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DIAGNOSTIC ACCURACY OF FINE NEEDLE ASPIRATION CYTOLOGY COMPARED TO HISTOPATHOLOGY IN SALIVARY GLAND SWELLINGS.

General Surgery

Dr. Nowshad.M Associate professor surgery Travancore medical college, kollam

Dr. C.V.Rajendran Additional professor, Department of surgery, Government medical college, Trivandrum - Corresponding author

ABSTRACT

Background A swelling arising from the salivary glands poses a diagnostic challenge to the surgeon. A definite preoperative diagnosis is helpful in better treatment planning, including the type of operation and post operative treatment. Fine-needle aspiration helps in reaching a preoperative diagnosis. The results of this investigation vary from institution to institution and depend on the skill of the cytopathologists. Our study aims to compare the diagnostic accuracy of fine-needle aspiration to final post operative histopathological report.

Methods We conducted this study at the department of surgery, government medical college Trivandrum in accordance with the declaration of Helsinki. We collected informed consent from all patients who participated in this observational study. We excluded patients with recurrent swellings, skin infiltrations and previous history of irradiation from the study. Fine-needle aspiration was done in a standardize manner by the cytopathologists. There after the smears were studied in detail. Patients were operated based upon the FNAC results if indicated. The decision to operate was taken by the attending surgeon. Histopathological reports were collected from the pathology department. All statistical analyses were carried out in R statistical software.

Results More than 60 % of patients in this study comprising of 122 patients were males. The age of the patients ranged from 14 to 72 years. Pleomorphic adenoma was present in 36(29.5%) of the study sample. Chronic sialadenitis constituted 32(2.2%) of the patients. Among the 122 patients, where FNAC was done, only 104 underwent surgery. The remaining 12 were treated conservatively. 4 did not come for follow up and two refused surgery. The post-operative histopathological report collected from the department of pathology revealed benign tumors in 49(47.2%) patients, chronic sialadenitis in 31(29.8%),malignant malignant tumors in 15(14.4%).In In this study group, out of the total 16 malignant tumours, 11 were diagnosed by FNAC (True Positive), 63 were diagnosed as benign (True negative), 72 were predicted as benign (Predicted negative), 15 were predicted as malignant (Predicted positive) by FNAC. The sensitivity was 73%(44-92) and specificity 71(61-80)

Discussion We assessed the diagnostic accuracy of FNAC with respect to postoperative histopathological diagnosis in patients operated for salivary gland swellings. This result showed that the diagnostic accuracy of FNAC in our institution is comparable to other results in the literature. Moreover , it showed FNAC can help in better decision making and treatment planning. FNAC with its marked diagnostic significance helps in the better management of salivary gland swellings. The diagnostic accuracy and specificity can be improved by the experience of the cytopathologist and refinement of technique. So it is a cost effective investigative modality. It has an important role in altering the management of salivary gland swellings, especially in those which are clinically benign and cytology showing malignancy and viceversa.

KEYWORDS:

salivary gland tumours, parotid tumours, pleomorphic adenoma, FNAC, histopathology, minor salivary gland swelling.

Introduction

Approximately 80-85% of all salivary gland neoplasms occurs in the parotid gland[1]. Although 80% of these are considered benign, earlier reports indicated a high recurrence rate after limited excision[2,3]. This has lead to a more aggressive approach to the treatment of these leasions in the recent years under the form of either subtotal or total conservative parotidectomy with excellent results[4-6]. A swelling over the region of the major salivary glands poses a number of diagnostic and therapeutic problems[7,8]. A preoperative histological diagnosis is very useful in management of salivary gland swellings[9,10].

Neoplasms of salivary gland are an interesting diverse group of tumours[11]. They form a fascinating subject for the head and neck surgeons[12]. The relative infrequency combined with considerable histologic and behavioural diversities and their regional anatomic relationship make them unusually interesting and challenging. The parotid tumours are more so because of their intimate relationship to the facial nerve, the presence of intra and para parotid lymph nodes and the presence of a deep lobe.[13-15]

The varied clinical presentation, biological activity, diagnostic difficulties and anatomic relations complicate the management16. Surgery is the prime mode of treatment. Radiation and chemotherapy play a significant role in the control and palliation of malignant tumours of the salivary glands[17-19] . As a result preoperative diagnosis of the condition is of paramount importance in better treatment planning and further follow up. Histopathological analysis has been revolutionized by the introduction of Fine needle aspiration cytology. Fine needle aspiration cytology has proven to be a very important diagnostic tool. Place of open biopsy is reduced to a minimum on these days. FNAC is more acceptable to the patient, surgeon and the pathologist because of its easy technique, reliability, less morbidity, less cost and low incidence of complications[20,21]The credibility of FNAC depends on the technique of obtaining smears and accuracy of interpretation [22]. The former requires special skills and the latter depends on the experience of the cytopathologist. The variability of the results require standardisation[23].

