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Full Length Article

Comprehensive five-year study on salivary gland tumors: Demographic, clinical, and histopathological insights

Rahul Rajbhar [1], Dhanashri Ekatpure [2], Ashvini Kolhe [*,2]

Department of Pathology, Seth G.S. medical college and K.E.M.H., Parel, Mumbai, 400012, Maharashtra, India

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ABSTRACT

Background: Salivary gland tumors account for 3 %–10 % of head and neck neoplasms. The aim of the study is to analyze demographic, clinical, and histopathological characteristics of salivary gland tumors.
Materials and methods: A five year retrospective analysis of surgically excised salivary gland tumor specimens was conducted. Data on demographics, clinical features, and histopathology were reviewed and statistically analyzed using descriptive and inferential methods.
Results: A total of 55,000 specimens were received; of these, 0.12 % was diagnosed as salivary gland tumors, with a male to female ratio of 1.1:1. Of the tumors, 85.1 % were benign and 14.9 % were malignant neoplasms, with the most common tumors being pleomorphic adenoma and mucoepidermoid carcinoma respectively. Benign tumors generally had a slower onset and were more encapsulated, while malignant tumors showed faster growth and were less encapsulated.
Conclusion: This study enhances understanding of salivary gland tumors, highlighting benign predominance, gender disparities, and key histopathological features for diagnosis and treatment.

1. Background

Salivary gland tumors represent a distinct subset of neoplasms in the head and neck region, constituting approximately 3 %–10 % of all tumors in this anatomical area (1,2). While most tumors arise in the parotid gland, others occur in the submandibular gland and minor salivary glands. Benign tumors predominate, outnumbering malignant ones by a ratio of 5:1 to 7:1, although some benign tumors can undergo malignant transformation. The histopathological diversity of salivary gland tumors, including adenomas and mucoepidermoid carcinomas, poses diagnostic challenges due to varied clinical presentations and morphological features. In this study, we conduct a comprehensive analysis of salivary gland tumors over a five-year period, aiming to delineate their demographic, clinical, and histopathological characteristics, and contribute to refining diagnostic approach in this field.

2. Materials and methods

A retrospective study spanning five years (January 1, 2015, to December 31, 2019) was conducted in the Department of Pathology, focusing on surgically excised specimens of salivary gland tumors. Exclusions comprised non-neoplastic lesions and salivary gland excisions within radical neck dissections for oral malignancies. Out of 88 lesions retrieved, 67 cases histomorphologically diagnosed as salivary gland neoplasms were included.

Demographic and clinical data, encompassing gender, age, symptomatology, anatomical location, and tumor size, were extracted from histopathology requisition forms. Histopathology slides underwent comprehensive review for diagnosis validation, categorizing tumors per the latest World Health Organization histological typing of salivary gland tumors [1,2]. Assessment included tumor capsulation, cellular architecture, perineural and vascular infiltration, and parenchymal characteristics. Special stains and immunohistochemistry (IHC) were employed as needed.

Gross and microscopic findings were compared with clinical and radiological records for correlation. Descriptive statistical analysis was utilized, presenting parameters as percentages. Continuous variables underwent 2-tailed Student's t-test comparison, while categorical

* Corresponding author.
E-mail addresses: dr.rahulrajbhar@gmail.com (R. Rajbhar), dhanashri@gmail.com (D. Ekatpure), drashvinikolhe@gmail.com (A. Kolhe).
[1] Present address: Department of Pathology, M.G.M. Medical college, Kamothe, Navi Mumbai.
[2] Present address: Department of Pathology, Seth G.S. medical college and K.E.M.H., Parel, Mumbai 400012, Maharashtra, India.

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variables were assessed with Fisher's exact test and Chi-square test. Statistical significance was set at $P < 0.05$.

3. Results

A total of 55,000 specimens were received; of these, 67 (0.12 %) was diagnosed as salivary gland tumors. The 67 neoplastic lesions comprised 57 (85.1 %) benign tumors and 10 (14.9 %) malignant tumors, yielding a benign-to-malignant ratio of 5.7:1 (Table 1).

