

Original study

Comparison of core needle biopsy and excisional biopsy findings for suspicious calcifications detected on screening mammography and the upgrade rate: A single-center retrospective analysis

Tarama mamografisinde saptanan şüpheli kalsifikasyonların core needle biyopsi sonrası eksizyonel biyopsi karşılaştırılması ve upgrade oranı: Tek merkezli retrospektif bir analiz

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ABSTRACT

Suspicious breast calcifications detected on mammography may represent a wide spectrum of histopathological findings ranging from benign alterations to malignancy. A nonmalignant result on core needle biopsy (CNB) may occasionally underestimate an underlying malignancy. This study aimed to determine the rate of upgrade from a nonmalignant CNB result to malignancy after surgical excision and to evaluate the association of patient age, calcification size, and Breast Imaging Reporting and Data System (BI-RADS) category with upgrade.

This retrospective single-center study included 47 patients who underwent CNB for suspicious mammographic calcifications followed by surgical excision between January 2020 and December 2025. CNB findings were classified as malignant or nonmalignant. Upgrade to malignancy was defined as the detection of ductal carcinoma in situ or invasive breast carcinoma in the surgical specimen after a nonmalignant CNB result. Patients with nonmalignant CNB findings were compared according to upgrade status. The associations of age, calcification size, and BI-RADS category with upgrade were evaluated, and receiver operating characteristic analysis was performed to assess the discriminatory ability of calcification size.

CNB revealed malignant pathology in 16 (34.0%) and nonmalignant pathology in 31 (66.0%) patients. Among the 31 patients with nonmalignant CNB findings, malignancy was detected after surgical excision in 10, corresponding to an upgrade rate of 32.3% (95% CI: 16.7–51.4). Calcification size was significantly greater in

patients with upgrade than in those without upgrade (19.6 ± 14.1 mm vs. 10.6 ± 9.5 mm, respectively; $p=0.048$), whereas age was not significantly different between the groups ($p=0.352$). The upgrade rate was higher in the high radiologic suspicion group comprising BI-RADS 4B, 4C, and 5 lesions than in the remaining BI-RADS categories (53.8% vs. 16.7%); however, this difference did not reach statistical significance ($p=0.052$). The area under the receiver operating characteristic curve for calcification size was 0.724 (95% CI: 0.496–0.951; $p=0.054$). A cutoff value of ≥ 14 mm yielded a sensitivity of 70.0% and a specificity of 85.7%.

Among patients selected for surgical excision after CNB of suspicious mammographic calcifications, approximately one-third of those with an initially nonmalignant CNB result were upgraded to malignancy. Larger calcification size was associated with upgrade, while higher BI-RADS categories showed a clinically relevant but statistically nonsignificant trend toward increased upgrade. These findings suggest that calcification size, radiologic suspicion, sampling adequacy, and radiologic-pathologic concordance should be considered together when determining the management of suspicious calcifications with nonmalignant CNB findings.

Keywords: Breast calcifications, core needle biopsy, BI-RADS, surgical excision, upgrade to malignancy, mammography

ÖZET

Mamografide saptanan şüpheli meme kalsifikasyonları, benign değişikliklerden maligniteye kadar geniş bir histopatolojik spektrumu temsil edebilir. Core needle biyopsi (CNB) sonucunun nonmalign olması, bazı olgularda altta yatan malignitenin gözden kaçmasına neden olabilir. Bu çalışmanın amacı, nonmalign CNB sonucundan cerrahi eksizyon sonrası maligniteye upgrade oranını belirlemek ve hasta yaşı, kalsifikasyon boyutu ve Breast Imaging Reporting and Data System (BI-RADS) kategorisinin upgrade ile ilişkisini değerlendirmektir.

Bu retrospektif tek merkezli çalışmaya, Ocak 2020 ile Aralık 2025 tarihleri arasında mamografide saptanan şüpheli kalsifikasyonlar nedeniyle CNB uygulanan ve ardından cerrahi eksizyon yapılan 47 hasta dahil edildi. CNB sonuçları malign ve nonmalign olarak sınıflandırıldı. Maligniteye upgrade, nonmalign CNB sonucu sonrasında cerrahi eksizyon materyalinde duktal karsinoma in situ veya invaziv meme karsinomu saptanması olarak tanımlandı. Nonmalign CNB sonucu olan hastalar upgrade durumuna göre karşılaştırıldı. Yaş, kalsifikasyon boyutu ve BI-RADS kategorisinin upgrade ile ilişkisi değerlendirildi ve kalsifikasyon boyutunun ayırt edici performansını belirlemek amacıyla alıcı işletim karakteristiği analizi yapıldı.