The present study is an attempt to assess the diagnostic accuracy of FNAC and its role in changing the treatment of salivary gland leasions seen in patients at Medical College Hospital, Trivandrum.

Materials and methods

Only those patients who gave written informed consent were included in the study. We conducted this study satisfying the criteria given in the declaration of Helsinki. All patients had the freedom to withdraw from the study at the part of the study.

The study subjects were those patients presented to the outpatient department with salivary gland swellings. Before conducting the study, we had done a formal sample size calculation. All those patients with recurrent swellings and with skin infiltrations were not considered for the study. In addition, patients with previous history of neck irradiation were excluded from the study.

A thorough history and clinical examination was attempted in all patients. A formal clinical diagnosis was arrived at. Thereafter, fine needle aspiration cytology was ordered in all patients with clinical diagnosis of salivary gland swelling or with feature suggestive of salivary gland swellings from the imaging studies. Using a 22 or 23 G needle, FNAC was done in all patients using a standardized procedure as being practiced in our institution by the residents in the pathology department [24-27]. Strict adherence to the protocol was maintained in all steps of the procedure. Smears prepared were fixed in standard solutions and studied. The cytological diagnosis like chronic sialadenitis,pleomorphic adenoma,warthin's tumors,monomorphic adenoma, adenoid cystic carcinoma, mucoepidermoid carcinoma and acinic cell carcinoma were reported. A scanty cellular smear or drying artifact making interpretation difficult was reported as inadequate. The cytology specimens were review by two independent pathologist

before arriving at the diagnosis.

Most of the patients included in the study were offered surgical treatment if needed as per the cytological diagnosis. Decision to operate or otherwise was taken by the concerned unit chief as per the unit protocols.

We have included all basic demographic variables in the study. Various cytological characteristics, FNAC diagnosis, clinical diagnosis, imaging studies were abstracted in addition to clinical and examination findings.

A pretested case report form was used to abstract data. We later used an excel based database to collect the data from the case report form for further analysis. Confidentiality of the patients were maintained during all phases of the study. We took enough precaution to ensure that no personal identifiers were collected in the data collection phase.

Two independent cytopathologists separately studied in detail the FNAC specimen and reported the finding in a standardized approach.

We used graphpad Instat and R statistical software for all statistical analysis of this study. Summary statistics were reported as mean and standard deviation and categorical variables as percentages.

Results

During the two-year period from March 1996 to March 1998, fine needle aspiration cytology was done on 122 patients. The majority of the patients who underwent FNAC of salivary glands were males. The age of the patients in this study ranged from 14 to 72 years. The FNAC results showed polymorphic adenoma as the most frequently occurred histopathological diagnosis. Polymorphic adenoma was present in 36(29.5%) of the study sample. Chronic sialadenitis constituted 32(26,2%) of the patients. In 15(12.3%) patients, cytopathological report was warthin's tumor. Mucoepidermoid tumor was present as per the FNAC report in 12(9.8) patients. Acinic and squamous-cell carcinoma constituted1(0.8%) each only. In our study, cytological report was inconclusive in 24(19.7%) specimens.

Among the 122 patients, where FNAC was done, only 104 underwent surgery. The remaining 12 were treated conservatively, 4 did not come for follow up and 2 refused surgery. The post-operative histopat hological report collected from the department of pathology revealed benign tumors in 49(47.2%) patients, chronic sialadenitis in 31(29.8%),malignant tumors in 15(14.4%). There was one metastatic tumor in the histopathological report. The remaining 8(7.7%) included atypical diagnosis like reactive lymph node in three patients, non specific cysts in 2 , lipomas in 2 and tuberculous lymph node in one patient. In the 49 benign tumors, majority was polymorphic adenoma with 35(71.4%) histopathological proven diagnosis. In 13(26.5%) patients, the histopathological diagnosis was warthin's tumor. One(2%) patients with a rare diagnosis of monomorphic adenoma. Among the 16 cases diagnosed as malignant tumours, only one was a metastatic tumor. Mucoepidermoid carcinoma constituted the most frequent diagnosis. Ten cases(62.5) cases were diagnosed as mucoepidermoid carcinoma. There were two (12.5%) carcinoma in polymorphic adenoma and acinic cell carcinomas. Adenoid cystic carcinoma occurred in only one patient.