Salivary gland neoplasms primarily affected the adult population, with the highest incidence observed among individuals aged 31–40 years (31.3 %), followed by those aged 41–50 years (28.4 %). The mean age was 35.2 years (range 13–68 years). The youngest patient diagnosed with pleomorphic adenoma was a 13-year-old female, while the oldest patient diagnosed with basal cell adenoma was a 68-year-old male. Overall, there was no gender predilection, with a male-to-female ratio of 1.1:1. However, a gender disparity emerged in benign (male-to-female ratio of 1.2:1) and malignant (male-to-female ratio of 1:2.3) tumors, with a male predominance in benign tumors and a female predominance in malignant tumors.

Most salivary gland tumors were located in the parotid gland (51 cases, 76.1 %), with benign tumors predominantly occurring in this site (46/57 cases, 80.7 %). Malignant tumors were more prevalent in the submandibular gland compared to benign tumors.

The clinical presentation varied, with the majority of patients experiencing symptoms for one to five years (36 cases, 53.7 %). Malignant tumors demonstrated a more rapid onset, with symptoms lasting approximately three months in 30 % of cases. Swelling was the most common symptom in both benign and malignant tumors, while pain was more prevalent in malignant tumors (20 % vs. 7 % in benign tumors). Facial nerve involvement was not observed in any case.

Pleomorphic adenoma was the most common benign neoplasm (52 cases, 91.2 %), followed by basal cell adenoma (4 cases, 7.0 %) and Warthin's tumor (1 case, 1.8 %). Among malignant tumors, mucoepidermoid carcinoma (6 cases, 60 %) predominated.

Superficial lobe excision (superficial parotidectomy) was the most frequently performed procedure, particularly for pleomorphic adenoma cases. Complete gland excision was the preferred surgical approach for malignant tumors.

Tumor sizes ranged from 1 to 5 cm at diagnosis, with benign tumors typically measuring 2–3 cm and malignant tumors measuring 3–4 cm. Gross examination revealed that most tumors exhibited a solid and firm consistency (54 cases, 80.6 %), with 19.4 % (13 cases) displaying solid-cystic characteristics. Benign tumors were predominantly encapsulated (84.2 %), while malignant tumors were unencapsulated (90 %). Additionally, most tumors were circumscribed (95.5 %).

Histologically, most tumors exhibited heterogeneous cellular composition, predominantly epithelial in origin. Chondromyxoid stroma was exclusively observed in benign neoplasms (pleomorphic adenoma), while myxoid stroma was present in both benign and malignant tumors. Necrosis and mitosis were more frequent in malignant tumors (Figs. 1–3).(see Fig. 4)

Chronic sialadenitis was more prevalent in conjunction with malignant tumors compared to benign tumors. Malignant tumors were significantly associated with histomorphological features such as acute onset, larger size, lack of capsule, increased mitosis, and necrosis.

Follow-up data were available for 39 cases (35 benign and 4 malignant) over a period of three to seven years. All patients were symptom-free and alive, except for one case of pleomorphic adenoma recurrence four years postoperatively.

Table 1
Distribution of clinicopathological features between benign and malignant salivary gland tumors.