CNB sonucunda 16 hastada (%34,0) malign, 31 hastada (%66,0) nonmalign patoloji saptandı. Nonmalign CNB sonucu bulunan 31 hastanın 10'unda cerrahi eksizyon sonrasında malignite saptandı ve upgrade oranı %32,3 (%95 GA: %16,7–51,4) olarak hesaplandı. Upgrade saptanan hastalarda kalsifikasyon boyutu, upgrade saptanmayan hastalara göre anlamlı olarak daha büyüktü (sırasıyla $19,6 \pm 14,1$ mm ve $10,6 \pm 9,5$ mm; $p=0,048$). Gruplar arasında yaş açısından anlamlı fark saptanmadı ($p=0,352$). BI-RADS 4B, 4C ve 5 kategorilerinden oluşan yüksek radyolojik şüphe grubunda upgrade oranı diğer BI-RADS kategorilerine göre daha yüksek bulundu (%53,8'e karşı %16,7); ancak bu fark istatistiksel anlamlılığa ulaşmadı ($p=0,052$). Kalsifikasyon boyutu için alıcı işletim karakteristiği eğrisi altında kalan alan 0,724 olarak hesaplandı (%95 GA: 0,496–0,951; $p=0,054$). ≥ 14 mm eşik değeri için duyarlılık %70,0, özgüllük ise %85,7 olarak bulundu.

Şüpheli mamografik kalsifikasyonlar nedeniyle CNB uygulandıktan sonra cerrahi eksizyona seçilen hastalarda, başlangıçta nonmalign CNB sonucu bulunan olguların yaklaşık üçte birinde maligniteye upgrade saptandı. Daha büyük kalsifikasyon boyutu upgrade ile ilişkili bulunurken, yüksek BI-RADS kategorileri artmış upgrade açısından klinik olarak dikkat çekici ancak istatistiksel olarak anlamlı olmayan bir eğilim gösterdi. Bu bulgular, nonmalign CNB sonucu bulunan şüpheli kalsifikasyonların yönetiminde kalsifikasyon boyutu, radyolojik şüphe düzeyi, örnekleme yeterliliği ve radyoloji-patoloji uyumunun birlikte değerlendirilmesi gerektiğini düşündürmektedir.

Anahtar kelimeler: Meme kalsifikasyonları, core needle biyopsi, BI-RADS, cerrahi eksizyon, maligniteye upgrade, mamografi

INTRODUCTION

Breast calcifications are radiologic findings frequently encountered in clinical practice, particularly with the widespread use of mammographic screening programs, and may represent a broad histopathologic spectrum ranging from benign changes to malignant lesions [1]. Detection of malignancy at surgical excision despite a nonmalignant image-guided biopsy result is an important clinical issue about sampling adequacy and radiologic-pathologic concordance. Breast microcalcifications, which are

among the principal findings of asymptomatic breast malignancies, may reflect a wide pathologic spectrum ranging from benign and inflammatory processes to invasive carcinomas, underscoring their critical role in the differential diagnosis [2].

The aim of this study was to determine the rate of upgrade from a nonmalignant biopsy result to malignancy among patients selected for surgical excision after undergoing core needle biopsy (CNB) for suspicious calcifications on mammography, to evaluate the associations of age and calcification size

with upgrade, and to describe upgrade rates across BI-RADS categories.

MATERIAL and METHOD

This study retrospectively reviewed patients in whom calcifications were detected on mammography performed as part of breast screening between January 2020 and December 2025, were considered suspicious on radiologic assessment and underwent CNB, followed by excisional biopsy. The decision to perform surgical excision was made by considering the CNB result, degree of radiologic suspicion, and the patient's clinical characteristics together. CNB results were classified into two groups as malignant and nonmalignant. Ductal carcinoma in situ (DCIS) and invasive breast carcinoma were considered malignant, whereas all other histopathologic findings that did not meet the criteria for malignancy were considered nonmalignant. Upgrade to malignancy was defined as the detection of DCIS or invasive breast carcinoma in the final surgical pathology despite a nonmalignant CNB result. Patients were included if calcifications were detected on screening mammography, CNB was performed because the calcifications were considered suspicious according to BI-RADS assessment, surgical excision was subsequently performed, and both biopsy and final excision pathology results were available. Patients without a CNB result, those who did not undergo excisional biopsy, those for whom the final excision pathology was unavailable, those who underwent biopsy or surgery for a primary indication other than calcification, and those with incomplete clinical, radiologic, or pathologic data were excluded. Because vacuum-assisted biopsy (VAB) was not available at our center, CNB was performed in all patients. Calcification size was obtained directly from the original pre-biopsy radiology reports and recorded in millimeters as documented. No additional retrospective measurements or reinterpretation of calcification dimensions were performed. BI-RADS 4B, 4C, and 5 were considered the high-risk BI-RADS group. In patients reported as BI-RADS 3, the decision to perform biopsy and surgical excision was based on persistent clinical-radiologic suspicion. Based on these criteria, a total of 47 patients were included in the study. Biopsies were performed by a single physician under mammographic or ultrasonographic guidance depending on lesion visibility. The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the İzmir Kâtip Çelebi University Ethics Committee on July 16, 2026 (approval no. 0675). Owing to the retrospective design, the requirement for written informed consent was assessed in accordance with the ethics committee decision.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 29.0

