Fine Needle Aspiration Cytology as a Diagnostic Tool in Parotid Swellings Among Patients Attending Khartoum Teaching Dental Hospital

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Abstract

Background/Objective: Parotid gland swellings are known of their diverse histological presentation. The tumors of this region comprise 3% of all head and neck tumors, and 0.6% of all tumors of the human body. The objective of the study was to analyse and interpret FNAC accuracy and utility for parotid swellings. *Methods:* The present study was a cross-sectional study, it was conducted at Khartoum Teaching Dental Hospital (KTDH) during a period from 2011 to 2015. Patients included in the study underwent FNAC and then subsequent surgery for the parotid mass. A comparison between FNAC and histopathological results was made. *Results:* The average age of the encountered patients was 44 years. There were 27 (49%) males and 28 (51%) females. The FNAC smear was non diagnostic in one case (1.8%). The cytological diagnosis showed that 13 cases (23.64%) were true-positive, 35 cases (63.64%) true-negative, and 6 cases (10.61%) false-negative. The accuracy in detecting malignant tumors was 88.89%, with 64.4% sensitivity, and 100% specificity. The positive and negative predictive values were 100% and 85.4% respectively. *Conclusion:* The study showed that the preoperative FNAC has an important role in the accurate diagnosis of parotid swellings. Though biopsy is the golden standard, FNAC is well tolerated, easy to perform, safe and cost effective procedure, without contraindications to its use. However FNAC may not specify types of malignancy, a factor which is important in preparing both surgeon and patient for an appropriate surgery.

1. Introduction

A lump in the salivary gland region often presents as a diagnostic challenge with regards to the site of origin and behaviour as benign or malignant. Most of salivary gland tumors occur in the parotid glands; low percentage occurs in the submandibular, sublingual, and minor salivary glands. Parotid gland lesions are of histological diverse group. Tumors of this region comprise 3% of all head and neck and 0.6% of all tumors of human body [1]. Eighty per cent of parotid tumors are benign [2, 3], while the malignancy rate for parotid tumors has been reported to be between14%-27% [4]. The traditional open biopsy is no longer justified because of the risk of tumour spillage and damage to the facial nerve [1].

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The fine needle aspiration cytology (FNAC) goes back to the 1920s where it came into use simultaneously in Europe and the United States [5,6], which is a cytodiagnostic method based on the morphological findings of individual cells, group of cells, and microparticles of tissue, acquired using a needle [7]. FNAC has its proponents and opponents. It is regarded as a diagnostic procedure to be superior to the combination of physical examination and radiological evaluation [8,9]. It is a safe diagnostic technique that is widely employed in the examination of parotid masses at relatively low cost and minimal risk to the patient. Many authors have reported FNAC as a useful diagnostic tool, with documented accuracy rates ranging from 79% to 98% for the large and diverse group of neoplastic and inflammatory lesions involving the parotid gland [10-14]. It can also be performed in children older than seven years [15].

FNAC as procedure has an advantages with minimal incidence of complications. The complications are rare and bleeding or inflammatory reaction in the region of the puncture, and the impairment of the involved nerves has been reported as a very rare complication [16, 17]. It has little influence on the clinical management since most of the parotid masses ultimately require surgery [18]. This point of view ignores a considerable number of benign salivary tumors that do not necessitate surgery.

In spite of the distinct morphology of parotid gland, the effectiveness of FNAC interpretation considered controversial and it's use just helps to distinguish between reactive inflammatory process and neoplastic lesions [7].In the last few years the cases of parotid tumors that have been presented KTDH were on increase. There is no obvious data focusing on the experience of using FNAC in the preoperative evaluation of parotid lesions. The information regarding the accuracy and utility of FNA for parotid swellings at KTDH is still limited. In this study, the author was seeked to analyse and interpret FNA accuracy and utility for parotid swellings from a clinical perspective.