Features		Benign (57)	Malignant (10)	p value
Age group	11–20	8 (14 %)	0 (0 %)	0.64
	21–30	12 (21.%)	3 (30 %)	
	31–40	18 (31.6 %)	3 (30 %)	
	41–50	15 (26.3 %)	4 (40 %)	
	51–60	3 (5.3 %)	0 (0 %)	
	61–70	1 (1.8 %)	0 (0 %)	
Male:Female		1:1.2	2.3:1	0.15
Major:Minor gland		56:1	10:1	0.67
Duration of onset (months)	</ = 3	1 (1.8 %)	3 (30 %)	0.002
	>3 to 12	14 (24.6 %)	2 (20 %)	
	>12 to 60	34 (59.6 %)	2 (20 %)	
	>60	8 (14 %)	3 (30 %)	
Size (cm)	0–3	38 (66.7 %)	3 (30 %)	0.03
	3.1–6	19 (33.3 %)	7 (70 %)	
Pain	Present	3 (5.3 %)	2 (20 %)	0.1
	Absent	54 (94.7 %)	8 (80 %)	
Gross appearance	Solid	48 (84.2 %)	6 (60 %)	0.07
	Solid-cystic	9 (15.8 %)	4 (40 %)	
Capsule	Present	48 (84.2 %)	1 (10 %)	less than 0.001
	Absent	9 (15.8 %)	9 (90 %)	
Cell type	One	4 (7 %)	2 (20 %)	0.18
	Multiple	53 (93 %)	8 (80 %)	
Necrosis	Present	1 (1.8 %)	4 (40 %)	less than 0.001
	Absent	56 (98.2 %)	6 (60 %)	
Mitosis	Present	2 (3.5 %)	4 (40 %)	less than 0.001
	Absent	55 (96.5 %)	6 (60 %)	
Chronic sialadenitis	Present	5 (8.8 %)	3 (30 %)	0.06
	Absent	52 (91.2 %)	7 (70 %)	

4. Discussion

The study of salivary gland tumors remains a vital area of research due to the complex interplay of demographic, clinical, and histopathological characteristics. Our comprehensive analysis of 67 surgically excised salivary gland neoplasms, predominantly originating from the parotid gland, provides essential insights into the prevalence, characteristics, and clinical implications of these tumors. Despite the limited number of malignant cases, the findings contribute to the existing body of literature, albeit with certain constraints (Tables 2–4) [3–12].

4.1. Age distribution of salivary gland neoplasms

The age distribution of salivary gland tumors in our study aligns with findings from various international studies, showing a predominance in younger adults. Our mean age for benign tumors was 34.78 years, consistent with several Asian studies that report a peak incidence in the fourth decade of life (Li et al., 2000; [13]). In contrast, many non-Asian studies highlight a trend toward older populations, particularly in the fifth to sixth decades of life [14,3]. This discrepancy may reflect regional differences in genetic predispositions, environmental factors, and lifestyle influences that warrant further investigation.

For malignant tumors, our mean age of 37.4 years aligns with findings from Asian literature [4,5] but deviates from certain non-Asian studies that report an increased incidence in older populations [6]. This suggests a need to consider demographic and regional factors when analyzing age-related trends in salivary gland tumors.

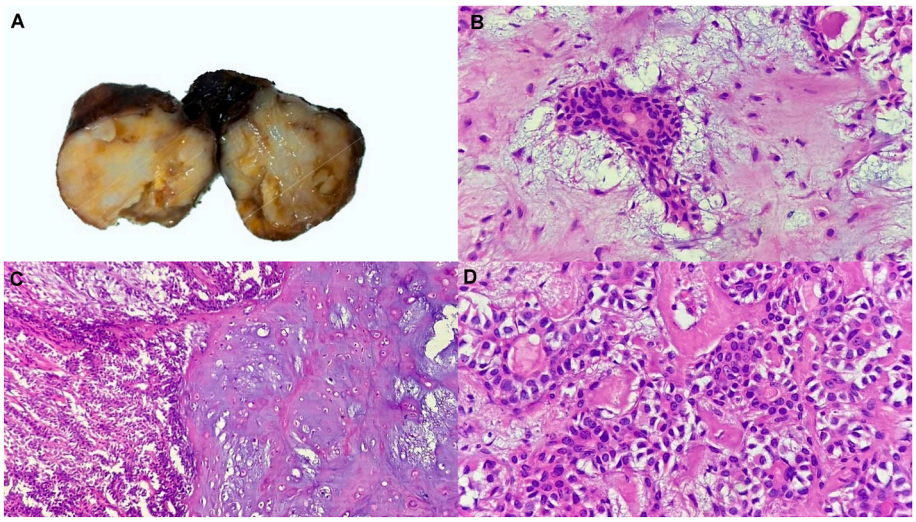

Fig. 1. Pleomorphc adenoma A) Gross photograph showing an encapsulated, grey-white mass with focal yellow and cystic areas; B) Epithelial and spindled myoepithelial cells in a myxoid stroma (Hematoxylin and eosin stain, x400); C) Chondromyxoid stroma (Hematoxylin and eosin stain, x100); D) Clear myoepithelial cells (Hematoxylin and eosin stain, x400).

