Original Article

The Value of Touch Preparation for Rapid Diagnosis of Brain Tumors as an Intraoperative Consultation

Tahere Khamechian, Javad Alizargar, Tahere Mazoochi

Abstract

Background: The touch preparation technique is an accurate and rapid method, and when used as intraoperative consultation examination technique it preserves a good amount of tissue for paraffin embedded sections. This study aimed at examining the accuracy of the touch preparation technique by comparing its diagnosis with that of final pathological diagnosis made by microscopic examinations.

Methods: The diagnoses of 139 central nervous system lesions by touch preparation technique and paraffin-embedded sections were compared.

Results: Touch preparation technique diagnosed correctly 118 (84%) of the lesions. However, the technique failed to correctly diagnose 12% of the cases. The highest rate of accurate diagnosis (100%) was observed in five types out of 11 types of tumor examined. However, the technique was not able to diagnose hydatid cysts correctly.

Conclusion: The findings indicate that touch preparation technique may be useful in diagnosing tumor type during surgical operations. Touch preparation technique is very accurate for intraoperative diagnosis. However, adequate clinical history, neuroimaging details, and the intraoperative impressions of the neurosurgeons, if provided, help the pathologists to improve the diagnostic accuracy of the technique.

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Keywords ● Intraoperative ● central nervous system ● frozen sections

Introduction

Tissue specimens taken from patients during operations or biopsies are usually assessed by the pathologists one or two days after the surgery. However, sometimes pathological results are needed urgently during the operation, while the patient is still on the operation table. In neurosurgical operations the need of a rapid diagnosis during the operation can be met by intraoperative consultation examinations. During surgeries, surgeons want to particularly know whether or not a lesion is malignant. The use of touch preparation technique, known as touch preparation as an intraoperative consultation examination technique is now well established.[1-3] A good intraoperative consultation examination technique should preserve good amount of tissue for paraffin embedded sections, and should be accurate and rapid. Frozen section is another intraoperative consultation examination

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technique that needs more tissue and has some freezing artifacts.

The architecture of tissues in frozen section closely approximates permanent histology sections, and enables a degree of comfort. Touch preparation provides a better and crisp cellular details and even some tissue architecture.[4] Touch preparation has been found quite reliable and useful in the determination of surgical resection margins,[5,6] sentinel lymph nodes,[7] adenomatous goiter,[8,9] and confirmation of parathyroid tissue.[10-12] This technique has some advantages in diagnosing and differentiating brain tumors.[13-15]

Various diagnoses can be well made by an expert pathologist using touch preparation technique, because the cytomorphological features of smears in every malignant or benign lesion are specific. The objective of the present study was to evaluate four years (2007-2011) of using touch preparation technique by Shahid Beheshti Hospital pathologists to examine benefits and possible defects of the technique in determining the diagnosis of central nervous system biopsies taken during operations. The accuracy of the technique was judged against the diagnosis made by final pathological diagnosis.

Materials and Methods

This study aimed at assessing the value of diagnosis made by touch preparation technique in 2007-2011. All of the patients signed the written informed consent to include their data in the study. The study was approved by the Ethics Committee, Kashan University of Medical Sciences. Biopsies taken from lesions were grossly examined, and hemorrhagic and necrotic areas were sampled and prepared for the touch preparation technique. At least two smears were taken from each case by using two clean grease-free glass slides. The smears were fixed with absolute alcohol and were stained with geimsa and papanicolau. After the surgeries, remaining tissues were processed for paraffin-embedded sections, haematoxylin and eosin staining, and microscopic examination.

The microscopic examination of paraffin sections, and touch preparation were made blindly by two pathologists. To examine the accuracy of diagnosis by touch preparation technique, the diagnoses obtained by this technique were compared with those obtained by microscopic examination of the smears. Accurate grading was attempted in our study whenever possible. All the cases were reviewed by two pathologists separately. All the patients personal information remained private.

The findings were analyzed using Statistical Package for Social Sciences (SPSS version 16). Descriptive statistics was used to analyze the findings.

