0.0	0.0	6.2	0.0
Li et al. 2008 ¹²	West China	3461	51.3	4.4	0.4	1.7	7.5	7.3	1.3	2.4	4.2	6.6	0.4
Subhashraj 2008 ³⁹	India	684	53.1	3.1	0.4	1.6	7.2	9.6	0.0	2.8	3.5	4.5	0.4
Jones et al. 2008 ¹³	UK	741	44.4	4.6	4.7	5.0	11.5	8.4	3.8	2.6	3.2	1.8	0.8
Al-Khateeb and Ababneh 2007 ¹⁶	Jordan	102	54.0	4.0	0.0	0.0	8.0	13.0	0.0	4.0	1.0	1.0	0.0
Ansari 2007 ²	Iran	130	65.4	0.0		1.8*	11.5	2.3	0.0	0.0	0.7	4.6	0.0
Ito et al. 2005 ⁵	Brazil	496	54.2	8.5	0.4	0.6	13.5	7.9	1.8	1.8	0.6	1.4	1.0
Lima et al. 2005 ³⁵	Brazil	245	68.5	6.9	0.8	0.0	4.4	5.3	0.0	4.9	3.6	3.6	0.0
Otoh et al. 2005 ³⁶	Nigeria	79	44.3	2.5		3.8*	10.1	8.9	0.0	2.5	5.1	2.5	0.0
Vuhahula 2004 ⁴⁴	Uganda	268	39.9	0.0	0.0	3.4	9.3	13.4	3.7	6.0	2.2	3.7	2.2
Vargas et al. 2002 ¹	Brazil	124	59.0	10.5	0.0	0.8	10.5	4.0	0.0	0.8	2.4	0.8	0.8
Satko et al. 2000 ⁴⁰	Slovakia	1021	53.9	9.7	0.0	2.5	5.2	6.4	0.0	3.9	0.8	3.5	0.0
Renehan et al. 1996 ¹⁸	UK	1194	65.0	13.0	0.0	1.0	3.0	6.0	0.0	2.0	2.0	3.0†	0.08
Saku et al. 1997 ¹⁹	Japan	120	53.3	13.3	0.8	2.5	10.0	9.1	0.8	0.0	4.1	2.5	0.0
Chidzonga et al. 1995 ¹⁴	Zimbabwe	282	73.0	7.0	0.0	0.0	4.2	8.9	0.0	0.0	0.4	0.0	0.0

ACC, adenoid cystic carcinoma; AcCC, acinic cell carcinoma; Adenoc. NOS, adenocarcinoma not otherwise specified; CExPA, carcinoma ex-pleomorphic adenoma; EMC, epithelial-myoepithelial carcinoma; MEC, mucoepidermoid carcinoma; PLGA, polymorphous low-grade adenocarcinoma.

*Basal cell adenoma and canalicular adenoma were evaluated as monomorphic adenoma in these studies.

†Included basal cell adenocarcinoma, papillary cystadenocarcinoma, mucinous adenocarcinoma, and adenocarcinoma, not otherwise specified.

minor glands, especially of the palate, are proportionally more affected by malignancies than major glands,^{16,20} the great majority of studies report the parotid gland as the most affected site by both benign and malignant neoplasias.^{6,14,15} However, by evaluating the distribution and demography of SGTs derived from two distant geographic locations (Finland and Israel), Bello et al. observed that most malignant tumors commonly occurred in the parotid gland in the Finnish centers; whereas among Israeli cases, malignant tumors were more commonly seen in the minor salivary glands, illustrating the broad differences obtained when analyzing the clinical features of SGTs.³⁸ Moreover, unlike the results of the present survey, in many studies the submandibular gland has been found to be the second most affected site, which is more commonly found in studies conducted in medical centers, whose samples are mainly formed by tumors affecting major glands.^{1,3,15,16,40}

In the present study, 74.8% of the cases were benign and 25.1% were malignant, confirming the predomi-

nance of benign SGTs.^{3,6,13,27,40,41} All epidemiologic studies clearly show that PA is by far the most common salivary gland neoplasia, both in major and in minor glands.^{13,37} In this survey, PA corresponded to 63.6% of all tumors, accounting for 72.8% of the major and 52.6% of the minor glands and mainly affecting female patients in the fourth decade of life. The second most common benign tumor was Warthin's tumor, which accounted for 7.3% of all tumors and 9.7% of benign tumors. Because Warthin's tumor occurs almost exclusively in the parotid, it is rarely reported in studies considering only tumors of the minor salivary glands, and in these series, canalicular adenoma may represent the second most common benign entity.^{6,9,38}

In accordance with the majority of studies, MEC was the most frequent malignant neoplasia found in the present survey (7.9% of all tumors), corresponding to 1.2% and 17.3% of the major and minor gland neoplasias, respectively, and mainly diagnosed in female patients in the fifth decade of life.^{5,6,12,42} However, unlike the majority of the studies, in the current series adeno-

Table VII. Incidence of intraoral minor salivary gland tumors in different continents