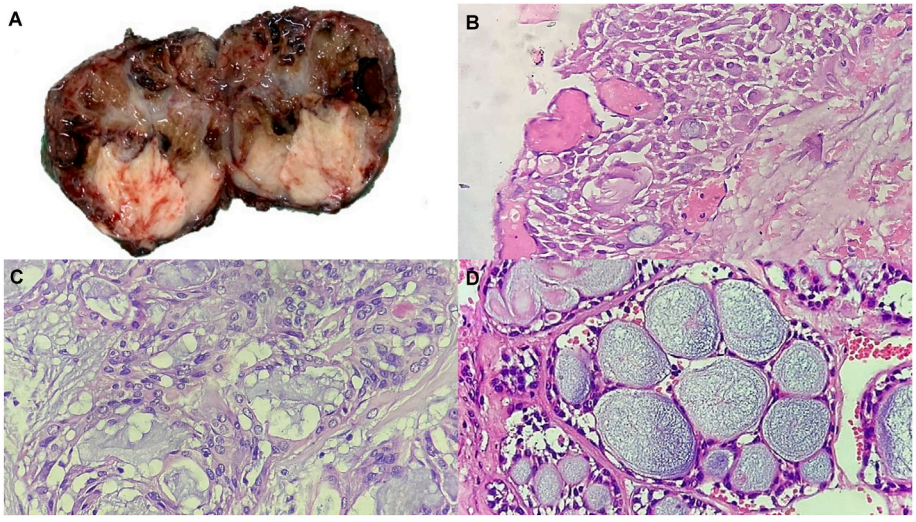

Fig. 2. A) Gross photograph of mucoepidermoid carcinoma showing a well-circumscribed. solid-cystic mass with mucinous areas; B) Mucoepidermoid carcinoma showing a cystic cavity lined by squamous epithelial cells, mucous cells, and intermediate cells (Hematoxylin and eosin stain, x400); C) Intermediate grade mucoepidermoid carcinoma showing mucocytes and epithelial cells with cystic areas (Hematoxylin and eosin stain, x400); D) Adenoid cystic carcinoma showing tumor cells arranged in cribriform pattern and containing mucoid material (Hematoxylin and eosin stain, x400).

4.2. Gender distribution of salivary gland neoplasms

The gender distribution in our study revealed no significant overall disparity, consistent with findings from numerous other studies (Li et al., 2000; [13]). However, a notable distinction emerged when examining benign and malignant tumors separately. Our findings indicated a male predominance in benign tumors (1.2:1) and a female predominance in malignant tumors (2.3:1). This observation aligns with some international literature that reports varying gender ratios across populations [14,7].

The marked gender disparity in malignant tumors raises questions regarding potential biological and environmental factors influencing tumor development and progression. Understanding these variations can aid in tailoring clinical approaches and screening measures for different demographics.

4.3. Distribution of tumors by salivary gland

Our study's findings highlight the parotid gland as the most common site for salivary gland tumors, corroborating results from the literature (Li et al., 2000; [13]). The parotid gland accounted for 76.1 % of cases in our analysis, with benign tumors predominantly localized here. This is consistent with the general trend observed in various populations, where major salivary glands, particularly the parotid, exhibit higher rates of neoplastic transformation compared to minor glands.

Interestingly, our study documented a higher prevalence of malignant tumors in the submandibular gland, a finding supported by earlier research [7]. This underscores the necessity for vigilant diagnostic practices in the submandibular region, where malignancies can often present with atypical clinical features.

