

INTERNET NEWS

BS Nguyễn Văn Công

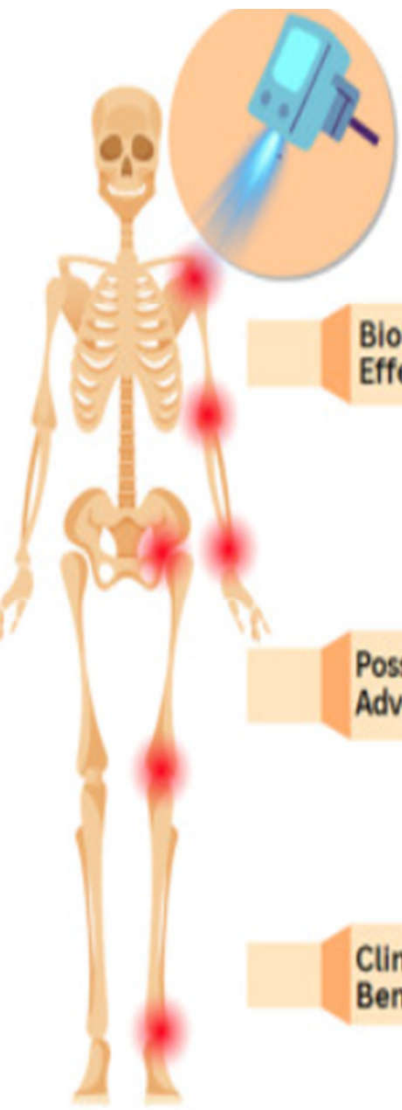
Low-dose Radiation Therapy (LDRT) in Managing Osteoarthritis: A Comprehensive Review

[Armin Hoveidaei](#)¹, [Mehdi Karimi](#)², [Amirhossein Salmannezhad](#)³, [Yasaman Tavakoli](#)⁴, [Seyed Pouya Taghavi](#)⁵,
[Amir Human Hoveidaei](#)^{6,*}

▶ [Author information](#) ▶ [Article notes](#) ▶ [Copyright and License information](#)

PMCID: PMC11964493 PMID: [40177366](#)

Osteoarthritis (OA) is the most common degenerative arthropathy, impacting the quality of life for millions worldwide. It typically presents with chronic pain, stiffness, and reduced mobility in the affected joints. Nonsurgical treatments like physiotherapy or pharmacotherapy may provide limited relief and may have adverse effects and complications. Recently, low-dose radiation therapy (LDRT) has emerged as a potential alternative for managing OA, utilizing its anti-inflammatory effects. LDRT's anti-inflammatory effects involve modulating immune responses, reducing pro-inflammatory cytokines, and inducing apoptosis in inflammatory cells. Clinical studies show varying degrees of symptom relief, with some patients experiencing pain reduction and improved joint mobility while others show minimal response. The variability in LDRT treatment designs, radiation dosages, and patient populations complicates standardized treatment protocols and raises concerns about potential carcinogenic risks. Despite these issues, LDRT shows promise as an alternative to other OA treatments, especially for patients who don't respond to other treatments. This review aims to provide updated information on the effectiveness, mechanisms, and safety of LDRT in treating OA. We reviewed the literature of studies on the safety and efficacy of LDRT on affected joints by OA, its biological effects, potential therapeutic and adverse effects, application and contraindications, clinical outcomes, and clinical evidence in subjects with OA.