The comparisons of FNAC results and histopathological report of 104 operated cases are given in table1.

Table 1: Cytological and histopathological features of operated cases.

diagnosis	FNAC N=104	HISTOPATHOLOGY N=104
Chronic sialadenitis	26 (25%)	22(71%)
Pleomorphic adenoma	36(29.5%)	1(33.6%)
Warthin's tumour	13(12.3%)	13(12.5%)
Monomorphic adenoma	1(0.8%)	1(0.9%)
Mucoepidermoid tumour	12(9.8%)	10(9.2%)
Acinic cell carcninoma	1(0.8%)	2(1.9%)
Squamous cell carcinoma	1(0.8%)	1(0.9%)
Inconclusive/others	24(19.7%)	8(7.6%)
Adenoid cystic carcinoma	0	1(0.9%)
Carcinoma in pleomorphic carcinoma	0	2(1.9%)

In all the 22 cases correctly diagnosed as chronic sialadenitis, FNAC showed smears with benign acinar and ductal cells and the background showing sheets of lymphocytes, macrophages or neutrophils.

In one case misinterpreted as pleomorphic adenoma, there were monolayered sheets of ductal cells in a background of lymphocytes. In some areas, cells with squamoid appearance were seen. In the case misinterpreted as Warthin's tumour the background showed amorphous and granular debris with sheets of lymphocytes. The smear showed sheets of oncocytic cells.

In the case reported as mucoepidermoid, showed a cellular smear with squamous cells, glandular cells, overlapping epithelial cells and intermediate cells.

All the 4 cases misdiagnosed as chronic sialadenitis on FNAC showed sheets of lymphocytes in a dirty background. The smears of all 29 cases diagnosed correctly as pleomorphic adenoma on FNAC were cellular and showed a biphasic population of tightly cohesive flat clusters of cells with tubular and irregular configurations. The clusters of cells were with eosinophilic cytoplasm and regular uniform nuclei. Plasma cystoid cells were also present. The background showed stellate cells or spindle cells in a chondromyxoid background with bare nuclei.

The FNAC smear of the case diagnosed as carcinoma in pleomorphic adenoma showed large cell clusters having pleomorphism and vesicular nuclei with prominent nucleoli. The FNAC smear of the case diagnosed as chronic sialadenitis showed a cluster of lymphocytes and polymorphs. The smear in the case diagnosed as Warthin's tumour showed cells with oncocytic features such as cosinophilic granular cytoplam with centrally placed nucleus. The smear of the case diagnosed as pleomorphic adenoma showed mild to moderate cellularity. The epithelial cells were arranged in clusters. The background had scattered lymphocytes.10 cases were diagnosed as mucoepidermoid on histopathological.The FNAC smear of the cases of mucoepidermoid tumour showed squamous calls, glandular cells, intermediate cells and over lapping epithelial cells. 13 cases were reported as Warthin's tumour on histopathological examination.The FNAC smear of the 11 cases diagnosed correctly as Warthin's tumour showed sheets of oncocytes in a background of cellular debris and lymphocytes. One case was misdiagnosed as mucoepidermoid carcinoma which showed, cells arranged in clusters of same type with granular cytoplasm and round nuclei. The cells showed little amount of pleomorphism. 13 cases were diagnosed as Warthin's tumour on FNAC.The FNAC smear of the 2 cases diagnosed as chronic sialadenitis on histopathology, showed acini with oncocytic change in a background of lymphocytes and neutrophils. Of the two cases of acinic cell tumour one was diagnosed on FNAC. The smear showed cluster of cells with basophilic granular cytoplasm and central nucleus with nucleoli. In the other one, the aspiration smear was inadequate. Among the 104 histologically confirmed cases, There were 16 malignant leasions and 88 benign leasions diagnosed by histology. The 88 benign leasions include 35 pleomorphic adenomas, 31 chronic sial adenitis, 13 warthin's tumour,1 monomorphic adenoma and 8 other benign leasions. Of the 16 malignant leasions there were 10 mucoepidermoid carcinomas, 2 carcinoma in pleomorphic adenoma, 2 acinic cell tumours, 1 adenoid cystic carcinoma and 1 metastatic squamous cell carcinoma.