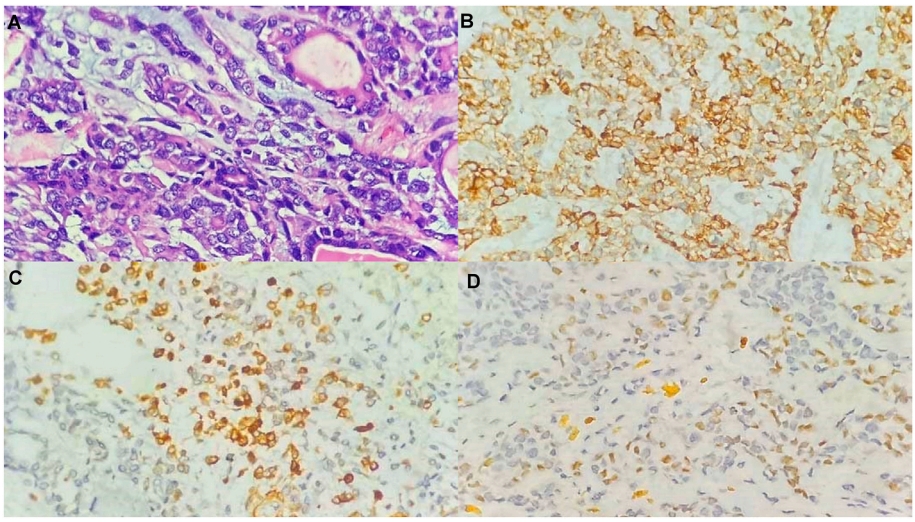

Fig. 3. Epithelial myoepithelial carcinoma A) Glandular arrangement of epithelial cells with spindle shaped myoepithelial cells (Hematoxylin and eosin stain, x400); B) CK membrane positivity in epithelial cells (x400); C) Calponin focally positive in myoepithelial cells (x400); D) P63 positive in myoepithelial cells (x400).

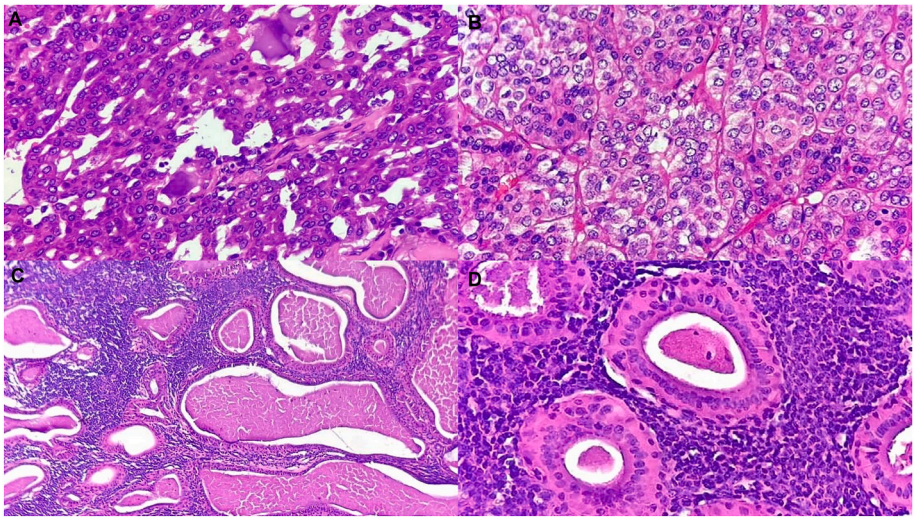

Fig. 4. A) Secretory carcinoma showing hyperchromatic cells arranged in the form of tubules with eosinophilic secretions (Hematoxylin and eosin stain, x400); B) Myoepithelial carcinoma showing sheets of tumor cells with round pale nuclei and abundant eosinophilic cytoplasm (Hematoxylin and eosin stain, x400); C) Warthin tumor showing papillary and cystic structures surrounded by lymphoid stroma (Hematoxylin and eosin stain, x100); D) Warthin tumor showing cystic structures lined by bilayered oncocytic epithelial cells in a lymphoid stroma (Hematoxylin and eosin stain, x400).

Table 2
Comparative analysis of salivary gland tumors with literature.