2. Materials and Methods

The study was carried out at KTDH, Oral and maxillofacial surgery department & Prof. Ahmed Sulaiman's labrotary of histopathology, Faculty of Dentistry, Khartoum.

The population for this study was all patients with parotid swelling who attended to the study area during the period from 2011 to 2015. The exclusion criteria included patient who refused to participate in the study, previously treated patients by irradiation, and patient with recurrence.

Data information sheet includes age, sex, clinical features of parotid swelling, FNAC result, histopathological result and FNA complications.

Data were entered in a computer master sheet using SPSS version 20. All statistical analysis was set at 95% confidence level, level of significance 0.05. The main dependent variables was the FNA biopsy result and excisional biopsy result while the independent variables was the age (continuous in years), gender and clinical features of the parotids welling. The procedure began by taking the history from patients who came to the clinic with parotid swelling, then clinical examination has carried out, then the following investigations were requested (FNAC was taken by histopathologist after evaluation of CT with contrast or MRI), then patients were operated under G.A and excisional biopsy sent for histopathological confirmation, and finally comparing between FNA results and histopathological results.

FNAC procedure: 23 guaze fine needle with 20 cc syringe and using the aspiration gun (needle holder) to secure single hand aspiration, the needle introduced into the swelling and aspirate smeared in 6_8 slides. Two of them stained by rapid stain and examined by the cytopathologist for interpreting and reporting.

3. Results

A total sample of 55 patients with parotid gland swellings attending KTDH were selected. Gender distribution was found to be similar among study participants with 27 (49%) males and 28 (51%) females. The mean age of study participants was (44 ± 17) years old (Mean ± St.d), the youngest patient was 14 years old male and oldest patient was 88 years old female. More than half of study participants (56%) were older than 40 years, while only 5% were less than 20 years old.

The results of screening of parotid gland swellings by FNAC, showed that majority of the lesions (74.5%) were benign tumors while 23.6% were malignant tumors (Table 1). One case (1.8%) could not be diagnosed by FNAC and it was excluded from further diagnostic accuracy analysis.

Table 1. Diagnosis of parotid gland swellings using FNA among study participants.

FNA diagnosis	Frequency	Percentage
Benign	41	74.5%
Malignant	13	23.6%
Not diagnosed	1	1.8%
Total	55	100%

Diagnosis of malignancy using histo-pathological examination showed more malignant lesions constituted

34.5% of parotid gland swellings, while 65.5% of swellings found to be benign lesions (Table 2).

Table 2. Diagnosis of parotid gland swellings diagnosed histo-pathologically among study participants.

Histo-pathological diagnosis	Frequency	Percentage
Benign	36	65.5%
Malignant	19	34.5%
Total	55	100%

Typing of parotid gland swelling also was done by each type of testing FNAC and histo-pathological examination. In FNAC, the most common swelling type was pleomorphic adenoma which accounted for 43.6%, followed by sialadenitis (10.9%), sialoadenosis (7.3%), malignant lesions (7.3%), malignant carcinoma (5.5%), mucoepidermoid carcinoma (5.5%), cysts (5.5%), lymph nodes hyperplasia (1.8%), Warthin's tumor (1.8%), acinic cell carcinoma (1.8%), sarcoma (1.8%), poorly differentiated carcinoma (1.8%), monomorphic adenoma (1.8%), and non diagnostic (1.8%) (Table 3).

Table 3. Distribution of parotid gland types according to FNAC.

Swelling typing by FNAC	Frequency	Percent
Sialoadenosis	4	7.3%
Sialadenitis	6	10.9%
Pleomorphic adenoma	24	43.6%
Mucoepidermoid carcinoma	3	5.5%
Cyst	3	5.5%
Benign salivary aspirate	1	1.8%
Lymph node hyperplasia	1	1.8%
Warthin's tumor	1	1.8%
Acinic cell carcinoma	1	1.8%
Soft tissue sarcoma	1	1.8%
Malignant carcinoma	3	5.5%
Malignant lesion	4	7.3%
Poorly differentiated carcinoma	1	1.8%
Monomorphic adenoma	1	1.8%
Not diagnosed	1	1.8%
Total	55	100%