Biological Effects



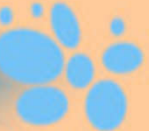
Macrophages

- Inhibiting iNOS
- Inhibiting ROS production
- M1>>M2




Lymphocytes

- Increasing apoptotic CD4+ T cells



Cytokines

- Increasing anti-inflammatory cytokines expression (IL-10, TGF- β)
- Decreasing pro-inflammatory cytokines expression (IL-1 β , TNF- α)




Endothelium

- Reducing expression of P-selectin, L-selectin, and E-selectin
- Reducing expression of ICAM-1 and VCAM-1

Possible Adverse Effects



Safe in most cases



Mild erythema Secondary malignancy Nail reaction

Clinical Benefits



Improving quality of life



Pain alleviation



Improving functional outcomes

Method

A comprehensive literature search was conducted using MeSH terms and query terms including “Low-dose Radiation Therapy” OR “LDRT” OR “Radiation Therapy” OR “Radiotherapy” AND “Osteoarthritis” OR “degenerative joint diseases” OR “Arthrosis”, across PubMed and ISI Web of Science databases. Additionally, a manual search was performed using Google Scholar to identify relevant studies published within the last 10 years, focusing on the most recent and updated articles related to the use of LDRT for managing osteoarthritis. The search was restricted to studies that provided evidence of the safety, efficacy, and mechanisms of LDRT in OA treatment. Articles that did not meet the inclusion criteria, such as those unrelated to OA or not focusing on LDRT, were excluded. Relevant studies were selected based on their methodological quality and clinical relevance to provide a comprehensive overview of LDRT's role in managing osteoarthritis.

Low-Dose Radiation Therapy (LDRT)

LDRT has been investigated as a treatment for various MSDs, including OA. For decades, it has primarily been used to treat benign inflammatory and degenerative disorders, such as epicondylitis and plantar fasciitis. By employing low doses of radiation, LDRT aims to achieve anti-inflammatory effects and pain relief, positioning it as a potential noninvasive option for managing conditions like OA.^{[26](#),[27](#)}

It is unclear how LDRT alleviates OA symptoms. However, it is thought to include the regulation of inflammatory processes. LDRT may inhibit the generation of pro-inflammatory cytokines and other inflammatory mediators, reducing pain and inflammation in afflicted joints.^{[28](#)}

LDRT presents an alternative for patients who may not respond adequately to conventional treatments, such as NSAIDs or corticosteroid injections, offering pain relief without the systemic side effects associated with these medications. While conventional therapies primarily focus on symptom management, LDRT targets the underlying inflammatory processes, potentially providing more sustained relief.^{[5](#),[29](#)} Additionally, LDRT is generally well-tolerated and carries a lower risk of adverse effects compared to higher-dose radiation therapies used in oncology; however, further long-term safety data are still needed to fully assess its risk profile.^{[30](#)}

Biological Effects of LDRT

According to current literature, the exact radiobiological mechanisms of LDRT are not yet well understood. The mechanism of action of LDRT is primarily based on immunomodulatory processes, which results in anti-inflammatory effects. LDRT can potentially regulate anti- and proinflammatory cytokine production and inflammation mediator cells' function.^{[31](#),[32](#)}

Application and Contraindications of LDRT

LDRT is not currently recommended as first-line treatment, but it is a viable choice for OA patients who did not respond to earlier medical therapies. Additionally, some cases requiring surgical intervention may preoperatively benefit from the radiotherapy, depending on the physician's discretion. According to the latest update of the German Society of Radiation Therapy and Oncology (DEGRO) guideline, LDRT is suggested as a higher level of recommendation for treating knee OA (category B) than hip, hand, and shoulder (category C).^{[73](#)} Category B is defined as “Should be carried out” and was proposed based on evidence level II or III. On the other hand, category C is described as “Can be carried out” and is supported by evidence level IV. DEGRO guidelines have not recommended any indication of LDRT for ankle OA. However, it has been recently indicated that LDRT can potentially alleviate the pain and improve joint mobility.^{[74](#)} More studies are needed to establish the effectiveness of LDRT on ankle OA.

