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5-YEAR RETROSPECTIVE SURVEY OF ORAL BIOPSY DIAGNOSES IN A
MILITARY ORAL AND MAXILLOFACIAL PATHOLOGY SERVICE

By

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A thesis submitted to the Faculty of the
Oral and Maxillofacial Pathology Graduate Program
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In partial fulfillment of the requirements for the degree of
Master of Science
in Oral Biology
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DISCLAIMER

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ABSTRACT

5-year Retrospective Survey of Oral Biopsy Diagnoses in a Military Oral and Maxillofacial Pathology Service

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Introduction: The patient population in the military is unique compared to the general public. Patient demographics and habits are some factors that separate these populations. These factors play a role in pathoses of the head and neck. To diagnose and treat these lesions, the military employs multi-disciplinary care and referral via general dentists, dental specialists, and physicians. Past studies have shown that a delayed diagnosis has a negative effect on prognosis. Delay can be caused when awaiting care from a specialist, but many lesions could be biopsied by a dental primary care provider. **Objective:** The purpose of this study is to perform a 5 year retrospective evaluation of diagnoses and the submitting provider types in a military oral and maxillofacial pathology practice. The study will provide information to evaluate pathologic trends and patterns and their associations with provider type. **Methods:** The biopsy reports of the Naval Postgraduate Dental School Oral and Maxillofacial Pathology Department from years 2015-2019 will be collected and statistically analyzed. Data points collected include: age, sex, site, diagnosis, and provider type. Significant findings will be identified and evaluated. **Results:** Two of the five years of diagnoses were recorded and evaluated, with further

data collection ongoing. 4,100 diagnoses were performed during 2015-2016. The median age of the patients was 35 years; 71% were male. 28% of the submitted specimens were from oral surgeons with the next closest provider type being otolaryngologists at 5.7%. 53% of submitting clinicians' provider type could not be identified from the collected pathology reports. **Conclusions:** Early diagnosis of disease has a positive effect to patient prognosis. Patients would benefit from earlier biopsy which could be performed in many cases without delays due to specialty referral. This information may be used to improve education and awareness to primary dental care providers.

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LIST OF ABBREVIATIONS

OMP

Oral and Maxillofacial Pathology

ABOMP

American Board of Oral and Maxillofacial Pathology

CHAPTER 1: Introduction

Military dentistry is similar to civilian dentistry performed in private practice offices, hospitals, or other organizations. Both entities are held to the highest standard of care and our patients are the top priority. That being said, there are key differences between military and civilian dentistry, most notably differences in the demographics of the patient population and in some social habits.

The patients treated in military dentistry have an average age of 27 years for enlisted members and 34.4 years for officers [1]. Studies also show that military members are more likely to use alcohol and tobacco products while being less likely to use illicit drugs [5]. These habits can increase the risk for multiple different benign, pre-malignant, and malignant pathologic conditions within the oral cavity. There are also external factors such as environment and work related stressors that play a role in the development of oral pathoses such as necrotizing ulcerative gingivitis which I have personally diagnosed and treated multiple patients for upon their return from intense training for pre-deployment.

Treating the military patient population with its unique demographics along with the external and internal risk factors for disease requires multiple dental specialties to work together in order to provide optimal care. Oral and maxillofacial pathology (OMP) is one of the dental specialties that is paramount to supporting the patient population of the military. OMP works alongside the other dental specialties to perform and/or assist with patient evaluation, biopsy procedures, microscopic diagnosis, and treatment. One of the most important clinical duties of an oral and maxillofacial pathologist is to be an expert in performing a head and neck exam. A head and neck exam involves the visual and tactile evaluation of the soft and hard tissues in the area of the head and neck region.

The head and neck exam is performed in order to detect signs of disease such as squamous cell carcinoma and other cancers. Oral cancer accounts for 2.8% of all cancers found in the United States and 1.8% of cancer deaths annually [6]. It has been shown that earlier detection of oral disease can lead to a better prognosis, a higher 5 year survival rate, and a lower mortality rate [4,12] The oral pathologist is not only an expert in performing the head and neck exam, but must also in teaching other dental health professionals how to effectively perform the exam and to know the clinical signs to look for to identify disease.