Population	Study	Year	Cases	M:F	Benign: Malignant	Most common gland involved
Asian (non idian)	Li (10)	2008	3461	1.1:1	1.5:1	Parotid
	Tian (1)	2010	6982	1.1:1	2.1:1	Parotid
	Wang (4)	2012	1176	1:1	3.1:1	Parotid
	Wang (7)	2015	2508	1:1	3.4:1	Parotid
	Gao (5)	2017	7190	1:1	1.8:1	Parotid
	Liao (12)	2020	559	1.4:1	3.3:1	Parotid
	Ghartimagar (11)	2020	130	1:1.4	3.1:1	Parotid
Western	Jones (13)	2008	741	1:1.3	1.9:1	Parotid
	Bello (2)	2012	2218	1:1.1	4.7:1	Parotid
	Vasconcelos (6)	2015	109	1:1.1	3.5:1	Parotid
	da Silva (3)	2018	2292	1:1.5	1.4:1	Parotid
Indian	Subhashraj (14)	2008	684	1.1:1	1.6:1	Parotid
	Present study	2024	67	1:1	5.7:1	Parotid

Table 3
Comparative analysis of benign salivary gland tumors with literature.

Population	Study	Year	Cases	M:F	Peak decade	Major:minor salivary gland	Most common tumor
Asian (non idian)	Li (10)	2000	2069	1:1	5th	4.5:1	Pleomorphic adenoma
	Tian (1)	2010	4743	1.1:1	5th, 6th	5.3:1	Pleomorphic adenoma
	Wang (4)	2012	887	1.1:1	5th	67.8:1	Pleomorphic adenoma
	Wang (7)	2015	1934	1:1	5th	6.4:1	Pleomorphic adenoma
	Gao (5)	2017	4654	1:1	5th	5.8:1	Pleomorphic adenoma
	Liao (12)	2020	430	1.5:1	4th, 5th	4.2:1	Pleomorphic adenoma
	Ghartimagar (11)	2020	98	1:1.7	4th	11.3:1	Pleomorphic adenoma
Western	Jones (113)	2008	481	1:1.2	6th	1:1.5	Pleomorphic adenoma
	Bello (2)	2012	1826	1:1.1	6th	11.2:1	Pleomorphic adenoma
	Vasconcelos (6)	2015	85	1:1.1	5th	3.7:1	Pleomorphic adenoma
	da Silva (3)	2018	1322	1:1.6	5th	1.6:1	Pleomorphic adenoma
Indian	Subhashraj (14)	2008	422	1:1	5th	3.6:1	Pleomorphic adenoma
	Present study	2024	57	1:1.2	4th	56:1	Pleomorphic adenoma

Table 4
Comparative analysis of malignant salivary gland tumors with literature.

Population	Study	Year	Cases	M:F	Peak decade	Major:minor salivary gland	Most common tumor
Asian (non idian)	Li (10)	2000	1392	1.3:1	5th	1.6:1	MEC
	Tian (1)	2010	2239	1:1	5th, 6th	1:1.2	ACC
	Wang (4)	2012	289	1:1.3	6th	8.7:1	MEC
	Wang (7)	2015	574	1:1	6th	1.7:1	MEC
	Gao (5)	2017	2536	1:1	5th	1.3:1	MEC
	Liao (12)	2020	129	1.3:1	5th, 6th	2.6:1	MEC
	Ghartimagar (11)	2020	32	1.5:1	5th	2.6:1	MEC
Western	Jones (13)	2008	260	1:1.6	6th	3.6:1	MEC
	Bello (2)	2012	392	1:1.3	6th	1.8:1	ACC
	Vasconcelos (6)	2015	24	1:1	5th	1.4:1	ACC
	da Silva (3)	2018	970	1:1.5	6th	1:1.6	MEC
Indian	Subhashraj (14)	2008	262	1.1:1	6th	3.4:1	MEC
	Present study	2024	10	2.3:1	5th	10:1	MEC

ACC = Adenoidcystic carcinoma, MEC = Mucoepidermoid carcinoma.

