

# 中国女性乳腺系列精细面元模型的建立及研究

## 摘要

乳腺癌已成为世界第一大癌症，乳腺对 DM 等外照射辐射极为敏感，因此需要通过精细且可变性的方式对乳腺外照射剂量进行准确的评估。然而国际通用模型大多采用高加索人的乳房特征进行建模，这并不符合中国女性乳房特征，影响剂量评估的准确性，因此亟需建立一套符合我国女性乳房结构的面元模型。本文采用中国女性内衣数据，采用数学方法生成了一套精细的符合中国女性乳房特征的系列乳房模型，模型中建立了腺体内脂肪组织、输乳管及 TDLU 腺小叶等多种精细结构，且该系列包含了 AA、A、B、C、D 五种尺寸的乳房模型，同时每类乳房模型中又分别建立腺体含量分别为 25%、50% 和 75% 的三组乳腺模型。同时通过蒙特卡罗模拟计算并绘制了 AP 几何照射场景中不同模型参数下腺体剂量转换系数随不同能量光子照射的变化曲线，探究了影响乳腺腺体剂量转换系数的因素。

## 关键词

面元模型；剂量转换系数；中国女性特征

## Abstract

Breast cancer has become the most prevalent cancer worldwide. Given the high radiosensitivity of breast tissue to external radiation such as diagnostic mammography (DM), accurate assessment of the external radiation dose to the breast is critically important. However, most internationally used models are based on the anatomical characteristics of Caucasian women, which do not adequately represent the breast morphology of Chinese women, thus affecting the accuracy of dose assessment. Therefore, there is an urgent need to develop a mesh-based breast model that reflects the anatomical features of Chinese women. In this study, we constructed a series of high-resolution breast models based on anthropometric data derived from Chinese women's underwear sizes. The models incorporate detailed anatomical structures, including adipose tissue within the glandular region, milk ducts, and terminal duct lobular units (TDLUs). The series includes five cup sizes—AA, A, B, C, and D—each further subdivided into three glandular content levels: 25%, 50%, and 75%. Monte Carlo simulations were performed to calculate and visualize the variations in glandular dose conversion coefficients under anterior-posterior (AP) irradiation scenarios across different photon energies. The study also explores key factors influencing glandular dose conversion, providing critical insights for improving the accuracy of breast dose assessments in Chinese women.

## Keywords

mesh-based model; dose conversion coefficient; anatomical characteristics of Chinese women

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