Results

During the study, 139 lesions, which had been sent for intraoperative consultation, were evaluated. These included 135 brain lesions and 2 hydatid cysts, and 2 dermoid cysts. The average patients' age was 57, and there were 70 males and 69 females. The total number tumor and correct diagnosis in touch preparation technique. Correct diagnosis was made in 118 (84%) of lesions. Errors in diagnosis were seen in 12% of lesions. The highest correlation (100%) was observed in five types of tumor, and no correct diagnosis was made in case of hydatid cyst. Oligodendrogliomas, haemangioblastoma, meningioma, choroid plexus papilloma, craniopharyngioma, megakaryocytic leukemia, and dermoid cyst were diagnosed totally (100%) correct (table 1).

Table 1: The total number of tumor and correct diagnosis in touch preparation technique

Tumors	Total cases	Correct diagnosis (%)
Oligodendroglioma grade II–III	6	6 (100)
Meningioma	15	15 (100)
Pituitary adenoma	13	11 (84)
Haemangioblastoma	3	3 (100)
Astrocytomas grade I	22	18 (81)
Astrocytomas grade II, III, IV	26	21 (80)
Glioblastoma multiforme	6	4 (66)
Metastatic carcinoma	9	6 (66)
Medulloblastoma	9	8 (88)
Choroid plexus papilloma	1	1 (100)
Schwannoma	11	10 (90)
Hydatid cyst	2	0 (0)
Craniopharyngioma	3	3 (100)
Inflammation and necrosis	4	4 (100)
Giant cell tumor	5	4 (80)
Dermoid cyst	2	2 (100)
Megakaryocytic leukemia	2	2 (100)
Total cases	139	118 (84)

The accuracy of touch preparation technique for astrocytoma, pituitary adenoma, glioblastoma multiforme, metastatic carcinoma, and giant cell tumor was 81%, 84%, 66%, 66%, 88% and 80%, respectively.

Glioblastoma multiforme was misdiagnosed twice as metastasic carcinomas, and high grade astrocytoma was misdiagnosed five times as metastasic carcinomas. Two cases of astrocytoma grade I was misdiagnosed as metastasic carcinomas, and one case of meduloblastoma was misdiagnosed as meningioma. Other misdiagnosed tumors were reported as benign or malignant microscopic results or inflammation (figure 1-6).

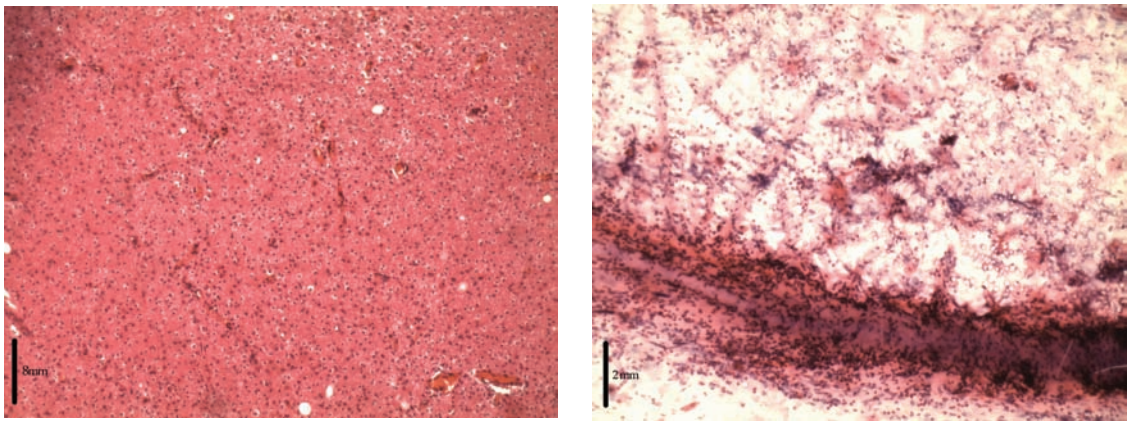

Figure 1: Low grade astrocytoma: mild nuclear pleomorphism, mild to moderate hyperchromasia, absence of mitotic activity and dyscohesive pattern, minimal derivatium in nuclear shapes. Left: permanent pathologic slide (hematoxylline eosin x10). Right: touch preparation (Geimsa ×40).

