

Mammogram marking protocol

Version 2.5

Date: 07.10.2025

1. The introductory part

1.1. Protocol assignment

This document describes the annotation process for mammographic images in the context of alignment quality assessment. The protocol is intended for team members involved in medical image annotation and ensures the consistency and accuracy of labeling.

1.2. Scope

The protocol applies to the annotation of images from the MGRegBench dataset.

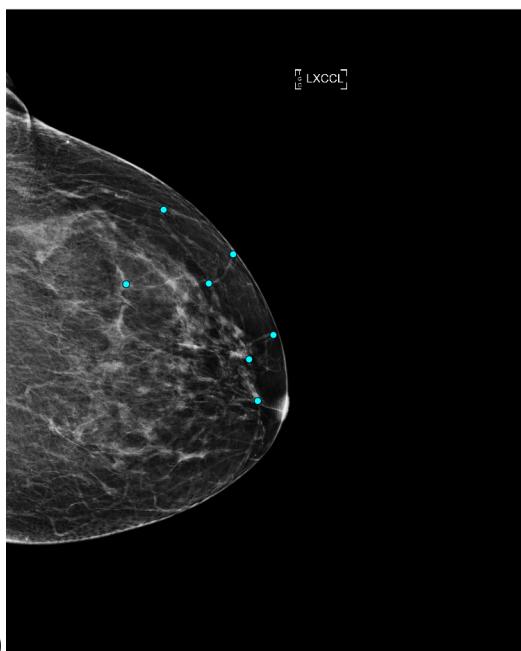
1.3. Terms and Definitions

- Landmark: An anatomically significant point (e.g., a vessel bifurcation). A pair of corresponding landmarks is used to assess the quality of image alignment. Landmarks serve as objective control points and enable the quantitative measurement of registration error. The integration of landmarks into the benchmark will facilitate the comparative analysis of registration methods, the optimization of their parameters, and the validation of the most accurate algorithms for subsequent applications, such as change detection over time.
 - Projection: The type of mammographic view (e.g., MLO - mediolateral oblique, CC - craniocaudal).
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2. Annotation Guide

2.1. General Annotation Rules

- Annotate only visible and clear anatomical structures: calcifications, sharp bends, bifurcations/trifurcations, ends of ducts/vessels, sharp edges of masses, concavities of masses, dark/bright spots.
- Points must be uniformly distributed across the glandular tissue.
Example (1) shows poor distribution - the lower part of the image is not covered. Example (2) shows good distribution - points are more evenly spread.