Table 4. Distribution of parotid gland types according to histo-pathological examination.

swelling typing by histo-pathological examination	Frequency	Percent
Sialoadenosis	1	1.8%
Pleomorphic adenoma	21	38.2%
Mucoepidermoid carcinoma	6	10.9%
Cyst	1	1.8%
Polycystic adenosis	1	1.8%
Mucinuscystadenoma	1	1.8%
Sialadenitis	9	16.3%
Hyperplasia	1	1.8%
Adenocarcinoma	2	3.6%
Adenoid cystic carcinoma	4	7.3%
Acinic cell carcinoma	2	3.6%
Fibrosarcoma	1	1.8%
Malignant carcinoma	1	1.8%
Poorly differentiated carcinoma	1	1.8%
Lymphoma	1	1.8%
Carcinoma expleomorphic adenoma	1	1.8%
Not diagnosed	1	1.8%
Total	55	100%

In histo-pathological examination, the most common swelling type was also pleomorphic adenoma which accounted for 38.2%, followed by sialadenitis (16.3%), mucoepidermoid carcinoma (10.9%), adenoid cystic carcinoma (7.3%) and other types of parotid gland swellings (Table 4).

Results of diagnostic accuracy of FNA:

Generally, FNAC showed 48% accuracy regarding to specific type of swelling in reference to proper histo-pathological typing. The non-diagnostic case which could not be diagnosed by FNAC was excluded from analysis (Table 5). Since the main indication for FNA is to determine malignancy status for parotid gland swellings, the measures of diagnostic accuracy were done depending on dichotomous categorization of diagnosis (either malignant or benign diagnosis). Thus, Parotid gland swellings have fallen in four categories which were True-positive (TP), False-positive (FP), True-negative (TN), and False-negative (FN) see table (6).

Table 5. Accuracy of specific swelling typing of FNAC with reference to histopathological typing (n=54).

Accuracy of specific swelling typing	Frequency	Percent
Accurate swelling typing	26	48%
Inaccurate swelling typing	28	52%
Total	54	100%

Table 6. Accuracy of FNAC in diagnosis of malignancy with reference to histopathological examination.

Diagnostic accuracy		Histopathological examination		Total
		Malignant	Benign	
FNAC	Malignant	13 (TP)	0 (FP)	13
	Benign	6 (FN)	35 (TN)	41
Total		19	35	54

Results of all diagnostic accuracy measures were shown in (Table 7) calculated with 95% confidence intervals.

Table 7. Diagnostic accuracy measures for FNAC with reference to histopathology.

Measures of diagnostic accuracy	Value	Lower C.I.	Upper C.I.
Sensitivity	64.4%	47.5%	89.3%
Specificity	100%	100%	100%
Positive Predictive Value	100%	100%	100%
Negative Predictive Value	85.4%	74.5%	96.2%
Overall accuracy	88.89%	80.5%	97.3%

4. Discussion

The role of FNAC in the diagnosis of parotid gland swellings has been well established as this is a safe and easy diagnostic procedure that causes little discomfort to the patient. The main objective of FNAC in parotid lesions is to differentiate between benign lesions and malignant tumors [10-14]. This

study was aimed to evaluate diagnostic accuracy of FNAC in reference to histopathological examination for determination of malignant parotid gland tumor.

The false-negative findings of the current study were (11%), which was obviously lower than findings described in many studies, 14 - 48% [19, 20, 21, 22]. Several false-negative findings in the current series were due to sampling errors rather than the misinterpretation of cytologic smears, most likely because the FNA was performed by clinicians. In this study, FNA performed usually in the laboratory by trained cytopathologist which subsequently reduced the false negative findings. Failure to obtain a representative sample may be the result of needle positioning outside the target tissue [23]. Low percentage of non-diagnostic samples was found in this study (only one case representing 1.8%). Low percentages of non-diagnostic smears are achieved when cytopathologists examine the smears immediately and repeat the procedure if there is inadequate material. Other studies reported similar or much higher percentages of non-diagnostic smears ranged from 1.6% - 11% in studies [7, 24, 25, 20, 26, 27].