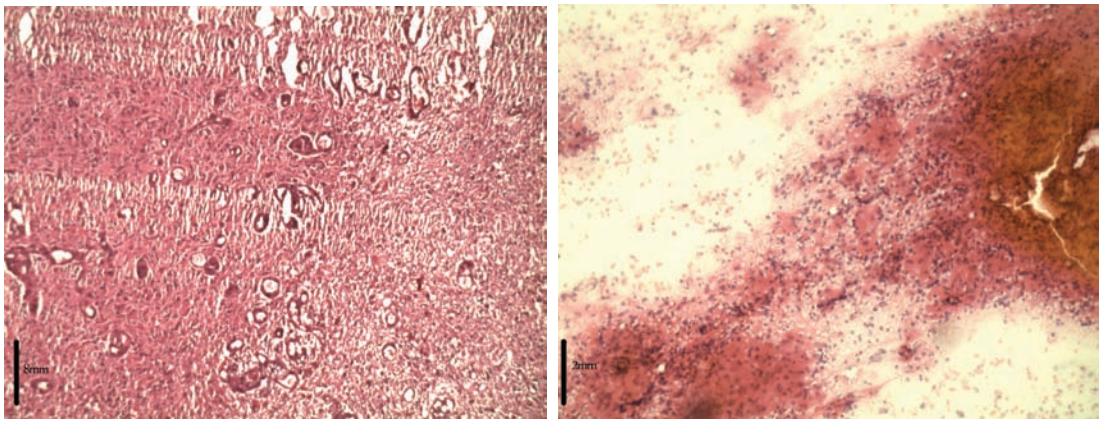

Figure 2: Glioblastoma multiform. Left: permanent pathologic slide (hematoxyllin eosinx10), anaplastic and pleomorphic cells without glial processes and endothelial hyperplasia. Right: touch preparation (papanicolau x40), pleomorphic cells and atypical nuclei.

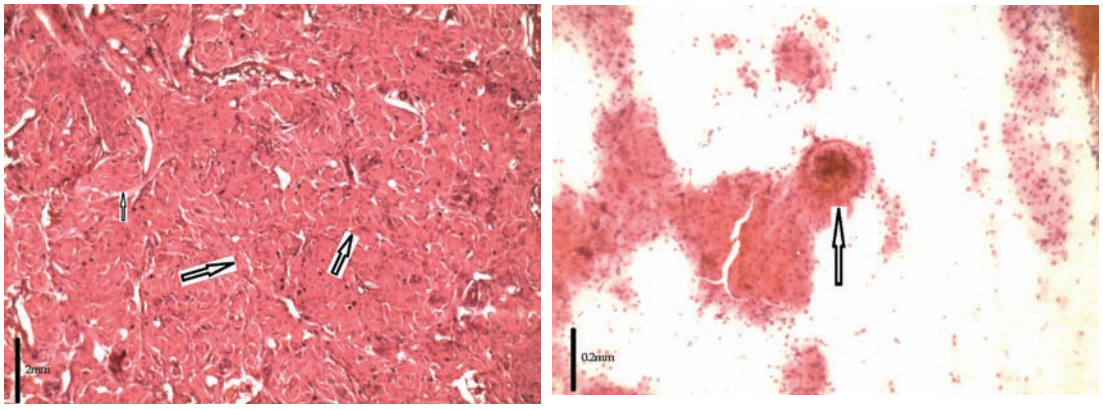

Figure 3: Meningioma: meningothelial cell proliferation with whorl formation. Left: permanent pathologic slide (hematoxyllin eosin x40), indicators show whorl formation. Right: touch preparation (papanicolau ×400), the indicator shows the whorl formation.

