

Mesenchymal tumours of the head and neck: a 10-year institutional archival study

Tumores mesenquimales de cabeza y cuello: estudio de archivo institucional de 10 años de duración

Shalini Krishnan¹ <https://orcid.org/0000-0001-8629-8183>

Varsha Salian^{2*} <https://orcid.org/0000-0002-4653-4943>

Neevan D'souza³ <https://orcid.org/0000-0002-4043-9638>

Pushparaja Shetty² <https://orcid.org/0000-0003-2432-8492>

¹ Shetty Memorial Institute of Dental Sciences (ABSMIDS), Department of Oral & Maxillofacial Surgery, Mangalore, Karnataka, India.

² Shetty Memorial institute of Dental Sciences (ABSMIDS), Department of Oral & Maxillofacial Pathology, Mangalore, Karnataka, India.

³ Hegde Medical Academy (KSHEMA), Mangalore, Karnataka, India.

*Corresponding author: varu_2002@yahoo.com

ABSTRACT

Introduction: Histopathological characterisation of benign and malignant lesions of the head and neck in a systematic and coherent way is an essential part of Oral Pathology and Oral Medicine.

Objective: To describe the frequency and histopathological profile of connective tissue tumours in the head and neck region reported in an Indian institute.

Methods: A retrospective analysis was made of the 10-year records of reports of biopsy samples of patients maintained by the department of oral pathology showing histopathological diagnosis of connective tissue neoplasms. The data obtained was compiled for age, gender, site and histopathology of the lesions. **Results:** Majority of the tumours were benign and patients were found to be in the 2nd or 4th decade of life with

female preponderance. The most common benign tumour was fibroma where buccal mucosa was the commonest location and malignant tumour was osteosarcoma where mandible was the commonest site. While fibromas were seen among general adult population, osteosarcomas were more in the males (7.2 %) and in the younger population (< 20 years). The uncommon tumours among benign variety were leiomyoma and teratoma while in malignant category 1 case of undifferentiated sarcoma was reported.

Conclusion: The findings in this study may be of help to oral and maxillofacial surgeons and general dentists in formulating diagnosis and rendering patient care in the existing local population.

Keywords: biopsy; fibroma; oral cavity; oral pathology; osteosarcoma.

RESUMEN

Introducción: La caracterización histopatológica de las lesiones benignas y malignas de cabeza y cuello de forma sistemática y coherente es una parte esencial de la Patología Oral y la Medicina Oral.

Objetivo: Describir la frecuencia y el perfil histopatológico de los tumores del tejido conjuntivo de la región de cabeza y cuello notificados en un instituto indio.

Métodos: Se realizó un análisis retrospectivo de los registros de 10 años de informes de muestras de biopsia de pacientes mantenidos por el departamento de patología oral que mostraban diagnóstico histopatológico de neoplasias del tejido conectivo. Se recopilaron los datos obtenidos en cuanto a edad, sexo, localización e histopatología de las lesiones.

Resultados: La mayoría de los tumores eran benignos y los pacientes se encontraban en la 2ª o 4ª década de la vida, con preponderancia del sexo femenino. El tumor benigno más frecuente fue el fibroma, cuya localización más frecuente fue la mucosa bucal, y el tumor maligno fue el osteosarcoma, cuya localización más frecuente fue la mandíbula. Mientras que los fibromas se observaron entre la población adulta general, los osteosarcomas fueron más frecuentes en los varones (7,2%) y en la población más joven (< 20 años). Los tumores menos frecuentes en la variedad benigna fueron el leiomioma y el teratoma, mientras que en la categoría maligna se registró un caso de sarcoma indiferenciado.

Conclusiones: Los hallazgos de este estudio pueden ser de ayuda para los cirujanos orales y maxilofaciales y los odontólogos generales en la formulación de diagnósticos y la prestación de atención al paciente en la población local existente.

Palabras clave: biopsia; fibroma; cavidad oral; patología oral; osteosarcoma.