In this study group, out of the total 16 malignant tumours, 11 were diagnosed by FNAC (True Positive), 63 were diagnosed as benign (True negative), 72 were predicted as benign (Predicted negative), 15 were predicted as malignant (Predicted positive) by FNAC.

The diagnostic accuracy with 95% confidence interval is given in table 2. Fishers exact test was used to find the statistical signifi cance (p=0.002)

Table 2: Diagnostic accuracy of FNAC versus histopathology. Point estimateConfidence interval

	Point estimate	Confidence interval
Prevalence	0.146	0.084-0.229
Sensitivity	0.733	0.449-0.922
Specificity	0.716	0.61-0.807
Positive predictive value	0.306	0.163-0.481

Negative predictive value	0.94	0.854-0.983
Positive likelihood ratio	2.581	1.645-4.051
Negative likelihood ratio	0.372	0.159-0.871

Discussion

In this study, we sought to find out the diagnostic accuracy of FNAC compared to the gold standard of histopathological diagnosis in patients with salivary gland swellings who underwent appropriate surgical intervention based on fine needle aspiration cytology findings. The sensitivity and diagnostic accuracy of FNAC vary in different centres based on the expertise of the cytopathologist, and the techniques employed. In 1970, Enroth and Zajicek in their study had a sensitivity of 64%28. In this study the sensitivity for diagnosing malignancy was 62.5%. Sismarius et all (1981) in their study, had a sensitivity of 85% and a diagnostic accuracy of 92%. David et AL in 1992 did his study in a community hospital setting [29]. He had a diagnostic accuracy of 74.2%. The major contribution to this field is from the Stockholm Radiumhemmet group who have since 1964 published a series of papers[30,31]. Their cytological accuracy has improved over the last few years.in our study,the sensitivity was 73 percent. This compares with other studies mentioned above. In most of the studies sensitivity ranged from 62 to 97 percent.

Enlargement of submandibular salivary gland is possible to differentiate from enlarged submandibular lymphnodes. It also help to differentiate between inflammatory conditions and salivary gland tumours.

The prime role of FNAC, is as a diagnostic tool that help in the evaluation of salivary gland masses and not as a histologic procedure on which operative decisions can be wholly based on. The other investigations like holography ,CT and CT sialography are expensive alternatives to cost effective FNAC. Though there were reports of tumor cells seedling in the needle tract, various studies like in Engzell et all reported no recurrence at skin or needle tract [32,33].

Frable also did not find any implantation in his study series. Dissemination of tumour cells by vascular channels is a potential danger. But practically it is not seen (Young et a159).

Before 1963 the diagnostic accuracy of FNAC for malignant tumours was only 31%. The earlier workers found it difficult to diagnose adenolymphoma by FNAC. Nuclear atypia common in oncocytes was considered as evidence of malignancy. The presence of bare nuclei and foamy or granular cytoplasm characteristic of acinic cell tumours should not be confused with oncocytomas.

The cellular atypia seen in the cytological smear of pleomorphic adenoma should be observed with caution. Only when, the smear contain many tumour cells with cytological features of malignancy, a diagnosis of malignant mixed tumour is justified. The basal cell adenoma is difficult to distinguish from adenoid cystic carcinoma. The majority of adenoid cystic carcinoma have globules or cylinders of hyaline material. In poorly differentiated adenoid cystic carcinoma the nuclei are larger with prominent nucleoli and coarse chromatin pattern. Well differentiated mucoepidermoid tumours produce no problems in diagnosis [34]. But high grade or poorly differentiated tumours may be difficult to diagnose and they are misdiagnosed as poorly differentiated squamous cell carcinoma. If there is a cystic tumour, the aspiration yield only mucus material and so diagnosis becomes difficult.

For most of the benign tumours, the recommended surgical treatment is wide local excision with an adequate margin of normal gland tissue, except when subtotal or total conservative parotidectomy is required because of the size or location of the tumour. The facial nerve should be visualised and preserved. This approach prevents recurrence and minimises the facial nerve injury since the risk of neural injury increases with the extent of surgical procedures. Acinic cell carcinoma or low grade mucoepidermoid carcinoma necessitates the removal of the remaining gland. Aenoid cystic carcinoma of parotid necessitates removal of the entire gland and partial resection of facial nerve. High grade malignancy necessitates cervical block dissection. Lay Field et al have recommended a limited resection of leasions which show high cellularity with mild to moderate epithelial atypia, followed by a frozen section analysis [35]. The cystic leasions with abundant mucus material and scanty cellularity may be mucoepidermoid carcinoma, pleomorphic adenoma or adenoid cystic carcinoma, benign cysts or Warthin's tumour. Multiple aspirations are required to prevent false-negative reports.