To further aid in early detection, it is important to understand the trends and patterns of diagnosis in the military population and who among the dental specialties is detecting and submitting tissue used to render a diagnosis. To evaluate these trends in diagnosis, studies have been conducted looking at the civilian population which give us insight into the lesions that appear to be the most common over time [11,13].

Lesions of the oral cavity can rarely be clinically diagnosed. The majority require a biopsy to be evaluated by an oral pathologist in order to confirm the diagnosis which allows for the most appropriate treatment to be provided.

The dental health providers who perform head and neck exams and subsequent biopsies have a daunting task due to the many oral diseases and varied clinical appearances. To add to the complexity of this task, not every dental health professional has the same amount of training, clinical experience, and expertise in oral pathology. Being able to review the past trends and patterns of the diagnoses found among the military population can allow oral pathologists to better understand this information. Subsequently, the oral pathologists will be better prepared to perform their vital role as an

educator to the other specialties. Important details such as common sites, patient age, and who is performing the biopsy will aid in educating the military's dental health professionals, which in turn increases the level of care provided.

The purpose of this study is to perform a 5 year retrospective evaluation of diagnoses submitted to an oral and maxillofacial pathology department with an active-duty military patient population. The oral pathology department to be evaluated is The Naval Postgraduate Dental School Oral and Maxillofacial Pathology practice. This practice is the largest among the oral pathology departments in the military. This study will provide information on the type of tissue being submitted, its location, patient demographics, diagnosis, and the type of provider submitting the tissue. No other study was identified that evaluated provider type and their biopsy submissions in an active-duty military population. Evaluating the information found in this study will allow oral pathologists to better educate and guide clinicians when performing a head and neck exam, subsequent biopsy, and ultimately final treatment. The goal of this retrospective record review study is to use the knowledge gained to help improve the education of the military's dental health professionals, enabling them to detect, diagnose, and treat oral and head and neck disease earlier and more effectively, improving the long-term prognosis for their patients.

CHAPTER 2: Materials and Methods

STUDY DESIGN

This protocol was reviewed and approved by the Walter Reed National Military Medical Center (WRNMMC) Institutional Review Board, IRB# WRNMMC-2021-0358. Biopsy reports from the Naval Postgraduate Dental School Oral and Maxillofacial Pathology biopsy service from the years 2015-2019 will be evaluated. This will be approximately 11,000 reports. The reports are accessed via CoPathPlus and will be evaluated for inclusion criteria of biopsy site to confirm maxillofacial anatomic location. Some cases have multiple parts (ex: Part A, Part B) and each part will be considered in the evaluation and treated as an individual biopsy. The reported cases will be entered into a Microsoft Access database for collection and statistical evaluation. The data will consist of patient age with patients older than 89 identified as >89, gender, biopsy site, diagnosis, if a differential diagnosis was provided or not, and provider type submitting the tissue. Provider type will be designated as one of the following categories: General Dentist, Periodontist, Endodontist, Oral Surgeon, other dental specialist, Otolaryngologist, other MD, and unknown. Site will be generalized as: gingiva, mucosa, tongue, intraosseous-maxilla/mandible, salivary gland, sinus, oropharynx, sinonasal, neck, thyroid, larynx, and skin. The complete diagnosis will be recorded verbatim and a separate column in the database will have the generalized diagnosis. This is done because some lesions/disease processes can have different names, but are actually the same thing. For example, mucocele, mucus escape reaction, and mucus extravasation phenomenon; these different names all describe the same pathologic entity and will be generalized as "mucocele." Thompson, L. Wenig, B. *Diagnostic Pathology Head & Neck*. Second ed. Salt Lake City,

United States: Elsevier; 2016 will be referenced for diagnostic terminology synonyms to "generalize" diagnoses. Also, cases that are labeled as a resection will be noted in the database.

All diagnoses have been made by diplomates of the American Board of Oral and Maxillofacial Pathology (ABOMP) practicing in the United States Armed Forces. The PI, associate investigators, and other members of the study team to include statisticians will be the only ones able to access the patient biopsy reports and the Microsoft database. The data spreadsheet will be stored on a secured drive. Data collection will be performed only on CAC accessed, network secured computers.