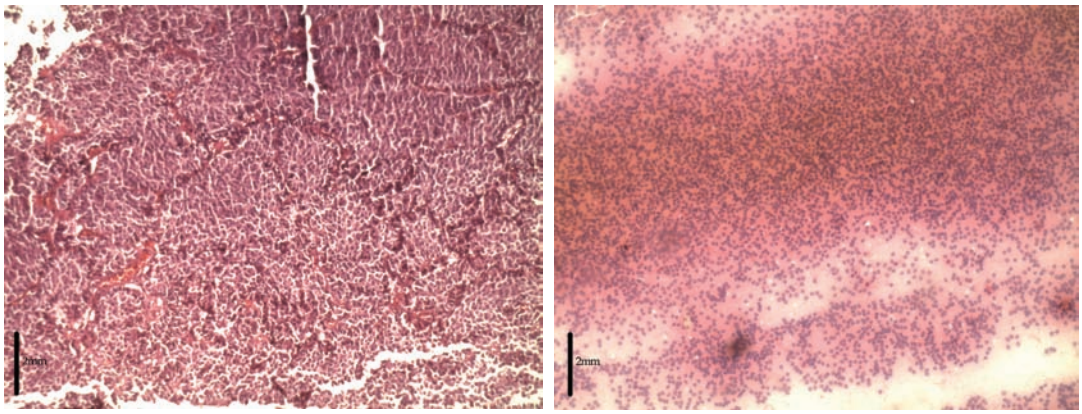

Figure 4: Pitutary adenoma: diffuse sheet of uniform cells, fibrovascular stroma, and absence of pleomorphic cells. Left: permanent pathologic slide (hematoxyllin eosin x40). Right: touch preparation (papanicolau ×40).

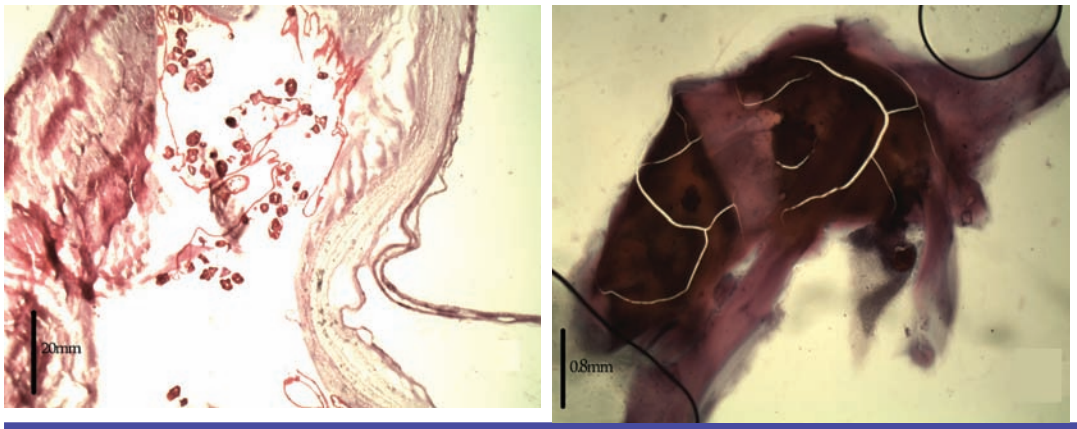

Figure 5: Hydatid cyst: cyst wall shows laminated layers and many scolexes. Left: permanent pathologic slide (hematoxyllin eosin x4), the structures are visible. Right: touch preparation (papanicolau ×100), the structures are not visible thus the diagnosis is hard to be made.

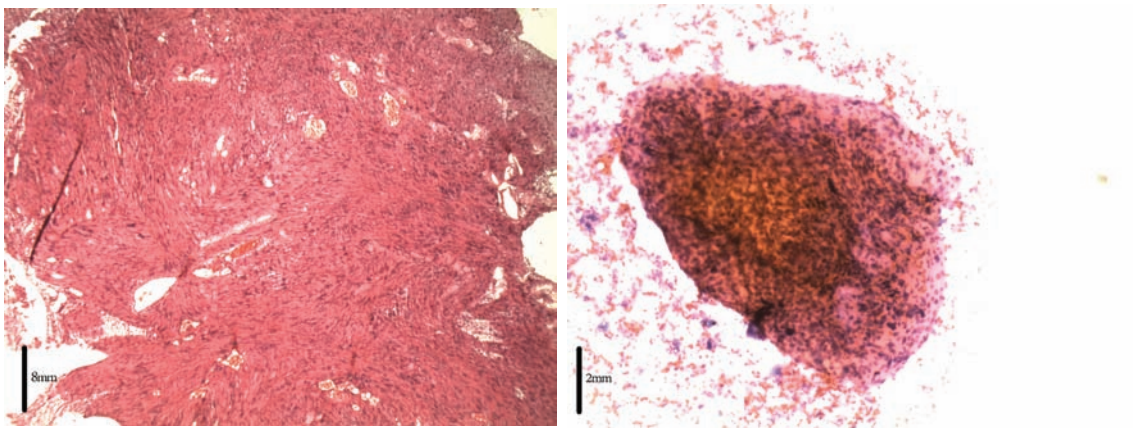

Figure 6: Schwannoma. Left: permanent pathologic slide (hematoxyllin eosin ×10); fusiform cells with long nuclei and eosinophilic cytoplasm arranged in hypercellular and hypocellular matrix. Right: touch preparation (papanicolau x40); a cluster of Schwann cells with elongated nuclei.