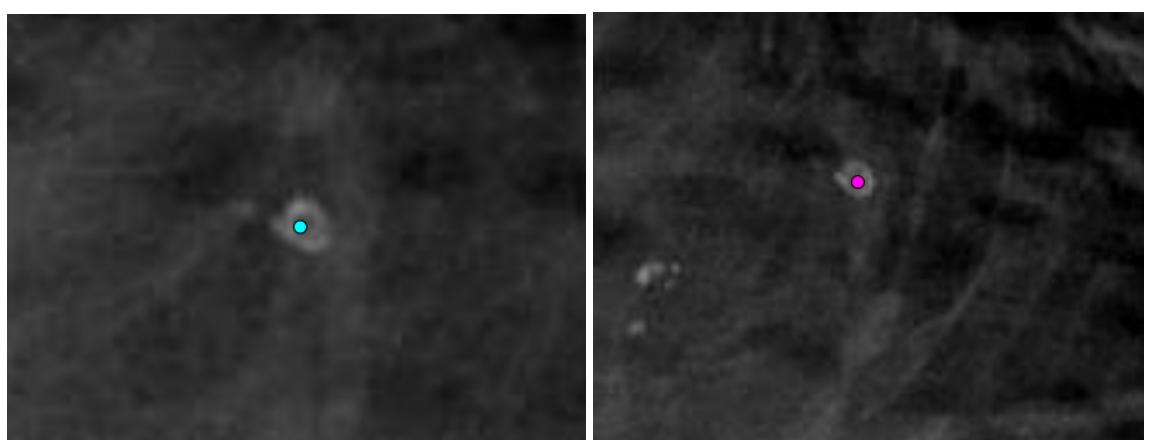
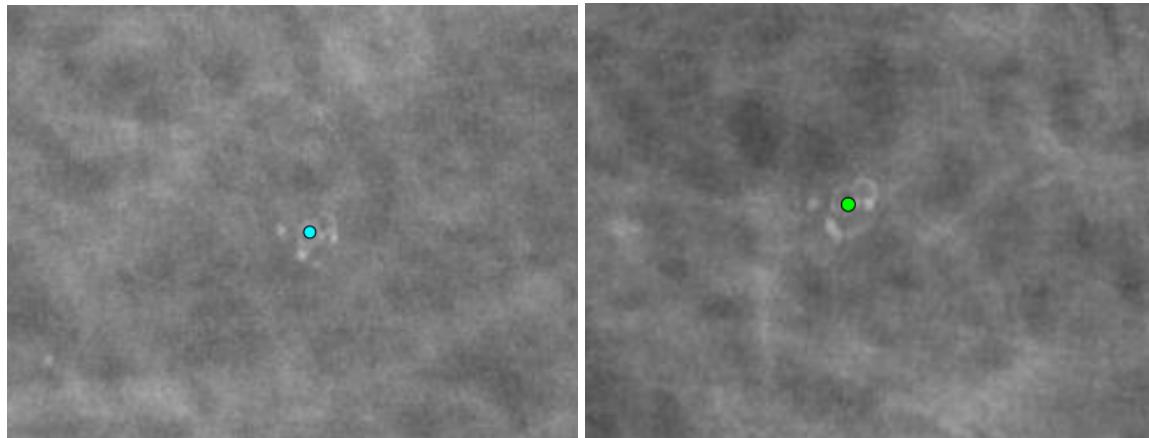


(1)



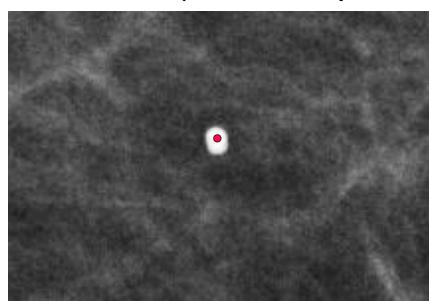
(2)

- Avoid annotating artifacts (e.g., skin folds, projection markers).
- Do not annotate the nipple point.
- Always place the first point on the left image, and the second point on the right image.
- Each image pair should contain 15-20 landmarks. It's recommended to mark points with some extras, as some points will be filtered out during the validation stage.
- Always carefully examine the image at a large scale! A mammogram may contain numerous small, well-distinguishable calcifications. Moreover, these calcifications are often clearly visible on both images in the pair and can be easily matched.