The decisions regarding the need for facial nerve sacrifice depend up on the clinical findings, peroperative findings and the extent of tumour. But if the cytological report gives suspicion of malignancy, it may help both the surgeon and the patient, mentally prepare for the possibility of sacrificing facial nerve. The surgeon can also think of the rehabilitative measures with the nerve graft[36,37].

In cases where a malignant leasion is suspected clinically (based on pain of the swelling, rapid growth of the tumour, and on examination hard and nodular swelling with or without facial nerve involvement), an FNAC is done. If the FNAC is positive for malignancy, then a radical procedure may be done. But, if FNAC done is negative for malignancy, then the FNAC should be repeated. If the repeated FNAC also turned out to be negative, then the surgical option should be restricted to superficial parotidectomy or submandibular sialad enectomy.

Even though, rare complications like small haematomas have been reported, there were no complications in the series.

Fine needle aspiration cytology has marked diagnostic significance in management of salivary gland swellings. It improves the management of salivary gland swellings positively. The diagnostic accuracy and specificity can be improved with the experience of the cytopathologist and refinement of technique. So it is a cost effective investigative modality. It has an important role in altering the management of salivary gland swellings, especially in those which are clinically benign and cytology showing malignancy and viceversa.

Reference

1. Pinkston JA, Cole P. Incidence rates of salivary gland tumors: results from a population-based study. Otolaryngology-Head and Neck Surgery 1999; 120(6): 834-40.
2. Spiro RH. Salivary neoplasms: Overview of a 35-year experience with 2,807 patients. Head & neck surgery 1986; 8(3): 177-84.
3. Eveson J, Cawson R. Salivary gland tumours. A review of 2410 cases with particular reference to histological types, site, age and sex distribution. The Journal of pathology 1985; 146(1): 51-8.
4. Lombardi D, McGurk M, Vander Poorten V, et al. Surgical treatment of salivary malignant tumors. Oral oncology 2017; 65: 102-13.
5. Salgado LR, Spratt DE, Riaz N, et al. Radiation therapy in the treatment of minor salivary gland tumors. American journal of clinical oncology 2014; 37(5): 492.
6. Olsen KD, Moore EJ. Deep lobe parotidectomy: clinical rationale in the management of primary and metastatic cancer. European Archives of Oto-Rhino-Laryngology 2014; 271(5): 1181-5.
7. Bialek EJ, Jakubowski W, Zajkowski P, Szopinski KT, Osmolski A. US of the Major Salivary Glands: Anatomy and Spatial Relationships, Pathologic Conditions, and Pitfalls 1. Radiographics 2006; 26(3): 745-63.
8. Spiro RH, Huvos AG, Strong EW. Cancer of the parotid gland: a clinicopathologic study of 288 primary cases. The American Journal of Surgery 1975; 130(4): 452-9.
9. Das DK, Petkar MA, Al-Mane NM, Sheikh ZA, Mallik MK, Anim JT. Role of fine needle aspiration cytology in the diagnosis of swellings in the salivary gland regions: a study of 712 cases. Medical Principles and Practice 2004; 13(2): 95-106.
10. Sismanis A, Merriam JM, Kline TS, Davis RK, Shapshay SM, Strong MS. Diagnosis of salivary gland tumors by fine needle aspiration biopsy. Head & neck surgery 1981; 3(6): 482-8.
11. Speight P, Barrett A. Salivary gland tumours. Oral diseases 2002; 8(5): 229-40.
12. Conley JJ. Salivary glands and the facial nerve: Grune & Stratton; 1975.
13. Perzik SL. Parotidectomy for inflammatory lesions. The American Journal of Surgery 1961; 102(6): 769-76.
14. Carlson ER, Ord RA. Salivary Gland Pathology: Diagnosis and Management: John Wiley & Sons; 2015.
15. Moore EJ, Olsen KD. Total parotidectomy. Salivary Gland Disorders: Springer; 2007: 247-66.
16. Foote FW, Frazell EL. Tumors of the major salivary glands: National Academies; 1954.
17. Mason DK, Chisholm DM. Salivary glands in health and disease: WB Saunders Company; 1975.
18. Armstrong JG, Harrison LB, Spiro RH, Fass DE, Strong EW, Fuks ZY. Malignant tumors of major salivary gland origin: a matched-pair analysis of the role of combined surgery and postoperative radiotherapy. Archives of Otolaryngology–Head & Neck Surgery 1990; 116(3): 290-3.
19. North CA, Lee D-J, Piantadosi S, Zahurak M, Johns ME. Carcinoma of the major salivary glands treated by surgery or surgery plus postoperative radiotherapy. International Journal of Radiation Oncology* Biology* Physics 1990; 18(6): 1319-26.
20. Ashraf A, Shaikh AS, Kamal F, Sarfraz R, Bukhari MH. Diagnostic reliability of FNAC for salivary gland swellings: a comparative study. Diagn Cytopathol 2010; 38(7): 499-504.
21. Huq AH, Aktaruzzaman M, Habib MA, Islam MS, Amin AS. A comparative study between fine needle aspiration cytology findings and histopathological report of major salivary gland neoplasm in a tertiary hospital of Bangladesh. Bangladesh Med Res Counc Bull 2013; 39(2): 69-73.
22. Shambayati B. Cytopathology: Oxford University Press; 2011.
23. Allen DC, Cameron IR. Histopathology specimens: clinical, pathological and laboratory aspects: Springer Science & Business Media; 2012.
24. Rajwanshi A, Gupta K, Gupta N, et al. Fine-needle aspiration cytology of salivary glands: Diagnostic pitfalls—revisited. Diagnostic cytopathology 2006; 34(8): 580-4.
25. Lioe T, Elliott H, Allen D, Spence R. The role of fine needle aspiration cytology (FNAC) in the investigation of superficial lymphadenopathy; uses and limitations of the technique. Cytopathology : official journal of the British Society for Clinical Cytology 1999; 10(5): 291-7.
26. Nggada H, Khalil M. Fine Needle Aspiration Cytology [FNAC] Technique As A Diagnostic Tool Of Tumours In The University Of Maiduguri Teaching Hospital,