(IBM Corp., Armonk, NY, USA). The primary end-point of the study was upgrade to malignancy, defined as the detection of DCIS or invasive breast carcinoma after surgical excision among patients with a nonmalignant CNB result. The upgrade rate was calculated by dividing the number of patients in whom malignancy was detected at surgical excision by the total number of patients with nonmalignant CNB results and was presented as number, percentage, and 95% confidence interval (CI).

The distributional characteristics of continuous variables were assessed using the Shapiro-Wilk test and graphical methods. Continuous variables were expressed as mean $\pm$ standard deviation and median, whereas categorical variables were expressed as number and percentage. Patients with nonmalignant CNB results were divided into two groups according to whether an upgrade was detected after surgical excision. Because of the limited sample size and violation of the normality assumption, the Mann-Whitney U test was used to compare the groups in terms of age and calcification size.

BI-RADS 4B, 4C, and 5 were classified as the high radiologic suspicion group. Cases reported as BI-RADS 4 without a specified subcategory were evaluated separately. The distribution of upgrade according to BI-RADS categories was summarized using frequencies and percentages.

The performance of calcification size in discriminating the development of upgrade to malignancy among patients with nonmalignant CNB results was evaluated using receiver operating characteristic (ROC) curve analysis. The area under the curve (AUC) was calculated. The optimal threshold value for calcification size in discriminating upgrade was determined using the Youden index, and the sensitivity and specificity corresponding to this threshold were reported. Because of the limited sample size and the small number of patients with upgrade, the ROC analysis was considered exploratory.

All statistical tests were two-sided, and $p < 0.05$ was considered statistically significant.

RESULTS

A total of 47 patients who underwent CNB because of suspicious calcifications detected on mammography and subsequently underwent surgical excision for final histopathologic evaluation were included in the study. The mean age of the patients was 52.5 ± 8.2 years, with an age range of 40-70 years. The mean calcification size was 18.5 ± 17.8 mm, with a range of 1-83 mm.

CNB revealed malignant pathology in 16 patients (34.0%) and nonmalignant pathology in 31 patients (66.0%). The primary upgrade analysis was performed in the 31 patients with nonmalignant CNB results. DCIS or invasive breast carcinoma was detected after surgical excision in 10 of these pa-

tients. Accordingly, the rate of upgrade from a non-malignant CNB result to malignancy was 10/31 (32.3%; 95% CI, 16.7-51.4). The number of patients with a nonmalignant CNB result who also had non-malignant pathology at surgical excision was 21 (67.7%) (Table 1).

When patients with nonmalignant CNB results were compared according to upgrade status, the mean age of patients with upgrade was 52.9 ± 6.5 years and the median age was 52 years, whereas the mean age of patients without upgrade was 50.8 ± 9.6 years and the median age was 50 years. There was no statistically significant difference between the groups in terms of age ($p=0.352$).

The mean calcification size was 19.6 ± 14.1 mm and the median calcification size was 19 mm in patients with upgrade, whereas the mean calcifica-

tion size was 10.6 ± 9.5 mm and the median calcification size was 8 mm in patients without upgrade. Calcification size was significantly greater in the upgrade group ($p=0.048$) (Table 2).

Table 1: Distribution of upgrade after surgical excision among patients with nonmalignant CNB results.

Surgical excision result	n	%
Upgrade	10	32.3
No upgrade	21	67.7
Total	31	100.0

Table 2: Age and calcification size according to upgrade status among patients with nonmalignant CNB results

Variable	Upgrade (n=10)	No upgrade (n=21)	p value
Age, years, mean $\pm$ SD	52.9 ± 6.5	50.8 ± 9.6	0.352
Age, years, median	52	50	
Calcification size, mm, mean $\pm$ SD	19.6 ± 14.1	10.6 ± 9.5	0.048
Calcification size, mm, median	19	8	

Note: p values were calculated using the Mann-Whitney U test. A single comparison test was applied for each variable.