There might be some concerns about RT exposure in OA patients. For instance, due to the low exposure, there is low concern about fetus radiation during pregnancy. Applying ionizing radiation for shoulder may subject the patients to a risk for cardiovascular problems, due to its nearby irradiation. Patients with breast cancer had an excess risk of cardiovascular diseases, exposure to 20 fractions of 2 Gy,⁷⁵ confirmed the risk of cardiovascular diseases following LDRT by other studies.⁷⁶ However, there is no evidence denoting any cardiac risk after LDRT for OA patients. In addition to the shoulder, radiotherapy targeting the hip joint may raise concerns about the potential risk of cancer in nearby sensitive organs, such as the prostate, uterus, or ovaries. However, to date, no definite contraindication was documented, including pregnancy, underlying conditions (eg, diabetes), active infection (eg, septic arthritis), cardiovascular diseases, and previous radiation therapy (especially high doses) or ongoing radiotherapy.

Discussion and Clinical Evidence

So far, 25 studies evaluated the effects of LDRT in OA patients. According to [Table 1](#), twelve retrospective studies with a level of evidence of III validated the pain relief and positive influence on joint function by LDRT. Furthermore, six prospective studies with level II evidence found that LDRT reduced the numerical rating scale (NRS), visual analog scale (VAS), and Von Pannwitz Score (VPS) in OA patients. However, five randomized clinical trial studies with a level of evidence of I questioned the efficacy of LDRT on OA. Two observational studies with a level of evidence III revealed a decrease in VAS score following LDRT. The lowest radiation dose was 0.05 Gy per fraction for a total dose of 0.3 Gy, while the highest dose was 1 Gy per fraction for a total of 6 Gy. Follow-ups range from 8 to 52 weeks. The total number of samples ranged from 16 to 4544. All research was carried out in Europe, including 19 in Germany.

SPONSORED
BY



CLINICAL NEWS | WOMENS IMAGING | BREAST

Maryland first state to consider BAC notification after mammogram

AuntMinnie.com staff writers

Mar 13, 2026

- Legislation introduced in the state of Maryland would require women to be informed if their mammogram results show breast arterial calcification (BAC).
- House Bill (HB) 1364 includes provisions that model breast density notification by letter after a mammography exam. It was introduced on February 13.
- "The bill would require notification to women in their mammogram results letter if breast arterial calcification, known as BAC, is present in their mammogram," Joseline Pena-Melnyk, speaker of the Maryland House of Delegates, told the House Health Committee on February 24. "Although BAC frequently appears on routine mammograms, there is currently no standardized protocol for reporting this information to a patient. Even when the presence is documented, reporting practices lack uniformity. This bill will provide that needed uniformity."
- The language included in HB 1364 is intended to raise nonalarming awareness that BAC is a common finding and that it may be an indicator of increased risk of cardiovascular disease. As written currently, the bill asks recipients to discuss the finding with their physician to assess cardiovascular risks and determine if additional testing is appropriate.

BY



CLINICAL NEWS | WOMENS IMAGING

AI-calculated BAC on mammograms predicts cardiovascular disease in women



Amerigo Allegretto

Mar 9, 2026



- Breast imaging features analyzed by AI could help predict cardiovascular events in women, suggest findings published March 9 in the *European Heart Journal*.
- Breast arterial calcifications (BACs) that are automatically quantified by AI are an independent predictor of major adverse cardiovascular events (MACE) and mortality, wrote a team led by Theodoros Dapamede, MD, PhD, from Emory University in Atlanta, GA. The researchers highlighted that this approach adds prognostic value to the Predicting Risk of cardiovascular disease EVENTS (PREVENT) score.
- “This approach may provide an opportunistic cardiovascular risk assessment during routine mammography screening without additional radiation exposure to guide earlier and more effective preventive care for women,” Dapamede and colleagues wrote.
- [Prior research](#) has established connections between BAC found on mammograms and cardiovascular disease risk. While the PREVENT calculator measures risk for cardiovascular disease, it relies on clinical and laboratory data and doesn't involve an anatomic assessment of cardiac vasculature.
- The group developed its transformer-based segmentation model to maintain high sensitivity while reducing false-positive detections related to artifacts or nonvascular calcifications. The model makes way for a standardized, automated quantification of BAC as an absolute physical metric (in mm²), it highlighted.
- Dapamede and colleagues studied whether AI-based automatic quantification of BAC from screening mammograms predicts cardiovascular disease and mortality beyond PREVENT scores.