Regarding treatment, there is some controversy as to whether FNAC does help plan treatment in parotid tumors. Some authors claim that the tissue diagnosis determines the type of surgery performed [28, 29]. In the literature, the majority of parotid gland tumors are benign usually between 75-80% [3, 30, 31].

In this study, a total of 65.5% of parotid gland swellings were benign which made a superficial parotidectomy is the procedure of choice. Although knowing the tissue diagnosis enables the surgeon to counsel the patient about their disease, it may make some authors claim that FNAC may not assist in planning surgery in the majority of cases. However a preoperative diagnosis of malignancy with FNAC is important for the surgeon for several reasons. First, it prepares the surgeon for the possibility of sub-clinical deep lobe involvement and occult cervical metastasis. Further imaging with either a computed tomography scan or magnetic resonance imaging will allow these questions to be addressed. Second, the patient can be counselled with regards to the extent of surgery, the surgical approach, the need for a neck dissection and the likelihood for nerve grafting intra-operatively [25].

In this study, the overall accuracy of FNAC in detecting malignancy of parotid gland swelling was found to be high (88.9%). This findings was similar to that in recent literature, where the overall accuracy of FNAC in detecting malignancy of parotid gland swelling was always high (more than 86%), as in studies conducted by Awan and colleagues, Ali and

colleagues, Riley and colleagues, Seethala and colleagues, Hartimath and colleagues and Zbaren and colleagues, there were 92%, 94%, 86%, 90%, 95% and 86% respectively [32, 7, 33, 34, 27, 24]. On the other side, studies by Zbaren and colleagues, and Dudheon and colleagues, have found accuracy of FNAC to be only (72%, 56%) respectively [4, 6], because they calculated accuracy level in different way. They included non-diagnostic cases during calculation of FNAC accuracy, which subsequently reduced the level of accuracy. While in this study, as well as other above mentioned studies, the non diagnostic cases were excluded from accuracy analysis of FNAC.

In current study, the sensitivity of FNAC in detecting malignant parotid gland swellings was 64.4% which was lower than that found usually in the literature [Table 8]. The reason could be a retrospective approach which has decreased the quality of data collected. Also there was no reliability assessment for cytopathologists who examined smears of parotid gland swellings. In many ways the studies in the literature are almost 'perfect world' studies. The present study tends to be more a 'real world' study. Also small sample size recruited in the present study (n=55) could contribute to some extent to the lower level of sensitivity. Most of other studies reported a sensitivity level of 80% or more, while few studies reported lower sensitivity than that level. A study conducted by Awan and colleagues, reported a low sensitivity level of 70%, which was most likely due to small sample size of only 50 patients recruited in the study [32].

Other studies (conducted by Hee and colleagues, and Zbaren and colleagues) reported low level of sensitivity 57% and 64%, although they included a large number of patients (n=169 and n=228). The reason of those lower sensitivity levels could be attributed to use of clinicians instead of pathologists in the performance of FNAC [20, 24].

Specificity of FNAC was found to be almost perfect (100%) in this study, which is consistent with high specificity levels found in the literature [7, 14, 23, 27, 32, 33, 34]. Hee and colleagues, and Lim and colleagues found also perfect level of specificity of FNAC in rolling out the possibility of malignant tumors [20, 25].

The current study found that positive predictive value (PPV) of FNAC was also perfect (100%), it is more important clinically than sensitivity and specificity. It means 100% of patients attended Khartoum Teaching Dental Hospital and tested positive (malignant) by FNAC, were actually had malignant tumors. Although PPV is more important clinically, but it is affected by the prevalence of malignancy among patients with parotid gland swellings who attended

the hospital. The prevalence of malignant tumors was found to be 34.5% of all parotid gland swellings in the current study. Most studies in the literature found level of PPV 90% or more [Table 8]. Studies found PPV less than 90% were usually characterized by lower prevalence of malignancy among their study participants; like Awan and colleague, who found PPV of 87% which could be a result of low prevalence of malignant lesions among study participants (only 20%).