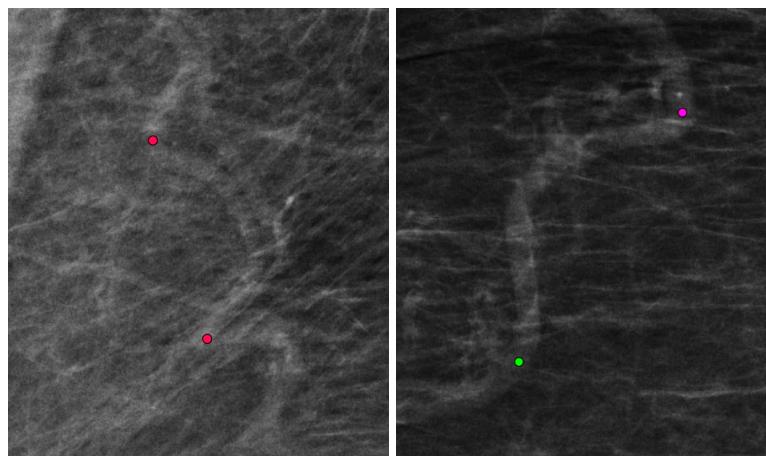


2.2. Landmarks examples

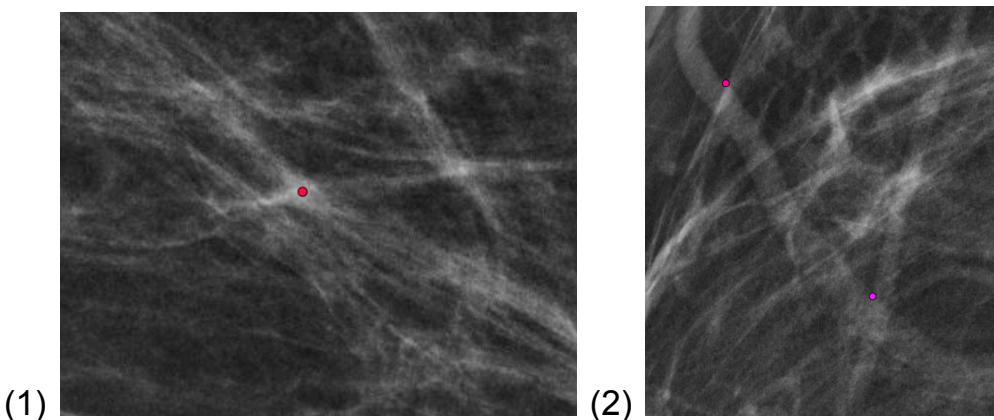
- Calcinates (the dot is placed in the center of the white spot)



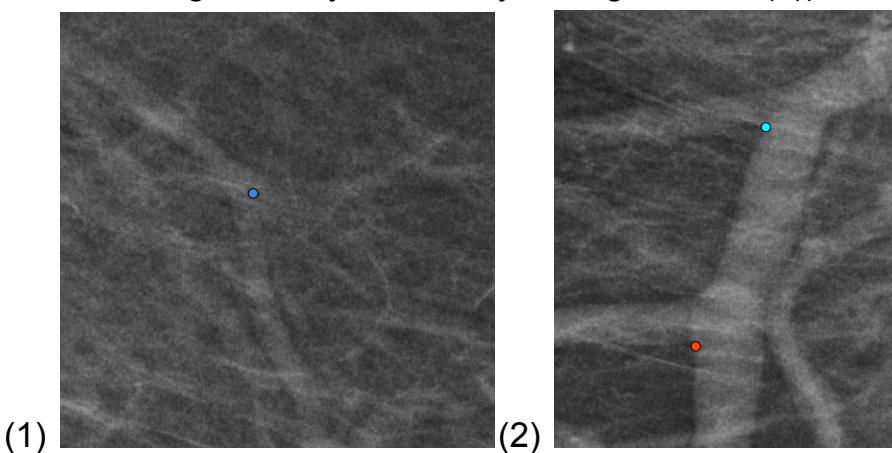
- Bends (the point is placed in the center of the bending structure at the bend point)



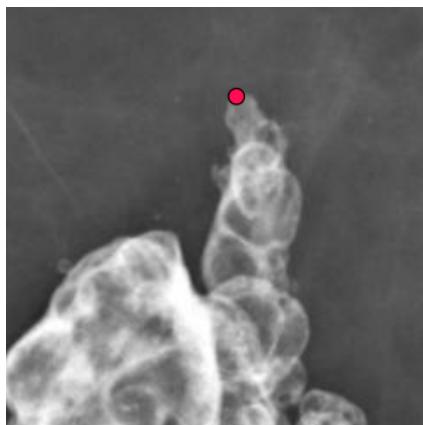
- Intersections of ducts (a dot is placed at the center of the intersection (1) or at the borders of the intersection of vessels if they are very clear and the structures are thick (2))



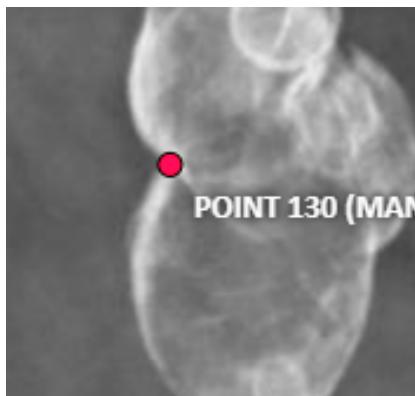
- Bifurcation (the dot is placed in the center of the bifurcation (1), or on the inner edges if they are clearly distinguishable (2))