Recibido: 02/04/2021

Aceptado: 10/06/2022

Introduction

A diverse group of pathologies affect the oral cavity comprising a broad spectrum of either benign or malignant lesions.⁽¹⁾ Soft tissue tumours are generally uncommon and are most commonly benign in nature, while sarcomas of the head and neck are very rare, representing only 1% of all primary tumours arising within the head and neck region.^(2,3)

Soft tissue tumours are often classified based on their differentiation and the malignant forms are broadly classified into bone sarcomas and soft tissue sarcomas.^(2,4)

Clinical differential diagnosis of oral lesions is often dependent on obvious changes in colour, size, consistency, and relation to neighbouring structures. Knowledge of the frequency and distribution of such lesions is also essential when establishing a diagnosis and putting forward a proper treatment plan.⁽⁵⁾ Benign tumours can sometimes resemble malignant tumours both clinically and radiologically, in which case histopathological analysis becomes an important tool to establish definitive diagnosis.⁽²⁾ Various authors have studied the trends in the clinicopathological profile of tumours and tumour-like lesions of head and neck. Guedes MM et. al studied all oral soft tissue biopsies, while Masamatti SS and Al-Khateeb TH analysed only benign lesions in their study and have found fibrous polyps and fibromas as common entities. Barosa J et.al and Kalavrezos N have found osteosarcomas and rhabdomyosarcomas to be more frequently reported sarcomas in Portugal and London respectively.^(1,2,3,4,5)

The present study describes the frequency and histopathological profile of connective tissue tumours in the head and neck region reported in our institute located in Mangalore, India in

the past 10 years. Knowledge and awareness about the presence of these tumours among this population may help in recognition and treatment of mesenchymal neoplasms by oral and maxillofacial surgeons and clinicians in future.

Methods

A retrospective analysis of the histopathology records of ten years, from January 1st, 2010 to December 31st, 2019 was carried out where, the criteria for the search included all connective tissue tumours, both benign and malignant in the oral cavity and head and neck. The demographic details, site of tumour and histopathological diagnosis were noted. For patients with more than one biopsy report, only the more representative definitive diagnosis was considered. Cases with unclear, inconclusive or missing data were excluded. A total of 4184 histopathological records were studied. After excluding the non-mesenchymal tumours and the records with missing data, we arrived at a final sample of 207 cases for analysis. The tumours were classified into benign, intermediate and malignant tumours and further subdivided according to the tissue of origin. The data obtained was tabulated and sent for statistical analysis (Neville BW et. al, 2002; Rajendran R & Sivapathasundaram S, 2009).

The SPSS software version 20 was used for data analysis. The descriptive variables were age, gender, site of tumour and diagnosis. Chi square test was used to find the association between age, gender and tumour type; $p < 0.05$ was considered to be statistically significant.

Results

The prevalence of mesenchymal tumours in our study population was found to be 0.05 %. Majority of the patients were found to be in the 3rd and 5th decades of life (19.5 % each). Females (52.9 %) were affected more than males (47.1 %). Out of 207 tumours, 197 were benign (95.2 %) and 10 were malignant (4.8 %). Buccal mucosa (29 %) was the most common site of tumour, followed by gingiva (14.4 %) and face (9.5 %).

According to tissue of origin, the most common benign tumour was fibrous (65.5 %), followed by neural (11.7 %), fat (8.6 %), bone (8.1 %), blood vessel (5 %), lymphatics (0.5