Nigeria. Highland Medical Research Journal 2003; 1(3): 28-30.
27. Owen E, Banerjee A, Kissin M, Kark A. Complications of parotid surgery: the need for selectivity. British journal of surgery 1989; 76(10): 1034-5.
28. Layfield LJ, Glasgow BJ. Diagnosis of salivary gland tumors by fine-needle aspiration cytology: A review of clinical utility and pitfalls. Diagnostic cytopathology 1991; 7(3): 267-72.
29. Pitts DB, Hilsinger RL, Karandy E, Ross JC, Caro JE. Fine-needle aspiration in the diagnosis of salivary gland disorders in the community hospital setting. Archives of Otolaryngology–Head & Neck Surgery 1992; 118(5): 479-82.
30. Cardillo M. Salivary gland masses: the diagnostic value of fine-needle aspiration cytology. Archives d'anatomie et de cytologie pathologiques 1989; 38(1-2): 26-32.
31. Cardillo M. Ag-NOR technique in fine needle aspiration cytology of salivary gland masses. Acta cytologica 1991; 36(2): 147-51.
32. Engzell U, Esposti PL, Rubio C, Sigurdson A, Zajicek J. Investigation on tumour spread in connection with aspiration biopsy. Acta radiologica: therapy, physics, biology 1971; 10(4): 385-98.
33. Frable MAS, Frable WJ. Fine-needle aspiration biopsy of salivary glands. The Laryngoscope 1991; 101(3): 245-9.
34. Lindberg LG, Åkerman M. Aspiration cytology of salivary gland tumors: diagnostic experience from six years of routine laboratory work. The Laryngoscope 1976; 86(4): 584-94.
35. Layfield LJ, Gopez EV. Cystic lesions of the salivary glands: cytologic features in fine-needle aspiration biopsies. Diagn Cytopathol 2002; 27(4): 197-204.
36. Shah JP, Patel SG, Singh B. Jatin Shah's Head and Neck Surgery and Oncology E-Book: Elsevier Health Sciences; 2012.
37. Plastic Surgery E-Book: Volume 3: Craniofacial, Head and Neck ... - Eduardo D Rodriguez, Joseph E Losee, Peter C. Neligan - Google Books.