Following the completion of data collection department assigned case numbers will be removed from the database. The data will then be analyzed to determine percentages of diagnosed entities, categorization of lesions (benign, pre-malignant, or malignant), and the breakdown of provider type in relation to site and diagnosis.

CHAPTER 3: Results

Two of the five years of data collection was completed and evaluated. The remaining three years of data collection is ongoing. 4,100 diagnoses were collected and submitted for statistical analysis. Patient demographic information was evaluated and reported in Table 1. It revealed a patient age range from <1 to over 89 years, with a mean of 37.9 and a median age of 35. As expected, males accounted for the majority at 70.9% of submitted diagnoses, while females were 29.1%. There were 202 different diagnoses reported in the analyzed pathology reports with the most common diagnoses being fibroma (14%), mucocele (9.6%), dentigerous cyst (7.6%), and periapical granuloma (7.1%). The diagnoses that presented over 1% are reported in Table 2. Table 1 also reports the biopsy sites and biopsy category which shows the most common biopsy site overall was intraosseous-maxilla/mandible (31.1%), buccal/lingual mucosa (29.4%), gingiva (15.3%), and tongue (11.6%). The vast majority of cases were benign (96%) with malignant (2.5%) and pre-malignant (1.4%) making up the remaining small amount of diagnoses submitted.

Provider types are reported in Table 1, Table 3, Table 6, and Table 7. Table 1 is a summary table which accounts for all submissions (4,100). Table 3 shows provider type from the total amount of submissions, but is for malignant diagnoses only. Table 6 breaks down the percentage of submissions from each provider type, but only accounts for the known providers, which decreases the overall submissions from 4,100 to 1,927. Table 7 does this also, but it shows the known provider type submissions for malignant diagnoses only.

CHAPTER 4: Discussion

This is a five-year retrospective analysis of the largest military oral and maxillofacial pathology practice. The study includes reports from 2015 to 2019. Currently two of the five years have been collected and analyzed with the study ongoing. This study is a separate arm to a broad data collection project that will utilize the data to answer multiple research questions. This study's focus is on the different provider types and their biopsy submissions. The collected data will help answer the "who," "where," and "what" of head and neck biopsies in a military oral pathology practice.

The data collected in this study will help fill in knowledge gaps in the biopsy process. Some of these gaps are: who are the provider types submitting specimens, where are the most common biopsy sites associated with the providers, and what type of specimens are being submitted to include benign, pre-malignant, and malignant? Of course, the actual diagnoses will also be considered in the analysis. Evaluating the distribution of provider types ultimately can improve access to care. This improvement can be done by identifying the most common lesions and their associated sites to help determine which provider type may be best suited for that lesion. Before a biopsy or referral is done, the disease process must be identified which typically is done by a primary dental care provider such as a general dentist. That being said, it has been reported that general dentists are competent in performing oral screenings, but tend to be reluctant to perform the biopsy [2,9]. If we are able to identify the providers who are performing biopsies and the associated anatomical sites, then we can potentially streamline our biopsy service which is important because past studies have shown a

correlation between delayed diagnosis and subsequent treatment with a poorer long-term prognosis [4].

Some ways to help accomplish this goal is by improving education to aid in lesion detection by identifying the common sites of disease. It has been reported in past studies that dental students and general dental practitioners feel they need more training in oral pathology to include data points evaluated in this study such as intraoral sites of cancer and pre-malignant lesions [3,7,8]. Oral pathologists in the military are the primary educators on these topics for our dental professionals, and that is another reason why studies like this one are important to our providers and patients.

At this point in the study, the total submissions evaluated is 4,100 from eight different provider types. 1,297 of the submissions are from known provider types. This was a discovered limitation during data collection. Provider type is not a standardized entry on a biopsy submission form and subsequent pathology report. This had a significant effect on the ability to collect and analyze the different provider types for this study. This finding supports a possible change to standardized forms to include not only the clinician's name, but also their provider type. This could help support clinical accountability and also support communication between the team of providers treating a patient.

During the evaluation of the different providers we found that oral surgeons submitted the highest percentage of specimens. General dentists were lower on the list of total submissions accounting for 3.6%. For the biopsy sites it was found that intraosseous lesions in the maxilla and mandible made up the majority of submissions at 31% which

correlates with the third and fourth most common diagnosis reported in the data; periapical granuloma and dentigerous cyst.