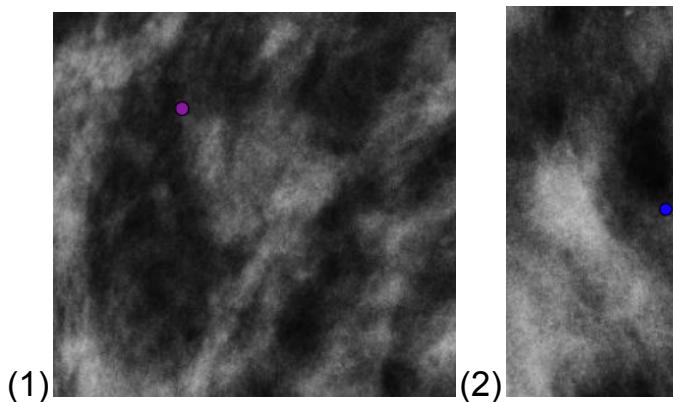
- Sharp edges of masses



- Concavities of masses



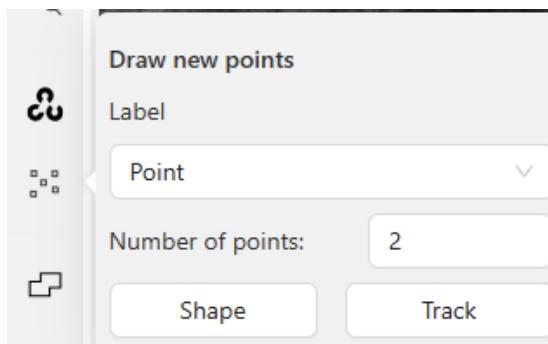
- Dark spots (the dot is placed on clearly distinguishable concavities or sharp edges of spots)



3. Initial Annotation

3.1. Annotation process

1. You have been provided with a link to the task in CVAT. Begin annotation with the first image pair, then proceed to the next, and so on.
2. Add points as follows:
 - Click the "Draw new points" button
 - Select the Label "Point".
 - Set the "Number of points" to 2.
 - Choose the annotation method "Shape" (not Track!)
 - Click on the left image at the landmark location and on the right image at the corresponding landmark location.



3. Review the annotation:
 - Verify that all landmarks correspond to anatomical structures.
 - If necessary, adjust the position of points. You can drag a point with the mouse to the desired location.
4. Save the annotation using Ctrl+S or by clicking the floppy disk icon, then proceed to the next image.