- The retrospective cohort study included 123,762 women from two healthcare systems -- Emory Healthcare and Mayo Clinic Enterprise -- who had screening mammograms. The team used a transformer-based neural network for segmentation to calculate BAC severity by the following: zero (0 mm²), mild (>0–10 mm²), moderate (>10 mm² to 25 mm²), and severe (>25 mm²).
- Dapamede and colleagues found BACs in 16.1% of the Emory cohort and 20.6% of the Mayo Clinic cohort. Compared with zero BAC, mild, moderate, and severe BAC all proved to be prognostic for any MACE.

Comparison of BAC categories by hazard ratio		
BAC category	Emory cohort	Mayo Clinic cohort
Zero	1 (reference)	1 (reference)
Mild	1.32	1.28
Moderate	1.75	1.79
Severe	3.29	2.8

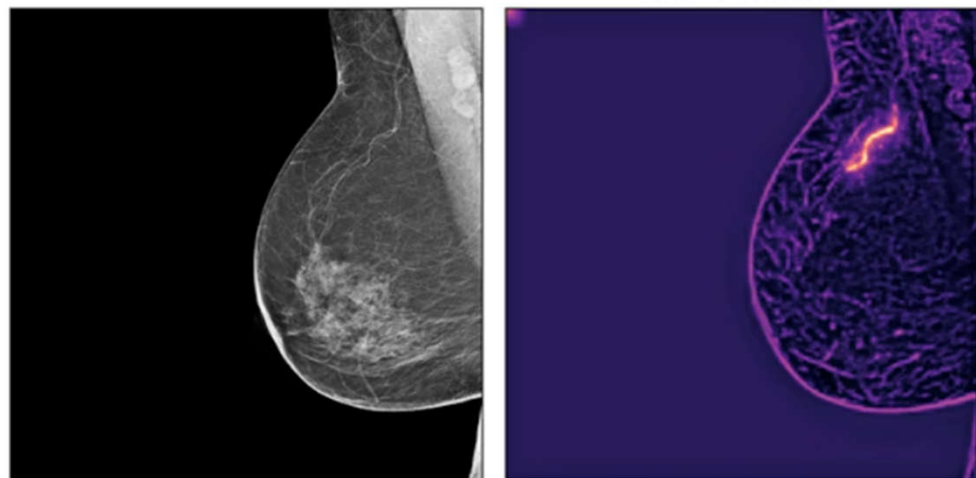
The researchers also found a pronounced dose-response relationship in both cohorts, where increasing BAC severity corresponded to increases in event rates.

In the Emory cohort, the incidence of MACE increased more than eightfold, from 5.96 per 1,000 person-years in women with zero BAC to 48.89 per 1,000 person-years in those with severe BAC. The team found that event rates were consistently higher in the Mayo Clinic cohort compared with the Emory cohort across all levels of BAC severity.

- Finally, each 1 mm² increase in BAC conferred an additional 2% to 3% risk for MACE (p < 0.001).