As expected, most lesions were benign. Although the pre-malignant lesions made up 1.4% of overall submissions no single pre-malignant diagnosis occurred at a rate greater than 1%. Table 2 displays the different diagnoses per provider type that presented over 1%. There are many more reported diagnoses, but this chart was produced to reflect the more common diagnoses. From this table we see that oral surgeons submitted the greatest percentage of lesions overall and included dentigerous cyst at 13.4%, fibroma at 11.4%, and mucocele at 9.7%. Otolaryngologists top submissions were squamous cell carcinoma at 15.5% and normal tissue at 12.9%. The high percentage of normal tissue submitted may partially represent some of the procedures performed by otolaryngologists which include reconstruction procedures like deviated septum repairs.

Periodontists were the second highest in submissions for the dental providers. Based on the findings from this study, periodontists are not only submitting a relatively high number of cases, but the diagnoses also show a broad range to include lesions outside of the gingiva like mucocèles, periapical cysts, and periapical granuloma. The most common submissions from periodontists were fibroma and foreign material. This finding along with the other common submissions based on diagnosis and anatomic location supports that most providers are submitting tissue from sites that they are highly trained in.

This is further supported when evaluating the endodontist provider type which shows their highest submissions were periapical granuloma and periapical cyst. The endodontist's diagnosis range was narrow compared to other provider types. General

dentists were found to submit tissue resulting in a relatively broad range of diagnoses, but their overall number of submissions was lower than what would be expected from a provider type that sees a high number of patients routinely.

The data was further broken down in Tables 3, 4, 5, and 7 to highlight malignant diagnoses. Although the malignant lesions only made up 2.5% of the overall submissions, the United States population; civilian and military, still has an estimated 54,000 new cases and 11,230 deaths involving cancer of the oral cavity and pharynx annually [6]. Otolaryngologists submitted the highest percentage of malignant lesions at 40.8%, and were followed by oral surgeons at 14.6%. The providers submitted malignant lesions most commonly from the tongue, mucosa, skin, and oropharynx. Interestingly, the intraosseous site was the least likely to have a malignant diagnosis even though it was the site of highest percentage submissions overall. The most common malignant diagnosis was squamous cell carcinoma which was found most commonly on the tongue.

CHAPTER 5: Conclusions

This study has been a five year retrospective analysis of the largest military oral and maxillofacial, head and neck pathology practice with a focus on different provider types and their biopsy submissions. Two of the five years have been collected and analyzed at this point. The data collection is ongoing and is a part of a broader project that will utilize the data to answer multiple research questions. As future years of data are collected it will be interesting to evaluate the trends and patterns in regard to provider type submissions, the diagnoses, and any effects from Covid-19 on the biopsy service.

The analyzed data showed that oral surgeons submitted the most biopsies overall and the most common biopsy site was the maxilla/mandible followed by mucosa, gingiva, and tongue. 96% of submissions were benign and mostly in sites that all dental care providers should be comfortable taking tissue for biopsy. That being said, the data showed that general dentists ranked sixth out of the eight provider types evaluated, and had no biopsy submissions with a malignant diagnosis. This supports that the overall number of biopsies by general dentists should be increased. The most important thing is that clinically worrisome lesions get biopsied immediately or at least efficiently referred and followed up [10]. Future studies could help by identifying factors that limit the number of biopsies performed by general dentists. Identifying areas in the biopsy process that can be improved; to include disease detection and performing the biopsy, only serves to better the care rendered to our patients, which keeps our military ready and strong.