%) and others (0.5 %). There was no specific age predisposition for benign tumours in general. Fibrous tumours were highest in the age group of 21-50 years and neural tumours were more in the younger age group (<20 years) and 31-40 years. Under the fibrous category, fibromas were the most common benign tumours encountered. They were more common in the age group of 21 to 50 years and more among the females in our study population (94.5 %). Buccal mucosa was the most common site of occurrence of fibromas (40 %). Neurofibroma was seen in majority among the neural tumours, majority occurring below 40 years and in females (63.6 %), with a predilection for the face (36.4 %). Benign fat tissue tumours consisted of lipomas, and blood vessel tumours of hemangiomas exclusively. Lipomas were seen more commonly in males (70.6 %), majority occurring above 40 years of age (76.4 %) and face being the common site of occurrence. Bone tumours consisted of osteomas in majority (81.2 %) and three cases of osteoblastoma were also reported, two in the mandible and one in the maxilla. Osteomas were more common in the mandibular alveolus (61.6 %), followed by the maxillary alveolus (15.4 %) and palate (7.7 %). They had a slight male predisposition (61.5 %) and was found more in patients less than 40 years (61.5 %). Hemangiomas, were found mainly in the buccal and labial mucosa (70 %), majority in the females (80 %) fairly evenly distributed across various age groups. The least common benign tumours were teratoma and leiomyoma, where one case each was reported.

Among the malignant tumours, lymphatics (40 %) was the most common tissue of origin, followed by bone (30 %), blood and blood vessel (20 %) (table 1). Apart from this, one case of undifferentiated sarcoma was reported, but no further analysis was available in this case. Lymphomas formed majority of the malignant tumours consisting of 3 cases of Non-Hodgkin's lymphoma and one Hodgkin's disease. Osteosarcomas were three in number, one in the maxillary alveolus, one in the mandible and one in the zygomatic bone. Among the malignant tumours of blood and blood vessels, we had one case of plasmacytoma in the palate and one case of hemangiopericytoma in the angle of mandible. The malignant tumours had a slight male predilection (60 %), while the benign tumours had a slight female predilection (53.2 %). Overall, the malignant tumours were more in patients less than 40 years of age (55.5 %), while no such predilection with respect to age was found in

benign tumours. There was also no significant association between age, gender and type of tumour.

Table 1- Frequency distribution of malignant tumours according to site and tissue of origin

SITE	TISSUE OF ORIGIN				TOTAL
	Lymphatics	Bone	Blood & Blood vessels	Others	
Palate	0	0	1	0	1
Buccal mucosa	1	0	0	0	1
Gingiva	0	0	0	0	1
Upper alveolus	1	1	0	0	1
Lower alveolus	0	0	0	1	1
Zygomatic bone	0	1	0	0	1
Mandible	0	1	1	0	2
Neck	1	0	0	0	1
Fascial space	1	0	0	0	1
Total	4	3	2	1	10

Discussion

Most of the previous studies^(1,2,5,6,7) have concentrated on reporting benign oral soft tissue masses. Our study is unique in that context, which analysed both benign and malignant connective tissue neoplasms. Fibromas formed the majority among tumours diagnosed in the benign connective tissue category. Fibromas are reactive connective tissues representing a fibrous overgrowth in response to local irritation or masticatory trauma, which occur most commonly in the buccal mucosa.⁽⁶⁾ Hence our case, is in agreement with previous findings^(2,5,7) where fibromas formed majority of soft tissue growths which were seen in buccal mucosa and tongue. Neurofibromas and lipomas formed the next majority among connective tissue tumours with neurofibromas slightly exceeding the lipomas.

Lipomas are benign tumours of fat tissue and their overall incidence in the oral cavity is thought to be less than 4.4 % of all benign oral mesenchymal neoplasms. The most common site of oral lipomas has been reported as the buccal mucosa, followed by the tongue, lip, floor of the mouth and buccal vestibule, palate, retromolar area, gingiva, and others.⁽⁸⁾ Our case however, of the 17 lipomas, 8 cases were found in the intraoral region

and 9 cases in the facial region. Of the 8 cases, majority were seen in the buccal mucosa which agrees with the above literature, however, gingiva also formed the next common region in our study which according to previous studies is an uncommon location.