Discussion

The present study was a retrospective analysis to determine the accuracy of touch preparation technique in diagnosing the type of tumors encountered during the operation. This technique is reliable, simple, and accurate. Different authors used various stains such as 1% alcoholic toluidine blue and May-Grunwald–Giemsa.[3,4] We, however, used Giemsa and papanicolau.

Compared to frozen section, in touch preparation technique and a large area of tissue can be examined. Besides, touch preparation technique provides enough tissue for intraoperative and

subsequent routine paraffin section diagnoses. The two techniques are complementary, but frozen section is a better technique for the tissues, which their consistency is confirmed.[5] Unlike permanent histology, the frozen section technique, which has the accuracy rate of about 97%, can be done during the surgery. However, cryostat facility is not available at many centers in Iran. Touch preparation technique provides more crisp cytologic detail than frozen sections do, and can avoid most of freezing artifacts in brain tumors, high lipid content and soft nature.[6] Frozen section is a reliable method for intraoperative consultation during surgery. The use of frozen section during surgery can give the surgeon the opportunity to avoid the second surgery. Touch preparation technique is a reliable method for intraoperative evaluation as well. Due to high predictive value, the touch technique can be used first in the operation room, and frozen section can be saved for cases with inconclusive diagnosis by the touch technique.[7]

This study is one of the largest studies of this technique on CNS tumors in Iran. Our findings are similar to those of other studies (table 2).[4,5,9,10] Previous reports indicate that the diagnostic accuracy of cytological smears ranged from 75% to 94%.[15,23] In the present study the accuracy of touch preparation technique in diagnosing brain lesions was 84%, which is lower than that of other studies that included tumors only. This may be to the inclusion of other types of tumor such as bone tumors in the studies of neurosurgical tumors. The low diagnostic accuracy of touch preparation technique in our study may be related to limited sample size.

The diagnostic accuracy of touch preparation technique for high and low grade astrosytoma was 81% (39 out of 48) in our study. Correct diagnosis rests on appropriate radiological and intraoperative impressions. When a small biopsy was submitted and typical features of pilocytic astrocytoma were not present, it was difficult to correctly diagnosis, or to grade the tumor. Moreover, when vascular proliferation and atypia was interpreted without adequate clinical history, a misdiagnosis of high grade astrocytoma was made. When cellular pleomorphism, giant cells, mitoses necrosis and vascular proliferation were present, the diagnosis of glioblastoma was obvious (figure 1). Because of high cellularity, pleomorphism and the round to polygonal appearance of the cells, high grade astrocytomas and glioblastoma are often confused with metastatic carcinoma. Glioblastoma multiforme is the most undifferentiated type of astrocytoma. Anaplastic and pleomorphic cells that have no glial process are the key point in the diagnosis glioblastoma multiforme. is another diagnostic clue. (figure 2). Meningothelial, transitional and psammomatous meningiomas (three types of meningiomas) usually present no diagnostic difficulty because they exhibit features of non-neoplastic arachnoid cap cells, particularly the tendency to form whorls. (figure 3). [12] The nuclei of many meningiomas (especially the meningothelial types) show two types of intranuclear vacuoles. One type is formed by invagination of cytoplasm into the nucleus and the other by clearing of chromatin material from the center of the nucleus. The latter type is more common and is of diagnostic help.

Distinction between schwannomas and meningiomas was the commonest difficulty. Especially the fibroblastic meningiomas were confused with schwannoma as they lack whorls. In addition to whorls, the presence of intranuclear inclusions and calcification is of help in diagnosing meningiomas.[14] Chordoid meningiomas were misinterpreted as chordoma and atypical meningioma with metastatic carcinoma. In haemangioblastomas, obtaining good quality smears was difficult. This made the identification of numerous blood vessels difficult. However, all of the cases of meningiomas and 10 out of 11 cases of schwannoma were diagnosed correctly, because of the mentioned diagnostic characteristics (figure 3 and 6).