BI-RADS 4B, 4C, and 5 were considered the high radiologic suspicion group. Among patients with nonmalignant CNB results, upgrade to malignancy was detected in 7 of 13 patients (53.8%) in the high radiologic suspicion group and in 3 of 18 patients (16.7%) in the other BI-RADS categories. Given the limited sample size, these findings were presented descriptively as frequencies and percentages (Table 3).

When BI-RADS subcategories were evaluated descriptively, upgrade to malignancy was detected in 1 of 3 patients (33.3%) in the BI-RADS 3 category, 1 of 4 patients (25.0%) reported as BI-RADS 4 without a specified subcategory, 1 of 11 patients (9.1%) in the BI-RADS 4A category, 2 of 5

patients (40.0%) in the BI-RADS 4B category, and 4 of 7 patients (57.1%) in the BI-RADS 4C category. Only one patient was classified as BI-RADS 5, and malignancy was detected after surgical excision in this patient. Because the 100% upgrade rate in this category was based on a single case, no additional statistical inference was made (Table 4).

The performance of calcification size in discriminating the development of upgrade from a non-malignant CNB result to malignancy was evaluated using ROC analysis. The AUC was 0.724 (95% CI, 0.496-0.951; $p=0.054$). For the ≥ 14 mm threshold determined according to the Youden index, sensitivity was 70.0% and specificity was 85.7% (Table 5).

Table 3: Distribution of upgrade according to BI-RADS group among patients with nonmalignant CNB results.

BI-RADS group	Upgrade n (%)	No upgrade n (%)	Total n	Upgrade rate, %
High radiologic suspicion: BI-RADS 4B, 4C, and 5	7 (53.8)	6 (46.2)	13	53.8
Other BI-RADS categories	3 (16.7)	15 (83.3)	18	16.7
Total	10 (32.3)	21 (67.7)	31	32.3

Table 4: Distribution of upgrade according to BI-RADS category among patients with nonmalignant CNB results.

BI-RADS category	Upgrade n	No upgrade n	Total n	Upgrade rate, %
BI-RADS 3	1	2	3	33.3
BI-RADS 4	1	3	4	25.0
BI-RADS 4A	1	10	11	9.1
BI-RADS 4B	2	3	5	40.0
BI-RADS 4C	4	3	7	57.1
BI-RADS 5	1	0	1	100.0
Total	10	21	31	32.3

Note: Cases reported as BI-RADS 4 without a specified subcategory are presented as a separate category.

Table 5: ROC analysis of calcification size for predicting upgrade among patients with nonmalignant CNB results.

Variable	Positive group n	Negative group n	AUC	Standard error	p value	95% CI	Threshold	Sensitivity	Specificity
Calcification size	10	21	0.724	0.116	0.054	0.496–0.951	≥14 mm	70.0%	85.7%

The 16 patients whose CNB results were reported as malignant were not included in the primary upgrade analysis. Malignancy was confirmed by surgical pathology in 15 of these patients (93.8%). In one patient, no residual malignancy was identified in the surgical excision specimen despite malignancy detected on CNB.

DISCUSSION

This study comparatively evaluated the upgrade rates observed after CNB for mammographically detected suspicious calcifications and the factors associated with final malignancy in relation to the literature. The observed upgrade rate of 32.3% is consistent with similar studies in the literature when the heterogeneous nature of mammographic calcifications and the possibility of sampling error are considered [3]. Although the determining role of the morphologic characteristics and distribution patterns of microcalcifications in the risk of malignancy has been emphasized in the literature, increasing calcification size has also been reported to be associated with malignancy risk [4]. Consistent with this, calcification size was significantly greater in cases with upgrade after percutaneous CNB (mean, 19.6±14.1 mm) than in those without upgrade (mean, 10.6±9.5 mm) ($p=0.048$). In addition, the discriminatory performance of calcification size for upgrade was explored using ROC analysis. The AUC was 0.724 (95% CI, 0.496–0.951; $p=0.054$). A threshold of ≥14

mm, identified by the Youden index, yielded a sensitivity of 70.0% and a specificity of 85.7%. However, given the lack of statistical significance and the limited sample size, this threshold should be considered exploratory rather than a validated clinical cut-off. Similarly, although the role of BI-RADS categories in stratifying the probability of malignancy has been emphasized, upgrade rates after CNB have been reported to vary across studies because of radiologic heterogeneity [5,6]. Surgical excision may therefore be necessary to achieve definitive diagnostic accuracy in selected patients, particularly when CNB findings are discordant with radiologic findings or when a high suspicion of malignancy persists [7]. However, considering the invasive nature and potential morbidity of surgical excision, its use should be limited to cases with persistent high clinical or radiologic suspicion for malignancy that are selected through multidisciplinary assessment [8,9]. These findings suggest that, particularly in high-risk BI-RADS categories and in larger calcifications, surgical excision may be considered as an option in clinical management even when percutaneous CNB results are nonmalignant, considering the risk of a missed diagnosis.