4.4. Distribution of tumor types

Pleomorphic adenoma emerged as the most common tumor type in our cohort, consistent with findings across multiple studies (Li et al., 2000; [14]). This tumor type's predominance in salivary gland pathology emphasizes the importance of accurate histopathological evaluation for effective management. The 91.2 % prevalence of pleomorphic adenoma in our study mirrors the trends observed in the literature, reinforcing the notion that this tumor type is a hallmark of salivary gland neoplasms.

Among malignant tumors, mucoepidermoid carcinoma was the most frequently diagnosed, aligning with findings from other studies [3,5]. The identification of only ten malignant cases in our study, however, raises questions about the statistical power and generalizability of our conclusions regarding malignant salivary gland tumors. The limited sample size constrains our ability to draw robust conclusions about the behavior and characteristics of malignancies in this context.

4.5. Duration and clinical presentation

The clinical presentation of salivary gland tumors varied, with the majority of patients experiencing symptoms for one to five years. This is indicative of the indolent nature of many benign tumors, particularly pleomorphic adenomas. However, the observation that 30 % of malignant tumors had a symptom duration of three months or less aligns with previous findings that underscore the aggressive nature of certain malignancies [15–17].

Our study's findings regarding pain as a symptom were noteworthy; while benign tumors had a lower incidence of pain (7 %), malignant tumors demonstrated higher rates (20 %). Although this difference did not reach statistical significance, it aligns with the general understanding that pain is often associated with malignancy due to factors such as infiltration into surrounding tissues and necrosis [6].

4.6. Tumor size distribution

In our analysis, a statistically significant difference was noted between the sizes of benign and malignant tumors. Benign tumors were primarily $\leq$3 cm, while malignant tumors tended to exceed this size. This finding is consistent with the literature, where larger tumor size has been correlated with malignant potential and poorer prognosis [18]. Our average size of pleomorphic adenoma (2–3 cm) further supports existing literature, emphasizing the necessity of size as a critical parameter in the TNM classification system for prognostication [6].

4.7. Gross and histomorphological features

Histopathological analysis revealed heterogeneous cellular composition, predominantly of epithelial origin. The exclusive presence of chondromyxoid stroma in pleomorphic adenomas aligns with findings from other studies [16–18]. Additionally, the observation of myxoid stroma in both benign and malignant tumors raises intriguing questions about the underlying mechanisms driving these histological variations.

Our study also noted a higher incidence of necrosis and mitosis in malignant tumors, reinforcing the notion that these features serve as crucial indicators of malignancy [15]. Chronic sialadenitis was found to be more prevalent in conjunction with malignant tumors, which aligns with literature suggesting that chronic inflammation can predispose to malignant transformations in salivary glands [15].

In conclusion, this study offers significant insights into the demographic, clinical, and histopathological characteristics of salivary gland tumors. The predominance of benign tumors, particularly pleomorphic adenoma, underscores the necessity for accurate diagnosis and monitoring to prevent potential malignant transformations. Although

the findings contribute to existing knowledge, the limited number of malignant cases warrants caution in generalizing the results.

The gender disparities observed in tumor distribution illuminate the complexities of tumor biology and emphasize the need for tailored clinical approaches based on demographic factors. Furthermore, the prevalence of malignant tumors in the submandibular gland highlights the importance of thorough investigation in less common anatomical sites.

Histomorphological features such as cellular composition, stromal characteristics, and the presence of necrosis and mitosis serve as crucial indicators of malignancy, guiding clinical management decisions. Future research focusing on the molecular mechanisms underlying tumor progression and therapeutic interventions tailored to histopathological subtypes will enhance the management of salivary gland tumors.

In summary, while this study provides valuable contributions to the field, it also underscores the need for larger, multi-center studies to further explore the intricacies of salivary gland neoplasms and their clinical implications.

Informed consent

Informed consent was obtained from all individual participants included in the study.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent for publication

Consent for publication was obtained for every individual person's data included in the study.

Data availability statement

Available.

Clinical trial registration

Not applicable.

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Conflict of interest

The authors declare that they have no conflict of interest.

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