The accuracy of the touch preparation technique for pituitary adenomas was 84%. The cellular monomorphism and the absence of a significant reticulin network distinguish pituitary adenomas from non-neoplastic anterior pituitary parenchyma (figure 4).[13] These characteristics made the diagnosis of this type of tumor easy. Eleven of 13 cases were diagnosed correctly, but two cases were not diagnosed correctly using

Table 2: Diagnostic accuracy of central nervous system lesions from a number of published studies.

Authors	Year	Lesions	Diagnostic accuracy
Adams et al.[16]	1981	Tumors	93.6%
Asha et al.[17]	1989	Tumors+Infection	87%
Shah et al.[18]	1992	Tumors	96%
Chako[19]	1998	Tumors+Infection	88%
Bleggi-Torres et al.[20]	2001	Tumors	97.3%
Roessler et al.[21]	2002	Tumors+Infection	95%
Goel et al.[22]	2007	Tumors+Infection	86%
Present study	2011	Tumors+Infection	84%

touch preparation technique.

In haemangioblastomas, obtaining good quality smears was difficult. This made the identification of numerous blood vessels difficult. The smears showed thick and dense trabeculae of elongated cells, which led to misinterpretation. The clinical history of posterior fossa location is mandatory for correct diagnosis. Haemangioblastoma had numerous mast cells [10], which helped in its diagnosis. All such characteristics helped correct diagnosing of all three cases of haemangioblastomas in our study.

Hydatid cysts are endemic in Kashan, Iran. Two cases of hydatid cysts were among the cases in the present study. Hydatid cysts are diagnosed by the presence of scolex and a cyst with a laminated layer (figure 5). Touch preparation technique could not the two cases of hydatid cyst in our study.

Conclusion

Touch preparation technique is a rapid diagnostic method and a good complimentary technique for frozen section. Inadequate clinical and imaging data can contribute to wrong diagnosis. The experience of a pathologist is very important as diagnosis is made on cytology alone without any special stains and in a short time. Awareness of the cytomorphological features on smears of various lesions is important. In 64% of cases correct diagnosis could be made on smears alone, and in another 20% after clinical and radiological correlation.

Touch preparation technique is a very accurate and rapid method of intraoperative diagnosis, especially when combined with frozen section. However, adequate clinical history, neuroimaging details, and the intraoperative impression of the neurosurgeon, if provided, helps the neuropathologists to improve the diagnostic accuracy.

Conflict of Interest: None declared.

References

1 Bleggi-Torres LF, de Noronha L, Schneider Gugelmin E, Martins Sebastião AP, Werner B, Marques Maggio E, et al. Accuracy of the smear technique in the cytological diagnosis of 650 lesions of the central nervous system. Diagn Cytopathol. 2001;24:293-5. doi: 10.1002/dc.1062. PubMed PMID: 11285629.

2 Roessl er K, Dietrich W, Kitz K. High diagnostic accuracy of cytologic smears of central nervous system tumors. A 15-year experience based on 4,172 patients. Acta Cytol. 2002;46:667-74. PubMed PMID: 12146028.

3 Regragui A, Amarti Riffi A, Maher M, El Khamlichi A, Saidi A. [Accuracy of intraoperative diagnosis in central nervous system tumors: report of 1315 cases]. Neurochirurgie. 2003;49:67-72. PubMed PMID: 12746721.

4 Khalid A, Haque AUl. Touch impression cytology versus frozen section as intraoperative consultation diagnosis. Int J Pathol. 2004;2:63-70.

5 Creager AJ, Shaw JA, Young PR, Geisinger KR. Intraoperative evaluation of lumpectomy margins by imprint cytology with histologic correlation: a community hospital experience. Arch Pathol Lab Med. 2002;126:846-8. PubMed PMID: 12088456.

6 Nash H, Haque A. Value of touch preparation cytology in intraoperative consultation diagnosis of Astrocytomas. Int J Pathol. 2003;1:8-12.