Table 1. Overall Summary

Characteristic	N = 4,100 (95% CI) ¹
Age [Median (IQR)]	35 (23, 51)
Sex	
Female	29% (28%, 31%)
Male	71% (69%, 72%)
Categorization	
Benign	96% (95%, 97%)
Malignant	2.5% (2.1%, 3.1%)
Pre-malignant	1.4% (1.1%, 1.9%)
Provider Type	
Endodontist	2.4% (2.0%, 3.0%)
General Dentist	1.7% (1.3%, 2.1%)
General Pathologist	3.3% (2.8%, 3.9%)
Oral Pathologist	0.7% (0.44%, 1.0%)
Oral Surgeon	28% (27%, 29%)
Other Dental Specialist	<0.1% (0.00%, 0.16%)
Other MD	0.7% (0.50%, 1.1%)
Otolaryngologist	5.7% (5.0%, 6.4%)
Periodontist	5.0% (4.3%, 5.7%)
Unknown	53% (51%, 54%)
Biopsy Site Category	
Gingiva	15% (14%, 16%)
Intraosseous-Maxilla/Mandible	31% (30%, 33%)
Larynx	0.4% (0.27%, 0.71%)
Mucosa	29% (28%, 31%)
Neck	<0.1% (0.00%, 0.16%)
Oropharynx	2.3% (1.8%, 2.8%)
Other	0.3% (0.14%, 0.50%)
Palate	4.0% (3.4%, 4.7%)
Salivary Gland	0.8% (0.56%, 1.1%)
Sinonasal	1.2% (0.87%, 1.6%)
Skin	3.2% (2.7%, 3.8%)
Soft Tissue	0.4% (0.23%, 0.65%)
Tongue	12% (11%, 13%)
Biopsy Site Normalized	
Ear	<0.1% (0.01%, 0.20%)
Epithelial	19% (18%, 20%)
Mass	42% (41%, 44%)
Minor Salivary Glands	<0.1% (0.00%, 0.16%)
Mixed Radiolucent/Radiopaque	1.1% (0.85%, 1.5%)
Other	1.9% (1.5%, 2.4%)
Pigmented	5.5% (4.8%, 6.3%)
Radiolucency	28% (26%, 29%)
Radiolucency And Epithelial	<0.1% (0.00%, 0.16%)
Radiopacity	1.9% (1.5%, 2.4%)
Ro	<0.1% (0.00%, 0.16%)
Sinonasal	0.4% (0.23%, 0.65%)
Tmj	<0.1% (0.00%, 0.16%)
¹ CI = Confidence Interval	