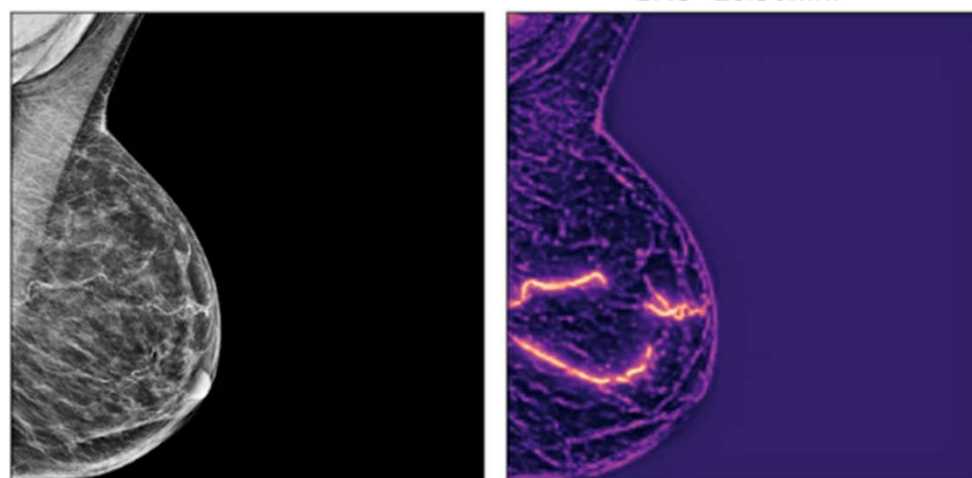
Mild BAC (>0 - 10mm²)

BAC=5.58mm²



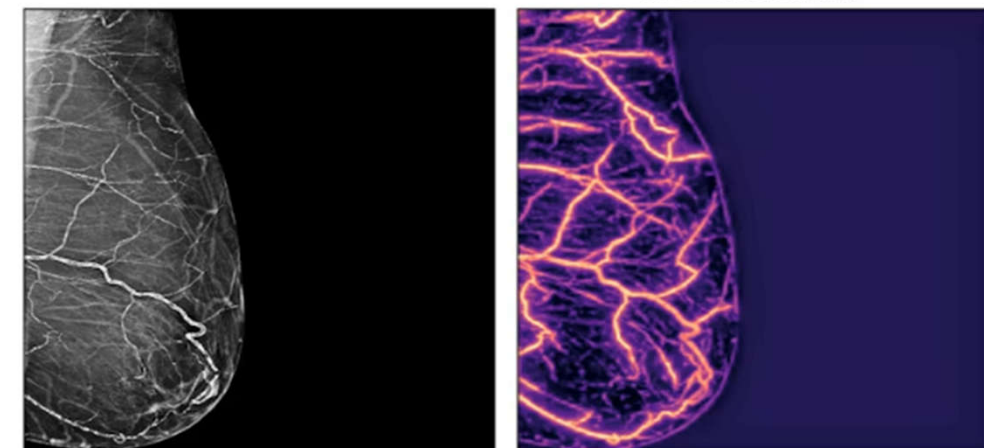
Moderate BAC (>10 - 25mm²)

BAC=18.30mm²



Severe BAC (>25mm²)

BAC=115.29mm²



Examples of mammograms with mild, moderate, and severe breast arterial calcification quantified by an AI model developed by researchers from Emory University and Mayo Clinic Enterprise. (Left) Original image. (Right) AI model heat map with breast arterial calcification score shown above.

- This approach could prove to be an opportunistic and effective cardiovascular risk assessment method in women, without added radiation exposure, the study authors highlighted.
- “Its predictive value is independent of traditional risk factors and PREVENT scores suggesting that BAC screening could enhance early cardiovascular risk detection in women undergoing routine mammography,” they wrote.
- The results of the implementation of BAC as an independent predictor of cardiovascular disease risk and mortality in women, wrote Lori Daniels, MD, from the University of California, San Diego, in an [accompanying editorial](#).
- "Regardless of the reporting metric ultimately adopted, it is time to shift BAC from observation to implementation, leveraging a touchpoint women already trust, to advance prevention for what remains the leading cause of death among women," Daniels wrote.