7 Memar B, Sadeghi R, Ayati NK, Aledavood SA, Tghizadeh A, Naseri S, eat al. The value of touch imprint cytology and frozen section for intra-operative evaluation of axillary sentinel lymph nodes. Pol J Pathol. 2010;61:161-5. PubMed PMID: 21225499.

8 Ku NN, Cox CE, Reintgen DS, Greenberg HM, Nicosia SV. Cytology of lumpectomy specimens. Acta Cytol. 1991;35:417-21. PubMed PMID: 1718113.

9 Henry-Tillman RS, Korourian S, Rubio IT, Johnson AT, Mancino AT, Massol N, et al. Intraoperative touch preparation for sentinel lymph node biopsy: a 4-year experience. Ann Surg Oncol. 2002;9:333-9. doi: 10.1245/aso.2002.9.4.333. PubMed PMID: 11986184.

10 Tworek JA, Giordano TJ, Michael CW. Comparison of intraoperative cytology with frozen sections in the diagnosis of thyroid lesions. Am J Clin Pathol. 1998;110:456-61. PubMed PMID: 9763031.

11 Belleannée G, Verdebout J, Feoli F, Trouette H, de Mascarel A, Verhest A. [Role of cytology and frozen sections in the intraoperative examination of the thyroid: comparison of two experiences]. Clin Exp Pathol. 1999;47:273-7. PubMed PMID: 10812432.

12 Westra WH, Pritchett DD, Udelsman R. Intraoperative confirmation of parathyroid tissue during parathyroid exploration: a retrospective evaluation of the frozen section. Am J Surg Pathol. 1998;22:538-44. PubMed PMID: 9591722.

13 Geelhoed GW, Silverberg SG. Intraoperative imprints for the identification of parathyroid tissue. Surgery. 1984;96:1124-31. PubMed PMID: 6390768.

14 Shidham VB, Asma Z, Rao RN, Chavan A, Machhi J, Almagro U, et al. Intraoperative cytology increases the diagnostic accuracy of frozen sections for the confirmation of various tissues in the parathyroid region. Am J Clin

Pathol. 2002;118:895-902. PubMed PMID: 12472283.
15 Savargaonkar P, Farmer PM. Utility of intraoperative consultations for the diagnosis of central nervous system lesions. Ann Clin Lab Sci. 2001;31:133-9. PubMed PMID: 11337901.
16 Adams JH, Graham DI, Doyle D. Brain biopsy: the smear technique for neurosurgical biopsies. London: Chapman and Hall; 1981.
17 Asha T, Shankar SK, Rao TV, Das S. Role of squash-smear technique for rapid diagnosis of neurosurgical biopsies--a cytomorphological evaluation. Indian J Pathol Microbiol. 1989;32:152-60. PubMed PMID: 2674004.
18 Shah AB, Bhagwati SN, Misra M. Rapid diagnosis of CNS tumors by smear technique. Neurol India. 1992;40:81-5.
19 Chacko G, Chandi SM, Chandy MJ. Smear diagnosis of central nervous system lesions: a critical appraisal. Neurol India. 1998;46:115-8.
20 Bleggi-Torres LF, de Noronha L, Schneider Gugelmin E, Martins Sebastião AP, Werner B, Marques Maggio E, et al. Accuracy of the smear technique in the cytological diagnosis of 650 lesions of the central nervous system. Diagn Cytopathol. 2001;24:293-5. doi: 10.1002/dc.1062. PubMed PMID: 11285629.
21 Roessler K, Dietrich W, Kitz K. High diagnostic accuracy of cytologic smears of central nervous system tumors. A 15-year experience based on 4,172 patients. Acta Cytol. 2002;46:667-74. PubMed PMID: 12146028.
22 Goel D, Sundaram C, Paul TR, Uppin SG, Prayaga AK, Panigrahi MK, et al. Intraoperative cytology (squash smear) in neurosurgical practice - pitfalls in diagnosis experience based on 3057 samples from a single institution. Cytopathology. 2007;18:300-8. doi: 10.1111/j.1365-2303.2007.00484.x. PubMed PMID: 17883691.
23 Monabati A, Kumar PV, Kamkarpour A. Intraoperative cytodiagnosis of metastatic brain tumors confused clinically with brain abscess. A report of three cases. Acta Cytol. 2000;44:437-41. doi: 10.1159/000328494. PubMed PMID: 10834007.