Table 2. Normalized Diagnosis (at least 1%) Per Provider Type

	Endodontist	General Dentist	General Pathologist	Oral Pathologist	Oral Surgeon	Other Dental Specialist	Other MD	Otolaryngologist	Periodontist	Unknown	Overall
	(N=100)	(N=69)	(N=136)	(N=27)	(N=1146)	(N=1)	(N=30)	(N=232)	(N=204)	(N=2155)	(N=4100)
Normalized Diagnosis											
Fibroma	1 (1.0%)	9 (13.0%)	8 (5.9%)	2 (7.4%)	131 (11.4%)	0 (0%)	2 (6.7%)	14 (6.0%)	39 (19.1%)	375 (17.4%)	581 (14.2%)
Mucocele	0 (0%)	19 (27.5%)	1 (0.7%)	1 (3.7%)	111 (9.7%)	0 (0%)	1 (3.3%)	4 (1.7%)	11 (5.4%)	245 (11.4%)	393 (9.6%)
Dentigerous Cyst	0 (0%)	6 (8.7%)	5 (3.7%)	1 (3.7%)	153 (13.4%)	0 (0%)	0 (0%)	0 (0%)	1 (0.5%)	146 (6.8%)	312 (7.6%)
Periapical Granuloma	65 (65.0%)	2 (2.9%)	6 (4.4%)	0 (0%)	23 (2.0%)	0 (0%)	1 (3.3%)	2 (0.9%)	14 (6.9%)	177 (8.2%)	290 (7.1%)
Hyperkeratosis And Acanthosis	1 (1.0%)	6 (8.7%)	10 (7.4%)	1 (3.7%)	48 (4.2%)	0 (0%)	0 (0%)	5 (2.2%)	6 (2.9%)	98 (4.5%)	175 (4.3%)
Hyperplastic Dental Follicle	0 (0%)	0 (0%)	4 (2.9%)	0 (0%)	98 (8.6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	52 (2.4%)	154 (3.8%)
Squamous Papilloma	0 (0%)	2 (2.9%)	3 (2.2%)	0 (0%)	39 (3.4%)	0 (0%)	0 (0%)	13 (5.6%)	6 (2.9%)	74 (3.4%)	137 (3.3%)
Periapical Cyst	15 (15.0%)	1 (1.4%)	2 (1.5%)	0 (0%)	15 (1.3%)	0 (0%)	0 (0%)	0 (0%)	10 (4.9%)	88 (4.1%)	131 (3.2%)
Chronic Mucositis	3 (3.0%)	0 (0%)	10 (7.4%)	1 (3.7%)	21 (1.8%)	1 (100%)	1 (3.3%)	7 (3.0%)	13 (6.4%)	59 (2.7%)	116 (2.8%)
Abscess	6 (6.0%)	0 (0%)	1 (0.7%)	0 (0%)	17 (1.5%)	0 (0%)	0 (0%)	3 (1.3%)	10 (4.9%)	63 (2.9%)	100 (2.4%)
Foreign Material	0 (0%)	2 (2.9%)	3 (2.2%)	0 (0%)	19 (1.7%)	0 (0%)	0 (0%)	3 (1.3%)	24 (11.8%)	40 (1.9%)	91 (2.2%)
Normal Tissue	1 (1.0%)	1 (1.4%)	5 (3.7%)	0 (0%)	19 (1.7%)	0 (0%)	3 (10.0%)	30 (12.9%)	2 (1.0%)	27 (1.3%)	88 (2.1%)
Squamous Cell Carcinoma	0 (0%)	0 (0%)	1 (0.7%)	4 (14.8%)	13 (1.1%)	0 (0%)	0 (0%)	36 (15.5%)	0 (0%)	14 (0.6%)	68 (1.7%)
Lichenoid Mucositis	0 (0%)	1 (1.4%)	9 (6.6%)	2 (7.4%)	14 (1.2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	32 (1.5%)	58 (1.4%)
Vascular Anomaly	0 (0%)	1 (1.4%)	3 (2.2%)	0 (0%)	16 (1.4%)	0 (0%)	2 (6.7%)	3 (1.3%)	0 (0%)	22 (1.0%)	47 (1.1%)
Melanotic Macule	0 (0%)	2 (2.9%)	0 (0%)	0 (0%)	19 (1.7%)	0 (0%)	0 (0%)	0 (0%)	6 (2.9%)	19 (0.9%)	46 (1.1%)
Pyogenic Granuloma	0 (0%)	2 (2.9%)	0 (0%)	3 (11.1%)	4 (0.3%)	0 (0%)	2 (6.7%)	1 (0.4%)	3 (1.5%)	29 (1.3%)	44 (1.1%)
Focal Epithelial Hyperplasia	0 (0%)	0 (0%)	0 (0%)	0 (0%)	10 (0.9%)	0 (0%)	0 (0%)	2 (0.9%)	1 (0.5%)	28 (1.3%)	41 (1.0%)

Table 3. Malignant Diagnoses Summary

	Malignant Lesion
	(N=103)
Age	
Mean (SD)	59.1 (16.9)
Median [Min, Max]	61.0 [9.00, 88.0]
Missing	2 (1.9%)
Sex	
Female	36 (35.0%)
Male	67 (65.0%)
Provider Type	
General Pathologist	12 (11.7%)
Oral Pathologist	5 (4.9%)
Oral Surgeon	15 (14.6%)
Other MD	4 (3.9%)
Otolaryngologist	42 (40.8%)
Unknown	25 (24.3%)
Biopsy Site Category	
Gingiva	10 (9.7%)
Intraosseous-Maxilla/Mandible	2 (1.9%)
Larynx	6 (5.8%)
Mucosa	18 (17.5%)
Oropharynx	11 (10.7%)
Palate	6 (5.8%)
Salivary Gland	4 (3.9%)
Sinonasal	3 (2.9%)
Skin	17 (16.5%)
Soft Tissue	3 (2.9%)
Tongue	23 (22.3%)
Biopsy Site Normalized	
Epithelial	73 (70.9%)
Mass	24 (23.3%)
Pigmented	4 (3.9%)
Radiolucency	2 (1.9%)