This site predilection may be related to the availability of adipose tissue, which is high in the buccal mucosa because of the proximity of the buccal fat pad and very low in the palate.⁽⁸⁾ As mentioned by some authors, the causes of lipoma include heredity, fatty degeneration, hormonal abnormalities, injuries, infection, infarction, muscle cell metaplasia, residual embryonic fat cells, and chronic irritation.⁽⁸⁾ This may be the cause for increase in the incidence of lipomas in the recent times.

Taiseer Hussain Al-Khateeba⁽⁵⁾ also found lipomas and neurofibromas to be the commonest mesenchymal neoplasms in their study, while Massamati & Gosavi⁽²⁾ found benign tumours to be forming a very small proportion as compared with malignant tumours and among the benign category, neurofibromas and lipomas were among the uncommon ones. Błochowiak⁽⁷⁾ did not find a single case of lipoma, neurofibroma or schwannoma in their study while fibromas formed the majority among benign neoplasms.

Guedes⁽¹⁾ in their study found only about 29 % of oral soft tissue biopsies in Portugal to be comprising of neoplasms of which benign tumours formed about 9 % mainly comprising of fibromas and lipomas while neurofibromas (2 cases) and schwannomas (1 case) were least in the category. In our analysis, we found totally 23 cases in the neural category, with 2 cases of traumatic neuroma, 13 cases of neurofibroma, 5 cases of schwannoma and 2 cases diagnosed as benign neural pathology without further confirmation. Osteoma is a benign neoplasm in which deposition of compact lamellar cortical or cancellous bone creates a tumour mass.⁽⁹⁾

Osteoid osteomas of the craniofacial and jaw bones are exceptionally uncommon where they usually arise in the mandible and accounts for approximately 12 % of benign bone tumors.⁽¹⁰⁾ Our study also showed osteomas to form a very small proportion among benign tumours. None of the previous studies mentioned above have reported osteomas. This could be due to the fact that osteomas as considered by many as developmental anomalies rather than neoplasm. We had three cases of osteoblastoma in our study, two in males and one female, seen in mandible⁽²⁾ and maxilla.⁽¹⁾

Osteoblastoma accounts for approximately 1 % of all primary bone tumours.⁽¹¹⁾ The term benign osteoblastoma was coined independently by Jaffe and Lichenstein to describe a benign, slow growing neoplasm of bone characterised by the proliferation of plump osteoblasts forming osteoid and bone trabeculae in a well-vascularised fibrous connective tissue stroma.^(12,13) The vertebral column is the most common site of osteoblastoma followed by the mandible and other craniofacial bones.⁽¹¹⁾

Majority of osteoblastomas are seen in patients younger than 30 years of age, which was also seen in our study where 2 of 3 patients were below 30 years of age. Al-Khateeb et. al have mentioned hemangiomas and lymphangiomas in the developmental anomalies category without mention of any osteomas. Massamati and Gosavi⁽²⁾ found hemangiomas in majority in their study. Generally, lipoma and haemangioma are the most common benign soft tissue tumours of oral cavity in adults and children respectively.⁽¹⁴⁾

Accordingly, in our case we found only 5% of cases showing hemangioma all which was seen in adults and not children. The most common location for benign neoplasms in our case was the buccal mucosa which is at par with many previous studies which report it as a common site. One study reported lips as the commonest site, whereas another reported palate, tongue and upper lip as the commonest sites.⁽¹⁵⁾ Palate was also reported to be the common site by Guedes MM.⁽¹⁾

Among the malignant bone tumours (excluding bone marrow tumours), osteosarcomas are the most common, usually affecting the metaphysis of long bones in children and adolescents. Jaw osteosarcomas are rare malignant tumours accounting for approximately 6 to 7 % of osteosarcomas and 1 % of all head and neck malignant neoplasms.^(16,17) In our analysis of mesenchymal tumours, osteosarcoma was the most common malignant bone tumour.