CLINICAL NEWS | WOMENS IMAGING

AI-mammography leads to no significant benefits in single-reader study



Amerigo Allegretto

Mar 20, 2026

- An AI mammography tool did not lead to significant benefits in a real-world single-reader study published March 18 in the *American Journal of Roentgenology*.
- Researchers led by Emily Ambinder, MD, from Johns Hopkins Medicine in Baltimore, MD, found that a federally approved AI interpretation tool for mammograms did not lead to significant changes in breast cancer detection and recall.
- “The present study failed to identify such benefits from AI assistance,” Ambinder and colleagues wrote.
- Recent studies have shown the potential benefits of using AI-assisted mammography in breast cancer screening. One study published in January analyzed results from the [Mammography Screening with Artificial Intelligence \(MASAI\) trial](#), which found that AI-assisted mammography led to more interval cancers being found and reduced radiologist workload. Another prospective study published in March found that AI-supported breast cancer screening that [excludes low-risk mammograms](#) from radiologist reading may be safe and effective.
- However, these European studies took place in double-reading settings, while U.S. practices employ single reading. The researchers called for more assessments in the U.S. with this in mind.

- Ambinder and colleagues studied the performance of radiologists when using a U.S. Food and Drug Administration-approved AI interpretation tool (Transpara Version 1.7.4-A, [ScreenPoint Medical](#)) in a real-world single-reading setting.
- The study included all screening mammograms performed using digital breast tomosynthesis (DBT) in 2024 and 2025. The team also formed a comparison group from DBT exams performed in 2022 and 2023.
- Final analysis included 24,520 screening mammograms from the same number of women after the AI tool was implemented. The comparison group consisted of 21,630 screening mammograms from the same number of women.
- The team found no significant differences between the two groups in terms of recall rate or cancer detection rate.

Comparison between pre-, post-AI implementation in breast cancer screening			
Measure	Pre-AI	Post-AI	p-value
Recall rate	12.3%	12.8%	0.13
Cancer detection rate per 1,000 women	6.7	7	0.69

- AI categorized 61.3% of exams as low risk, 34.9% as intermediate risk, and 3.8% as elevated risk. For the low-, intermediate-, and elevated-risk categories, the recall rate was 8.5%, 17.9%, and 35.7%, respectively ($p < 0.001$). And the cancer detection rate per 1,000 women was 0.5, 8.4, and 98, respectively ($p < 0.001$).
- All 91 cancers diagnosed in women classified by AI as elevated risk corresponded to AI-marked findings. The same went for 65 of 72 cancers diagnosed in women classified by AI as intermediate risk.
- The AI tool missed 15 of the 171 diagnosed cancers. These included all eight cancers deemed low-risk and the seven cancers for intermediate-risk exams that did not correspond with AI-marked findings. The missed cancers in the low-risk group included six invasive ductal carcinomas (IDCs) and two cases of ductal carcinoma in situ (DCIS). The intermediate-risk group included four IDCs and three cases of DCIS.
- With the slight increases seen in the study, the authors suggested that the results may support the use of AI for patient stratification.
- Still, they noted that breast cancer measures “did not significantly change after implementation of AI for mammography interpretation.”

BY



CLINICAL NEWS | WOMENS IMAGING

The future of BI-RADS includes AI



Amerigo Allegretto

Mar 10, 2026



- AI will further improve BI-RADS in later editions in measuring breast cancer risk, according to a presentation given March 6 at ECR 2026.
- In her talk, Linda Moy, MD, from NYU Langone Health in New York City, shared her thoughts on how radiologists should become AI literate as well as the need for more data and audits to validate the latest version of BI-RADS.
- “Where we’re going is what I’m calling AI-driven BI-RADS as a future workflow,” Moy said.
- The American College of Radiology (ACR) in late 2025 published its latest edition of BI-RADS, the first such update since 2013. Some additions to this version include new descriptors for elasticity assessment on breast ultrasound, MR imaging for breast implants, and nonmass lesions on ultrasound and digital breast tomosynthesis (DBT), among others. It also includes 900 clinical images that breast radiologists can use as a reference point.
- Radiologists continue to explore ways to integrate AI algorithms into clinical workflows, with research suggesting that AI assistance could lead to better patient outcomes.
- “We really need help from AI to decrease the number of follow-up exams and benign biopsies,” Moy said.
- She added that BI-RADS “has not fully adapted to” complexities in real-world settings for common benign findings and new modalities such as contrast-enhanced mammography (CEM). Prior studies also suggest moderate inter-reader variability for BI-RADS 3 and 4 lesions.