Table 4. Malignant Diagnosis Per Provider Type

Normalized Diagnosis of Malignant Lesion	General Pathologist	Oral Pathologist	Oral Surgeon	Other MD	Otolaryngologist	Unknown	Overall
	(N=12)	(N=5)	(N=15)	(N=4)	(N=42)	(N=25)	(N=103)
Squamous Cell Carcinoma	1 (8.3%)	4 (80.0%)	12 (80.0%)	0 (0%)	35 (83.3%)	13 (52.0%)	65 (63.1%)
Basal Cell Carcinoma	1 (8.3%)	0 (0%)	1 (6.7%)	3 (75.0%)	0 (0%)	5 (20.0%)	10 (9.7%)
Mucoepidermoid Carcinoma	3 (25.0%)	0 (0%)	0 (0%)	0 (0%)	1 (2.4%)	1 (4.0%)	5 (4.9%)
Melanoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (7.1%)	0 (0%)	3 (2.9%)
Plasmacytoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (12.0%)	3 (2.9%)
Squamous Cell Carcinoma, Keratoacathoma Type	0 (0%)	0 (0%)	1 (6.7%)	0 (0%)	0 (0%)	1 (4.0%)	2 (1.9%)
Adenocarcinoma Nos	1 (8.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Classical Hodgkin Lymphoma	1 (8.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Fibrosarcoma	1 (8.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Neuroendocrine Carcinoma	1 (8.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Oncocytic Carcinoma	1 (8.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Polymorphous Adenocarcinoma	1 (8.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Small Cell Carcinoma	1 (8.3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Nasopharyngeal Carcinoma, Non-Keratinized Undifferentiated	0 (0%)	1 (20.0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Malignant Glomus Tumor	0 (0%)	0 (0%)	1 (6.7%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Carcinoma-In-Situ	0 (0%)	0 (0%)	0 (0%)	1 (25.0%)	0 (0%)	0 (0%)	1 (1.0%)
Adenoid Cystic Carcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (2.4%)	0 (0%)	1 (1.0%)
Basal Cell Adenocarcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (2.4%)	0 (0%)	1 (1.0%)
Diffuse Large B-Cell Lymphoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (2.4%)	0 (0%)	1 (1.0%)
Adenosquamous Carcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (4.0%)	1 (1.0%)
Verrucous Carcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (4.0%)	1 (1.0%)

Normalized Diagnosis	Gingiva	Intraosseous- Maxilla/Mandible	Larynx	Mucosa	Oropharynx	Palate	Salivary Gland	Sinonasal	Skin	Soft Tissue	Tongue	Overall
	(N=10)	(N=2)	(N=6)	(N=18)	(N=11)	(N=6)	(N=4)	(N=3)	(N=17)	(N=3)	(N=23)	(N=103)
Squamous Cell Carcinoma	7 (70.0%)	2 (100%)	5 (83.3%)	16 (88.9%)	9 (81.8%)	2 (33.3%)	1 (25.0%)	1 (33.3%)	1 (5.9%)	0 (0%)	21 (91.3%)	65 (63.1%)
Basal Cell Carcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	10 (58.8%)	0 (0%)	0 (0%)	10 (9.7%)
Mucoepidermoid Carcinoma	1 (10.0%)	0 (0%)	0 (0%)	1 (5.6%)	0 (0%)	3 (50.0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	5 (4.9%)
Plasmacytoma	2 (20.0%)	0 (0%)	0 (0%)	1 (5.6%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (2.9%)
Melanoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (17.6%)	0 (0%)	0 (0%)	3 (2.9%)
Squamous Cell Carcinoma, Keratoacathoma Type	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (11.8%)	0 (0%)	0 (0%)	2 (1.9%)
Neuroendocrine Carcinoma	0 (0%)	0 (0%)	1 (16.7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Polymorphous Adenocarcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (9.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Small Cell Carcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (9.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Diffuse Large B-Cell Lymphoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (16.7%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Adenocarcinoma Nos	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (25.0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Basal Cell Adenocarcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (25.0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Oncocytic Carcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (25.0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Fibrosarcoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (33.3%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Nasopharyngeal Carcinoma, Non- Keratinized Undifferentiated	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (33.3%)	0 (0%)	0 (0%)	0 (0%)	1 (1.0%)
Carcinoma-In-Situ	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (5.9%)	0 (0%)	0 (0%)	1 (1.0%)
Adenoid Cystic Carcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (33.3%)	0 (0%)	1 (1.0%)
Classical Hodgkin Lymphoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (33.3%)	0 (0%)	1 (1.0%)
Malignant Glomus Tumor	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (33.3%)	0 (0%)	1 (1.0%)
Adenosquamous Carcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (4.3%)	1 (1.0%)
Verrucous Carcinoma	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (4.3%)	1 (1.0%)