Negative predictive value (NPV) was found to be 85.4% in this study, also other studies reported high levels of NPV. It means that 85.4% of patients attended KTDH and tested negative (benign) by FNAC, were actually had benign swellings. It is less affected by the prevalence of malignancy than PPV. Other studies findings of NPV were demonstrated in the table 8.

Regarding the histological typing of FNAC, it showed 48% accuracy regarding to specific type of swelling in reference to proper histological typing. Zbaren and colleagues have found that histological typing of FNAC was correct in 27 of all 88 (31%) of studied tumors [23]. The histopathological findings of this study showed that, the most common tumor type was found to be pleomorphic adenoma which accounted for 38.2%, followed by sialadenitis 16.3%, mucoepidermoid carcinoma 10.9%, adenoid cystic carcinoma 7.3% followed by other types of parotid gland swellings. Similar results reported by Ali and colleagues, reported that pleomorphic adenoma was the most common benign tumor although it constituted much higher percentage 60% of all tumors while mucoepidermoid carcinoma was the most common malignant and constituted 12% [7].

Riley and colleagues had found pleomorphic adenoma by far the highest frequent tumor comprising almost half of all tumors, and almost 85% of benign lesions. Warthin's tumor, the second commonest benign condition, accounted for 8% of the total and around 14% of the benign lesions. They found the commonest malignancy was squamous cell carcinoma, around 53% of malignancies and 19% of the total. Mucoepidermoid carcinoma was rare at 2% overall, and under 6% of malignancies [33]. Hartimath also found pleomorphic adenoma the most common parotid gland tumor 41%, mucoepidermoid carcinoma 22%, lymphadenitis 15% and then followed by tumors like Warthin's tumor, adenocystic carcinoma and chronic sialoadenitis [27].

Concerning findings of histological typing performed by FNAC, the results of this study showed consistency with results in the literature, where the most common tumor type was pleomorphic adenoma (accounted for 43.6% of all parotid gland tumor). This is in agreement with Carillo and colleagues [26], Hee and colleagues [20], Hartimath and colleagues [27], and Zaberan and colleagues [24], where the most frequent tumor was pleomorphic adenoma. The most common malignant tumor in this study was malignant lesions (7.3%) followed by malignant carcinoma (5.5%), mucoepidermoid carcinoma (5.5%). The previous studies showed different findings where lymphoma was the most common [26], metastatic squamous cell carcinoma [20], mucoepidermoid carcinoma [24, 27].

Regarding complications of FNAC, no serious complications followed FNAC among participants of the current study. In the literature, there was no evidence for serious complications due to performing FNAC. One study conducted by Ali and colleagues, reported local inflammation affected only two cases after performing of FNAC [7]. Also a unique case revealed a xanthogranulomatous inflammatory process as a result of the aspiration procedure [11]. Therefore, it is believe that FNAC has a definite role in the evaluation of parotid masses and should be incorporated as part of the holistic management in patients who present with a parotid mass. Attempts to reduce non-diagnostic and false-negative results should be considered by clinicians and pathologists.

Table 8. Diagnostic accuracy measures found in the recent literature.