Osteosarcomas of the jaws have been reported from 6 to 70 years of age with a mean age of presentation varying from 27 to 36 years.^(18,19,20,21) In our study, the age of presentation of osteosarcoma varied from 26 to 38 years, which is in accordance with the above studies. Jaw osteosarcomas can occur both in the mandible and maxilla. In our series, the sites were mandible (1), maxilla (1) and zygoma (1). Skull is the other reported site of head and neck osteosarcomas.⁽¹⁸⁾ Swelling is the most common presenting symptom. Pain, paraesthesia and ulceration are less common.⁽²²⁾ Jaw osteosarcomas are micromorphologically similar to

their peripheral counterparts, yet differ in certain aspects. The age of presentation in mandibular and maxillary osteosarcomas is usually 10-20 years later than peripheral osteosarcomas.^(23,24) Hematogenous metastasis is infrequent and is reported to affect only 6-21 % of jaw osteosarcomas after an average time of 17-23 months and hence, are believed to have a better prognosis than long-bone osteosarcomas.⁽²³⁾

Malignant lymphomas are a diverse group of malignancies arising from the lymphoreticular system. They are classically divided into two types: Hodgkin's and Non-Hodgkin's lymphoma.⁽²⁵⁾

Unlike HL, NHL demonstrates non-contiguous nodal spread, often with extra nodal involvement and frequently disseminated at time of diagnosis. Both usually present with painless cervical lymphadenopathy. A vast majority of NHL patients present with involvement of extra nodal head and neck sites. Constitutional symptoms are more common with Hodgkin's disease.⁽²⁶⁾

Primary extra nodal head and neck lymphomas are relatively uncommon. Oral cavity involvement is quite rare accounting for 0.1 to 5 % of all extra nodal lymphomas. Primary lymphomas of bone comprise 5% of all extra nodal lymphomas and are found in the maxilla, mandible, skull, zygoma, paranasal sinus, and orbit.^(25,27)

Other reported soft tissue sites of extra nodal involvement are tonsil, nasopharynx, base of tongue, scalp, thyroid gland, salivary glands, gingiva, skin of the face and larynx.⁽²⁵⁾ In our series, we had three cases of extra nodal Non-Hodgkin's Lymphoma (NHL) and one Hodgkin's disease (HD). Sites of NHL were maxillary alveolus, buccal fascial space, maxillary vestibule and Hodgkin's disease in the submandibular lymph node. NHL was associated with AIDS in one patient.

It is reported that nearly 15 % of patients with acquired immunodeficiency syndrome present with lymphoma.⁽²⁶⁾ Female to Male ratio in lymphomas has been reported to be 1.4 to 2.3 in most series.⁽²⁶⁾ This was different from our study, where the female to male ratio was 3:1. Hodgkin's disease presents at a younger age compared to NHL. The median age at diagnosis is reported as 27.7 years for HD and 67.2 years for NHL.⁽²⁷⁾ In contrast to this, the median age of presentation in our study was 55 years for HD and 43 years for NHL. We had one case each of solitary plasmacytoma of bone and hemangiopericytoma, both of which are rare in the maxillofacial bones. Plasmacytoma is a discrete, unifocal,

monoclonal, neoplastic proliferation of plasma cells.⁽²⁸⁾ Head and neck extramedullary plasmacytoma is usually found in the soft tissues of the upper aerodigestive tract, most commonly in the sinonasal area.⁽²⁹⁾

Solitary plasmacytoma accounts for 3 % of all plasma cell neoplasms and may originate from the bone or soft tissues. It is considered to be a precursor of multiple myeloma with 50 % of the cases undergoing transformation. Solitary plasmacytomas are seen in the vertebrae and long bones and are extremely rare in the maxillofacial bones.⁽²⁸⁾