Authors	Country	n	Benign tumors				Malignant tumors						
			Pleomorphic adenoma	Warthin's tumor	Canalicular adenoma	Basal cell adenoma	MEC	ACC	PLGA	AcCC	CExPA	Adenoc. NOS	EMC
Present study, 2012	Brazil	156	51.9	0.0	7.0	0.0	17.3	6.4	8.4	1.2	1.2	1.9	1.2
Venkata and Irulandy et al. 2011 ³¹	India	185	22.1	0.0	0.0	1.0	34.0	14.5	9.7	0.0	0.5	7.5	0.0
Dhanuthai et al. 2009 ²³	Thailand	311	42.7	0.0	0.3	2.8	22.8	18.3	0.6	0.0	0.6	9.3	0.3
Buchner et al. 2007 ⁴¹	United States	380	39.2	0.0	6.1	1.6	21.8	6.3	7.1	1.6	0.5	2.1	0.0
Pires et al. 2007 ⁹	United States	546	33.2	0.0	9.2	0.0	22.9	6.4	5.1	3.8	0.4	3.8	0.4
Wang et al. 2007 ¹¹	China	737	37.3	0.1	0.0	0.5	12.4	19.4	4.6	0.9	3.0	5.6	1.4
Jaber et al. 2006 ²⁴	Libya	75	30.6	0.0	1.3	2.6	25.3	17.3	4.0	0.0	2.6	10.6	0.0
Toida et al. 2005 ²⁹	Japan	82	65.8	0.0	0.0	0.0	9.7	12.1	0.0	3.6	2.4	2.4	0.0
Yih et al. 2005 ³³	United States	213	43.6	0.0	11.7	0.0	21.1	10.3	8.4	0.5	0.9	1.9	0.0
Poomsawat et al. 2004 ²⁸	Thailand	60	30.0	0.0	0.0	0.0	43.3	15.0	1.7	0.0	5.0	1.7	0.0
Jansisyantont et al. 2002 ²⁵	United States	80	21.3	0.0	1.2	1.2	41.3	8.8	11.3	3.8	0.0	3.8	0.0
Lopes et al. 1999 ²⁶	Brazil	196	33.1	0.0	0.0	1.5	38.7	17.3	1.5	0.5	0.0	4.5	0.0
Bastidas et al. 1996 ²²	Venezuela	62	38.7	0.0	0.0	3.2	29.0	9.7	0.0	0.0	0.0	3.2	0.0
Loyola et al. 1995 ²⁷	Brazil	164	53.0	0.0	0.0	1.0	17.0	13.0	2.0	4.0	0.0	1.0	1.0
Van Heerden et al. 1991 ³⁰	South Africa	70	48.5	0.0	0.0	0.0	15.2	12.8	15.7	0.0	7.1	1.4	1.4
Waldron et al. 1988 ³²	United States	426	40.8	0.0	10.7*		15.2	9.3	11.0†	3.5	1.4	0.0	0.0

ACC, adenoid cystic carcinoma; AcCC, acinic cell carcinoma; Adenoc. NOS, adenocarcinoma not otherwise specified; CExPA, carcinoma ex-pleomorphic adenoma; EMC, epithelial-myoepithelial carcinoma; MEC, mucoepidermoid carcinoma; PLGA, polymorphous low-grade adenocarcinoma.

*Basal cell adenoma and canalicular adenoma were evaluated as monomorphic adenoma in this study.

†The authors included the so-called lobular polymorphous terminal duct trabecular carcinomas.

carcinoma NOS was the second most frequent malignant tumor, accounting for 6.6% of all tumors and 26.6% of malignant tumors.^{1,37} This high frequency, nonetheless, is in accordance with that reported by the latest series published by the Armed Forces Institute of Pathology, where adenocarcinoma NOS also represented the second most frequent malignancy of salivary glands.⁴³ This neoplasia mostly affected the parotid gland of male patients in the sixth and seventh decades of life. Adenoid cystic carcinoma was the third most common malignant tumor, accounting for 4.4% of all tumors. This incidence is lower than that observed in many other studies, where it represents the most or the second most frequent malignant neoplasia.^{13,16,18,37,38,41,44} In the present survey, adenoid cystic carcinoma usually affected the submandibular and the palatal glands, with equal gender distribution and predominance for the seventh decade of life.

Not surprisingly, the main difference observed between samples derived from surgical and oral pathology services was related to the distribution of tumors preferentially affecting the major or minor salivary glands. In the current study, most cases from the surgical pathology center affected major glands (72.5%),

particularly the parotid, which accounted for 62.3% of the 332 cases. In contrast, intraoral minor salivary glands represented the most common site in the oral pathology service, accounting for 86.9% of the 161 cases. These findings are in agreement with almost all international series previously reported.^{6,26} Most epidemiologic studies suffer this bias, as can be seen with other diseases such as odontogenic tumors (ameloblastoma vs odontoma) and oral cancer (studies that include cases from lip and oropharynx vs those that do not). Thus, although the overall distribution of SGTs in the current study diverged from that of studies conducted in dental hospitals, regarding only neoplasias affecting intraoral minor glands the present results agree with the majority of the previous studies from oral pathology services. Such studies have observed MEC and adenoid cystic carcinoma, or PLGA, as the most frequent malignancies, and PA and canalicular adenoma as the most common benign neoplasias,^{9,25,26,30,33,41} and the minor glands of the palate as the most frequently affected site.^{29,31} In addition, the benign:malignant ratio proved to be higher in the medical sample than in the dental one, mainly because of the higher incidence of PA in the former, which has been reported in almost every previous study.^{6,16} By contrast, no significant differ-

ence could be found in gender distribution and in the mean age of the patients between the two centers.

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