Study	FNAC	Sensitivity	Specificity	PPV*	NPV**
Current study	55	64.4%	100%	100%	85.4%
Awan 2004 [32]	50	70%	97%	87%	92%
Carrillo 2009 [26]	138	92.3%	98.6%	98.4%	93.2%
Ali 2011 [7]	129	84%	98%	93%	95%
Zbaren2004 [23]	101	85%	90%	-	-
Hee 2001 [20]	169	57%	100%	-	-
Seethala 2005 [34]	220	86%	92%	-	-
Hartimath 2011 [27]	51	90.9%	96.6%	90.0%	96.7%
Lim 2007 [25]	91	80%	100%	-	-
Zbaren$_b$ 2001 [24]	228	64%	95%	83%	87%

*PPV= Positive Predictive Value
**NPV= Negative Predictive Value

5. Conclusion

FNAC, as a preoperative diagnostic technique for the malignancy of parotid gland, was considered safe, simple moderately sensitive and perfectly specific procedure. The main problem of using FNAC was the presence of false negative aspirates which could reduce the sensitivity to detect a malignant tumor. The overall accuracy of FNAC was high and it could guide the planning of surgery. The non-diagnostic and false-negative results are the limitations of FNAC that should be reduced to improve its usefulness in the evaluation of parotid swellings. The majority of parotid glands swellings were benign; pleomorphic adenoma was the commonest type, followed by sialadenitis.The mucoepidermoid carcinoma was the most common malignant tumor of the parotid gland followed by adenoid cystic carcinoma. Clinical features like old age, facial nerve deficit and ill-defined margin of parotid gland swellings increase the probability of malignancy.

Acknowledgements

References

[1] McGuirt WF, McCabe BF. Significance of node biopsy before definitive treatment of cervical metastatic carcinoma, Laryngoscope 1978;88: 594–597.

[2] Leverstein H, Vander Wal JE, Tiwari RM et al. Malignant epithelial parotid gland tumours: Analysis and results in 65 previously untreated patients. Br. J. Surg 1998; 85: 1267–72.

[3] Smith JA, Fleming WB. An approach to malignant parotid tumours. Aust. N.Z. J. Surg1989; 59: 317–20.

[4] Zbaren P, Schupbach J, Stauffer E, Greiner R, Ha¨usler R. Carcinoma of the parotid gland. Am J Surg2003;186: 57–62.

[5] Martin HE, Ellis EB. Biopsy by needle puncture and aspiration," Annals of Surgery 1930; 92: 169–181.

[6] Dudheon LS, Patrick CV. A new method for the rapid microscopical diagnosis of tumors. British Journal of Surgery 1972; 15: 250–261.

[7] Ali. N.S, et al. Diagnostic Accuracy of Fine Needle Aspiration Cytology in Parotid Lesions. Aga Khan University Hospital, Karachi Pakistan. ISRN 2011.

[8] Zurrida S, Alasio L, Tradati N, Bartoli C, Chiesa F, Pilotti S. Fine-needle aspiration of parotid masses. Cancer 1993; 72: 2306–2311.

[9] Owen EERTC, Banerjee AK, Prichard AJN, Hudson EA, Kark AE. Role of fine-needle aspiration cytology and computed tomography in the diagnosis of parotid swellings. Br J Surg 1989; 76: 1273–1274.

[10] Megerian CA, Maniglia AJ. Parotidectomy: a ten-year experience with fine needle aspiration and frozen section biopsy correlation. Ear Nose Throat J 1994; 73: 377–380.

[11] Stewart CJ, MacKenzie K, McGarry GW, Mowat A. Fine needle aspiration cytology of salivary gland: a review of 341cases. Diagn Cytopathol 2000; 22: 139–146.

[12] Chan MK, McGuire LJ, King W, et al. Cytodiagnosis of 112 salivary gland lesions. Correlation with histologic and frozen section diagnosis. ActaCytol 1992; 36: 353–363.

[13] Orell SR. Diagnostic difficulties in the interpretation of fine needle aspirates of salivary gland lesions: the problem revisited. Cytopathology 1995; 6: 285–300.

[14] Zbaren P, Guelat D, Loosli H, Stauffer E. Parotid tumours :fine-needle aspiration and/or frozen section. Otolaryngol Head Neck Surg 2008; 139: 811–815.