They are commonly found in the bone-marrow rich areas of the mandible such as the retromolar area, angle, body and ramus, and less commonly reported in the zygoma, maxilla and hard palate.^(28,30) In our study, palate was the site of presentation of plasmacytoma. Solitary plasmacytoma of bone occurs in slightly younger age group compared to multiple myeloma, with a mean age of presentation of 55 years, and is more prevalent in males with a ratio of 2:1.⁽²⁸⁾ This was consistent with the presentation in our study where it was found in a 46-year-old male. Radiographically, they are seen as expansile, osteolytic lesions.⁽²⁹⁾ Surgery and radiotherapy are the treatment of choice in plasmacytoma.^(29,30)

Hemangiopericytomas are rare vascular tumours that arise from the pericytes of Zimmerman, that are smooth muscle-like cells found around capillaries with the ability to contract and regulate luminal diameter. They can occur anywhere there are capillaries but mostly in the lower extremities, pelvis, retroperitoneum, trunk and lower extremities. Head and neck hemangiopericytomas are rare and account for 11 to 16 % of all hemangiopericytomas. In the head and neck region, they are found in the connective and soft tissue, the nasal cavity, parotid gland, oral cavity, jaws, orbit, paranasal sinuses and intracranially within the central nervous system.⁽³¹⁾ Intraosseous hemangiopericytoma is rare, but have been reported.⁽³²⁾

Our case was one such, the site being the angle of mandible in an 18-year-old female. Head and neck hemangiopericytomas can occur in any age, but rare before the second decade and after seventh decade and has a slight female predilection, which is a similar presentation in our study.^(32,33) Distant metastasis is low but delayed and hence requires long-term follow up. Wide surgical excision with adjuvant radiotherapy is the treatment of choice.⁽³¹⁾

Limitations of study: As our study was retrospective in nature, we were unable to access parameters such as follow-up and prognosis that would throw light on the behaviour of these neoplasms. This was mainly due to availability of clinical, radiological and histopathological data at various different sources.

The prevalence of mesenchymal tumours arising in the maxillofacial region in general and oral cavity in particular is rare in comparison to the epithelial and odontogenic tumours. A good knowledge about their clinical presentation and behaviour will help in diagnosis, treatment and thereby the overall prognosis. Further studies in different populations will give us better insight into the epidemiology, etiology, pathogenesis and treatment of these mesenchymal tumours.

References

1. Guedes MM, Albuquerque R, Monteiro M, Lopes CA, do Amaral JB, Pacheco JJ, *et al*. Oral soft tissue biopsies in Oporto, Portugal: an eight-year retrospective analysis. *J Clin Exp Dent*. 2015;7(5): e640-8. DOI: <https://doi.org/10.4317/jced.52377>
2. Masamatti SS, Gosavi AV. Benign soft tissue lesions of oral cavity: a histopathological study. *J Clin Biomed Sci*. 2016;6(3):88-90.
3. Barosa J, Ribeiro J, Afonso L, Fernandes J, Monteiro E. Head and neck sarcoma: analysis of 29 cases. *Eur Ann Otorhinolaryngol Head Neck Dis*. 2014;131(2):83-6. DOI: <https://doi.org/10.1016/j.anorl.2012.11.007>
4. Kalavrezos N, Sinha D. Head and neck sarcomas in adulthood: current trends and evolving management concepts. *Br J Oral Maxillofac Surg*. 2020;58(8):890-7. DOI: <https://doi.org/10.1016/j.bjoms.2020.05.015>
5. Al-Khateeb TH. Benign oral masses in a northern Jordanian population-a retrospective study. *Open Dent J*. 2009;3:147-53. DOI: <http://doi.org/10.2174/1874210600903010147>
6. Gonsalves WC, Chi AC, Neville BW. Common oral lesions: part II. Masses and neoplasia. *Am Fam Physician*. 2007 [access 24/11/2020];75(4):509-12. Available at: <https://pubmed.ncbi.nlm.nih.gov/17323711/>