- Moy also said the data used to update BI-RADS is largely qualitative and has weak integration across imaging modalities and over time.
- “That makes it hard for us to really apply large-scale data capture to help improve this,” Moy said. “The update cycles for BI-RADS lag behind imaging and AI innovation.”
- She cited recent studies showing how standalone AI can be on par with radiologists interpreting mammography images and how AI can detect interval cancers missed on initial screening. She also highlighted the MASAI trial, which showed that AI assistance leads to improved cancer detection rates and positive predictive values, and also found that AI led to a 44% workload reduction.
- Moy emphasized the importance of AI literacy among radiologists. This includes having radiologists be aware of the advantages and challenges of AI use, so they don’t over-trust AI in breast cancer screening.
- Finally, she outlined how shifting from qualitative to quantitative data could help improve BI-RADS by standardizing data points to be machine-readable.
- “BI-RADS [currently] underrepresents quantitative and prognostic information that modern imaging can provide,” she said.
- She proposed that the future BI-RADS pipeline will include AI-calibrated risk estimates. This includes having AI provide continuous malignancy scores, refine and harmonize lexicon descriptors, and improve cross-modality consistency. This shift in data will help create the machine-readable framework needed for AI to perform, she added.
- “I would say that the long-term vision is a computable, adaptive BI-RADS that integrates AI outputs with patient-level risk to support personalized management,” Moy said.

So sánh BI-RADS 2013 vs 2025 (nhũ ảnh 2D)

Nội dung	BI-RADS 2013	BI-RADS 2025
Cấu trúc báo cáo	Chuẩn hóa gồm: chỉ định, kỹ thuật, mô tả, kết luận	Giữ cấu trúc cũ, nhấn mạnh rõ "assessment + management" tách biệt hơn
Phân loại mật độ tuyến vú	4 loại (A–D)	Không đổi, nhưng nhấn mạnh vai trò nguy cơ và ảnh hưởng đến phát hiện ung thư
Mô tả khối (mass)	Hình dạng, bờ, đậm độ	Không đổi cơ bản, nhưng chuẩn hóa thuật ngữ chặt hơn, giảm mơ hồ
Biến đổi vôi hóa (calcifications)	Phân loại hình thái và phân bố	Giữ nguyên, nhưng làm rõ hơn các pattern nguy cơ cao
Độ bất đối xứng (asymmetry)	4 loại (asymmetry, focal, developing, global)	Nhấn mạnh "developing asymmetry" là dấu hiệu đáng chú ý hơn
Biến dạng cấu trúc (distortion)	Có mô tả	Nhấn mạnh hơn vai trò cảnh báo ác tính, đặc biệt khi không thấy khối
Phân loại BI-RADS (0–6)	Không đổi	Không đổi, nhưng tăng liên kết với khuyến cáo xử trí cụ thể hơn
Ngôn ngữ báo cáo	Cho phép linh hoạt	Chuẩn hóa mạnh hơn, hạn chế từ mơ hồ (ví dụ: "probably benign" phải rõ tiêu chí)
Việc hợp AI / CAD	Không đề cập rõ	Bắt đầu đề cập vai trò AI hỗ trợ, nhưng không thay thế đánh giá bác sĩ
Định hướng lâm sàng	Chủ yếu mô tả hình ảnh	Tăng tính "hướng dẫn quyết định" (decision support)
So sánh với phương tiện khác	Có nhưng hạn chế	Khuyến khích liên kết với DBT, MRI, siêu âm khi cần

BI-RADS 6th Edition: What's New, What's Not - Sample https://www.youtube.com/watch?v=2LOjYI_sD00