The main limitations of this study are its retrospective, single-center design, limited sample size, and inclusion only of patients selected for surgical excision. The use of CNB in all patients because VAB was not available at the center is another limitation that may have affected sampling adequacy in

large and heterogeneous areas of calcification. It should be considered that CNB may not represent all histopathologic components of a large or heterogeneous calcification field, which may influence the rate of malignancy detected after surgical excision. In addition, the lack of analysis of clinical risk factors such as family history and the inability to classify nonmalignant biopsy results into histopathologic subgroups limit the interpretation of the findings and their applicability to general clinical practice. Because only 10 upgrade events were observed among 31 patients with nonmalignant CNB results, multivariable logistic regression was not performed to reduce the risk of model overfitting and unstable estimates. Therefore, analyses of age and calcification size were limited to univariable comparisons, while BI-RADS categories were summarized using frequencies and percentages.

Patients with malignant CNB results were excluded from the primary upgrade analysis and were summarized descriptively.

Conclusion

In the management of suspicious calcifications with nonmalignant CNB results, not only the histopathologic result but also calcification size, BI-RADS category, sampling adequacy, and radiologic-pathologic concordance should be evaluated together. However, because of the retrospective and single-center design, limited sample size, and inclusion only of patients who underwent surgical excision, the findings should not be generalized to all suspicious breast calcifications. Large, multicenter prospective studies in which biopsy techniques and histopathologic subgroups are evaluated in detail are needed to validate these findings and to develop a reliable risk-stratification approach that can be used in clinical decision-making.

REFERENCES

1. Sünger E. Memenin Benign Tümörlerinde Malignite Riski ve Takip. In: Sedef AM (Ed.), Meme Kanseri, Akademisyen Yayınevi, 2026, pp 247-256.
2. Lohitvisate W, Kaeorat C, Kwankua A. Mammography of suspicious calcifications among ductal carcinoma in situ and benign breast disease. *South African J Radiology*. 2024;28(1):2852-2852.
3. Bulut N, Dağıstanlı S, Sönmez S. Is it important to evaluate the demographic characteristics and radiological findings of patients who have micro calcific lesions in the breast with biopsy results in the decision of excision? *Research Square*. 2022 June. DOI: 10.21203/rs.3.rs-1705371/v1
4. Ünal S, Gürsoy M, İkizceli T, Pasin Ö. Excisional Biopsy Outcomes of Mammographically Detected Breast Calcifications and Their Correlation with Calcification Morphology. 2026.
5. Fawzy M, Sheta H, hafez AAE, Harb D, Zuhdy M, Alghandour R, et al. Accuracy and Upgrading of CNB and BI-RADS Diagnoses Compared to Excision: A Clinicopathological-Radiological Correlation of Papillary Breast Lesions and Neoplasms. *Asian Pacific Journal of Cancer Prevention*. 2022;23(11):3959-69.
6. Catanzariti F, Avendaño D, Cicero G, Garza-Montemayor M, Sofia C, Rullo EV, et al. High-risk lesions of the breast: concurrent diagnostic tools and management recommendations. *Insights into Imaging*. 2021;12(1):63-63.
7. Tuncez HC, Gültekin TÖ, Adıbelli ZH, Çavdar DK. Are Benign Core Needle Biopsy Results Really Benign in BI-RADS 4 and 5 Breast Lesions? *Iranian Journal of Radiology*. 2024;21(4).
8. Lee S, Wahab RA, Sobel LD, Zhang B, Brown AL, Lewis K, et al. Analysis of 612 Benign Papillomas Diagnosed at Core Biopsy: Rate of Upgrade to Malignancy, Factors Associated With Upgrade, and a Proposal for Selective Surgical Excision. *American Journal of Roentgenology*. 2021;217(6):1299-311.
9. Bulut N, Dağıstanlı S, Sönmez S. Demographic characteristics and radiological findings of patients with breast micro calcifications. *PONTE International Scientific Researchs Journal*. 2023;79(2).