7. Błochowiak K, Farynowska J, Sokalski J, Wyganowska-Świątkowska M, Witmanowski H. Benign tumours and tumour-like lesions in the oral cavity: a retrospective analysis. *Post Derma i Alerg.* 2019;36(6):744-51. DOI: <https://doi.org/10.5114/ada.2018.78805>
8. Naruse T, Yanamoto S, Yamada S, Rokutanda S, Kawakita A, Takahashi H, *et al.* Lipomas of the oral cavity: clinicopathological and immunohistochemical study of 24 cases and review of the literature. *Indian J Otolaryngol Head Neck Surg.* 2015;67 Supl 1:67-73. DOI: <https://doi.org/10.1007/s12070-014-0765-8>
9. Gundewar S, Kothari DS, Mokal NJ, Ghalme A. Osteomas of the craniofacial region: a case series and review of literature. *Indian J Plast Surg.* 2013;46(3):479-85. DOI: <https://doi.org/10.4103/0970-0358.121982>
10. Petur G, Rosenberg AE. Update on bone forming tumors of the head and neck. *Head Neck Pathol.* 2007;1:87-93. DOI: <https://doi.org/10.1007/s12105-007-0023-4>
11. Jones AC, Prihoda TJ, Kacher JE, Odingo NA, Freedman PD. Osteoblastoma of the maxilla and mandible: a report of 24 cases, review of the literature, and discussion of its relationship to osteoid osteoma of the jaws. *Oral and maxillo pat.* 2006;102(5):639-50. DOI: <https://doi.org/10.1016/j.tripleo.2005.09.004>
12. Jaffe HL. Benign osteoblastoma. *Bull Hosp Joint Dis.* 1956 [access 24/11/2020];17(2):141-51. Available at: <https://pubmed.ncbi.nlm.nih.gov/13413389/>
13. Lichtenstein L. Benign osteoblastoma; a category of osteoid-and bone-forming tumors other than classical osteoid osteoma, which may be mistaken for giant-cell tumor or osteogenic sarcoma. *Cancer.* 1956;9(5):1044-52. DOI: [https://doi.org/10.1002/1097-0142\(195609/10\)9:5%3C1044::AID-CNCR2820090523%3E3.0.CO;2-O](https://doi.org/10.1002/1097-0142(195609/10)9:5%3C1044::AID-CNCR2820090523%3E3.0.CO;2-O)
14. Tröbs RB, Mader E, Friedrich T, Bennek J. Oral tumors and tumor-like lesions in infants and children. *Pediatr Surg Int.* 2003;19:639-45. DOI: <https://doi.org/10.1007/s00383-003-0983-8>
15. Mashhadi F, Moharamkhani V, Housh-mand B, Chaghazardi S, SepidehA. Prevalence of peripheral soft connective tissue lesions in patients referred to pathology department of Shahid Beheshti dental school, 1981-2006. *J Mashhad Dent Sch.* 2008 [access 24/11/2020];26(1):79-84. Available at: <https://www.sid.ir/paper/22135/en>
16. Neville BW, Damm DD, Allen CM, Bouquot JE. *Oral and maxillofacial pathology.* Philadelphia, EE.UU: WB Saunders; 2002. p. 574-8.