Table 5. Normalized Malignant Diagnosis Per Site

Table 6. Known Provider Type Overall Submissions

Provider Type (Known)	N = 1,927
Oral Surgeon	59%
Otolaryngologist	12%
Periodontist	11%
General Pathologist	7.0%
Endodontist	5.1%
General Dentist	3.6%
Oral Pathologist	1.5%
Other MD	1.5%

Table 7. Known Provider Type Malignant Submissions

Provider Type	N = 78
Otolaryngologist	40.8%
Oral Surgeon	14.6%
General Pathologist	11.7%
Oral Pathologist	4.9%
Other MD	3.9%

REFERENCES

1. Active Duty Members, 2020 Demographic Profile. <https://download.militaryonesource.mil/12038/MOS/Infographic/2020-demographics-active-duty-members.pdf>.
2. Anandani, Chitra, et al. "Awareness of General Dental Practitioners about Oral Screening and Biopsy Procedures in Udaipur, India." *Oral Health Prev Dent*, vol. 13, no. 6, 2015, pp. 523–530., doi:10.3290/j.ohpd.a32993.
3. Bakr, Mahmoud, et al. "Oral Cancer: An Evaluation of Knowledge and Awareness in Undergraduate Dental Students and the General Public." *Oral Health Prev Dent*, vol 14, 2016, pp. 403-411., doi:10.33290/j.ohpd.a36471.
4. Baykul T, Yilmaz HH, Aydin U, Aydin MA, Aksoy M, Yildirim D. Early diagnosis of oral cancer. *J Int Med Res*. 2010 May-Jun;38(3):737-49. doi: 10.1177/147323001003800302. PMID: 20819411.
5. Bray RM, Marsden ME, Peterson MR. "Standardized comparisons of the use of alcohol, drugs, and cigarettes among military personnel and civilians." *Am J Public Health*. 1991;81(7):865-869. doi:10.2105/ajph.81.7.865.
6. "Cancer Stat Facts: Oral Cavity and Pharynx Cancer." *NIH National Cancer Institute*, <https://seer.cancer.gov>.
7. Dave, B. "Why do GPs fail to recognize oral cancer? The argument for an oral cancer checklist." *British Dental Journal.*, vol. 214, no. 5, 2013, pp. 223-225., doi:10.1038/sj.bdj.2013.214.
8. Hassona, Yazan, et al. "Oral Cancer Knowledge and Diagnostic Ability Among Dental Students." *J Canc Educ.*, vol. 32, pp. 566-570., doi:10.1007/s13187-015-0958-1.
9. McGurk, M, Scott, S.E. "The reality of identifying early oral cancer in the general dental practice." *British Dental Journal.*, vol. 208, no. 8, 2010, pp. 347-351., doi:10.1038/sj.bdj.2010.345.
10. "Oral Health Topics, Cancer (Head and Neck)." ADA Websites, American Dental Association, 17 January 2019, <https://www.ada.org/resources/research/science-and-research-institute/evidence-based-dental-research/oral-cancer-guideline>.
11. Santos, A.S., et al., Demographic, Clinical, and Microscopic Findings of Biopsies From the Oral Cavity: a 6-Year Retrospective Study. *Oral Surgery, Oral Medicine, Oral Pathology & Oral Radiology*, 2018. 126(3): p. e176-e176.

12. Tax, CL, et al. "Oral cancer screening: knowledge is not enough." *International Journal of Dental Hygiene.*, vol. 15, 2017, pp. 179-186., doi:10.1111/idh.12172.
13. Weir, J.C., W.D. Davenport, and R.L. Skinner, A diagnostic and epidemiologic survey of 15,783 oral lesions. *J Am Dent Assoc*, 1987. 115(3): p. 439-42.