[15] Liu ES, Bernstein JM, Sculerati N, Wu HC. Fine needle aspiration biopsy of pediatric head and neck masses. International Journal of Pediatric Otorhinolaryngology 2001; 60: 135–140.

[16] Allen EA, Ali SZ, Mathew S. Lymphoid lesions of the parotid. Diagnostic Cytopathology 1999; 21: 170–173.

[17] Schroder U, Eckel HE, Rasche V, Arnold G, Ortmann M, Stennert E. Value of fine needle aspiration biopsy in the diagnosis of the parotid gland neoplasm. HNO2000; 48, 421_429.

[18] Batsakis JG, Sneige N, El-Naggar AK. Fine needle aspiration in salivary glands: its utility and tissue effects. Annals of Otology, Rhinology and Laryngology 1992; 101, 185–188.

[19] Wong DSY, Li GKH. The role of fine-needle aspiration cytology in the management of parotid tumours: a critical clinical appraisal. Head Neck 2000; 22: 469–473.

[20] Que Hee CG, Perry CF. Fine-needle aspiration cytology of parotid tumours: is it useful? Aust N Z J Surg. 2001; 71: 345–348.

[21] AlKhafaji BM, Nestok BR, Katz RL. Fine-needle aspiration of 154 parotid masses with histologic correlation. Cancer Cytopathology. 1998; 84(3): 153-9.

[22] Costas A, Castro P, Martın-Granizo R, Monje F, Marron C, Amigo A. Fine needle aspiration biopsy (FNAB) for lesions of the salivary glands. British Journal of Oral and Maxillofacial Surgery. 2000; 38(5): 539-42.

[23] Zbaren P,Nuyens M, Loosli H, Stauffer E. Diagnostic Accuracy Of Fine-Needle Aspiration Cytology And Frozen Section In Primary Parotid Carcinoma. Cancer2004; 100: 1876-83.

[24] Zbaren P, Schar C, Hotz MA, Loosli H. Value of fine-needle aspiration cytology of parotid gland masses. Laryngoscope 2001; 111: 1989–1992.

[25] Lim C M et al.Role Of Fine-Needle Aspiration Cytology In The Evaluation Of Parotid Tumours. ANZ J 2007;77: 742_744.

[26] Carrillo J, Ramírez R, Flores L, Ramirez-Ortega MC, Arrecillas MD, Ibarra M, et al. Diagnostic Accuracy of Fine Needle Aspiration Biopsy in Preoperative Diagnosis of Patients With Parotid Gland Masses. Journal of Surgical Oncology 2009; 100: 133–138.

[27] Hartimath B, Kudva A, Rathore AS. Role of Fine-Needle Aspiration Cytology in Swellings of the Parotid Region. Indian J Surg (January–February) 2011; 73(1): 19–23.

[28] Filopoulos E, Angeli S, Daskalopoulou D, Kelessis N, Vassilopoulos P. Pre-operative evaluation of parotid tumours by fine needle biopsy. European Journal of Surgical Oncology (EJSO). 1998; 24(3): 180-3.

[29] 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.

[30] Ball A, Fish S, Thomas JM. Malignant epithelial parotid tumours: a rational treatment policy. British journal of surgery. 1995; 82(5): 621-3.

[31] Malata C, Camilleri I, McLean N, Piggot T, Kelly C, Chippindale A, et al. Malignant tumours of the parotid gland: a 12-year review. British journal of plastic surgery. 1997; 50(8): 600-8.

[32] Awan MS, Ahmed Z. Diagnostic Value of Fine Needle Aspiration Cytology in Parotid Tumors. JPMA 2004; 54: 617.

[33] Riley N, Allison R, Stevenson S. Fine-needle aspiration cytology in parotid masses: our experience in Canterbury. New Zealand ANZ J Surg 2005; 75: 144–146.

[34] Seethala RR, LiVolsi VA, Baloch ZW. Relative accuracy of fine-needle aspiration and frozen section in the diagnosis of lesions of the parotid gland. Head Neck 2005; 27: 217–223.