17. Regezi JA, Sciubba JJ. Oral pathology clinical pathologic correlations. Philadelphia, EE.UU: WB Saunders; 1999. p. 397-404.
18. Patel SG, Meyers P, Huvos AG, Wolden S, Singh B, Shaha AR, *et al.* Improved outcomes in patients with osteogenic sarcoma of the head and neck. *Cancer*. 2002; 95(7):1495-503. DOI: <https://doi.org/10.1002/cncr.10849>
19. Azizi T, Motamedi MHK, Jafari SM. Gnathic osteosarcomas: a 10-year multi-center demographic study. *Indian J Cancer*. 2009;46(3):231-3. DOI: <https://doi.org/10.4103/0019-509X.52958>
20. Nissanka EH, Amaratunge EA, Tilakaratne WM. Clinicopathological analysis of osteosarcoma of jaw bones. *Oral Dis* 2007;13(1):82-7. DOI: <https://doi.org/10.1111/j.1601-0825.2006.01251.x>
21. Olubemiga M, Folake O, Lanre W, Ladipo A, James O. Osteogenic sarcoma of the jaw bones: a single institution experience over a 21-year period. *Oral and maxillo pat*. 2006; 101(1):76-81. DOI: <https://doi.org/10.1016/j.tripleo.2005.03.035>
22. Jasnau S, Meyer U, Potratz J, Jundt G, Kevric M, Joos UK, *et al.* Craniofacial osteosarcoma. Experience of the cooperative German-Austrian-Swiss osteosarcoma study group. *Oral Oncol* 2008;44(3):286-94. DOI: <https://doi.org/10.1016/j.oraloncology.2007.03.001>
23. Baumhoer D, Brunner P, Eppenberger-Castori S, Smida J, Nathrath M, Jundt G. Osteosarcomas of the jaws differ from their peripheral counterparts and require a distinct treatment approach. Experiences from the DOESAK Registry. *Oral Oncol*. 2014;50(2):147-53. DOI: <https://doi.org/10.1016/j.oraloncology.2013.10.017>
24. El Kordy MA, El Baradie TS, El Sebai HI, Amin AAE, Khair SM. Osteosarcoma of the jaw: challenges in the diagnosis and treatment. *J Egypt Natl Canc Inst*. 2018; 30(1):7-11. DOI: <https://doi.org/10.1016/j.jnci.2018.02.001>
25. Etemad-Moghadam S, Tirgary F, Keshavarz S, Alaeddini M. Head and neck non-Hodgkin's lymphoma: a 20-year demographic study of 381 cases. *Int J Oral Maxillofac. Surg*. 2010; 39(9):869-72. DOI: <https://doi.org/10.1016/j.ijom.2010.03.029>
26. Urquhart A, Berg R. Hodgkin's and non-Hodgkin's lymphoma of the head and neck. *Laryngoscope*. 2001;111(9):1565-9. DOI: <https://doi.org/10.1097/00005537-200109000-00013>

27. Pazoki A, Jansisyanont P, Ord RA. Primary non-Hodgkin's lymphoma of the jaws: report of 4 cases and review of the literature. *J. Oral Maxillofac. Surg.* 2003;61(1):112-7. DOI: <https://doi.org/10.1053/joms.2003.50018>
28. Chittemsetti S, Guttikonda VR, Sravya T, Manchikatla PK. Solitary plasmacytoma of mandible: a rare entity. *J Oral Maxillofac Pathol.* 2019;23(1):136-9. DOI: https://doi.org/10.4103%2Fjomfp.JOMFP_175_18
29. Venkatesulu B, Mallick S, Giridhar P, Upadhyay AD, Rath GK. Pattern of care and impact of prognostic factors on the outcome of head and neck extramedullary plasmacytoma: a systematic review and individual patient data analysis of 315 cases. *Eur. Arch. Oto-Rhino-L* 2017;275;595-606. DOI: <https://doi.org/10.1007/s00405-017-4817-z>
30. Liu Y, Li K. Solitary plasmacytoma of maxillofacial bones: correlation of CT features with pathological findings. *BIR.* 2020;49(1):20190277. DOI: <https://doi.org/10.1259/dmfr.20190277>
31. Shaigany K, Fang CH, Patel TD, Park RC, Baredes S, Eloy JA. A population-based analysis of head and neck hemangiopericytoma. *Laryngoscope.* 2015;126(3):643-50. DOI: <https://doi.org/10.1002/lary.25681>
32. Rajendran A, Sivapathasundharam B. *Shafer's Textbook of Oral Pathology.* New Delhi, India: Elsevier; 2009.
33. Wushou A, Miao XC, Shao ZM. Treatment outcome and prognostic factors of head and neck hemangiopericytoma: meta-analysis. *Head Neck.* 2015;37(11):1685-90. DOI: <https://doi.org/10.1002/hed.23812>