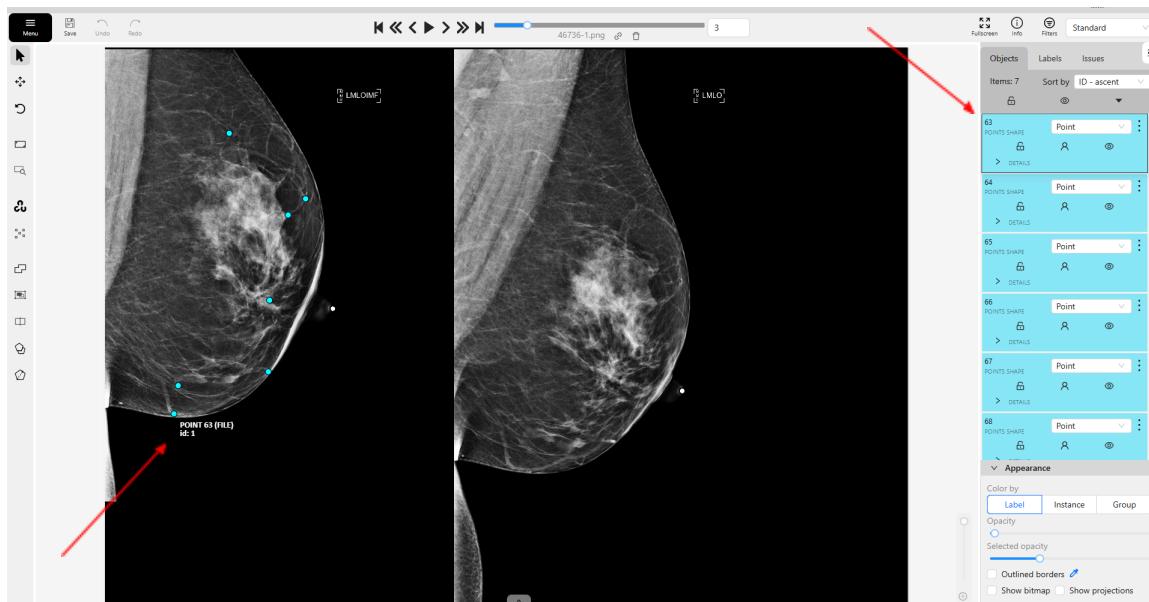
3.2. Exporting Annotations

1. Click Menu -> Export job dataset.
2. In the pop-up window, select Export format: CVAT for images 1.1, specify the archive name, and save it to your preferred directory.

4. Secondary Annotation (Validation)

4.1. Annotation Process

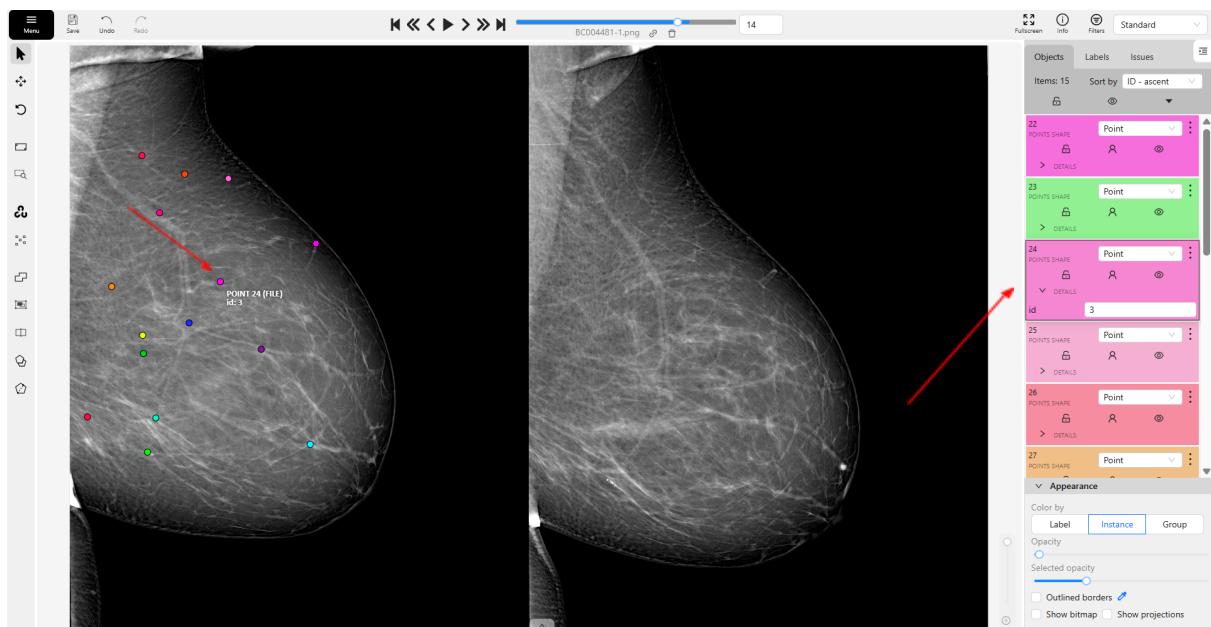
1. You have been provided with a link to the task in CVAT. Begin with the first image pair, then proceed to the next, and so on.
2. During the validation stage, points are already placed on the left image. Your task is to find the corresponding pair for each existing point. If you cannot identify which anatomical structure corresponds to an existing point, it is likely that your colleague marked a small but well-matchable calcification. Therefore, you should examine the image at a larger scale.
3. To add a point:
 - Click the "Draw new points" button
 - Select the Label "Point".
 - Set the "Number of points" to 2.
 - Choose the annotation method "Shape" (not Track!).
 - Click on the image in the place of the intended landmark on the image where the dots are not marked.
4. At this stage, it is crucial to track the ID of each point. To determine a point's ID:
 - Look at the panel on the right side, which lists all already placed points.
 - Hover over the point for which you need to find a pair. In the example below, the cursor is hovering over point number 63. This same point is highlighted on the left image. It can be seen that it has ID = 1.



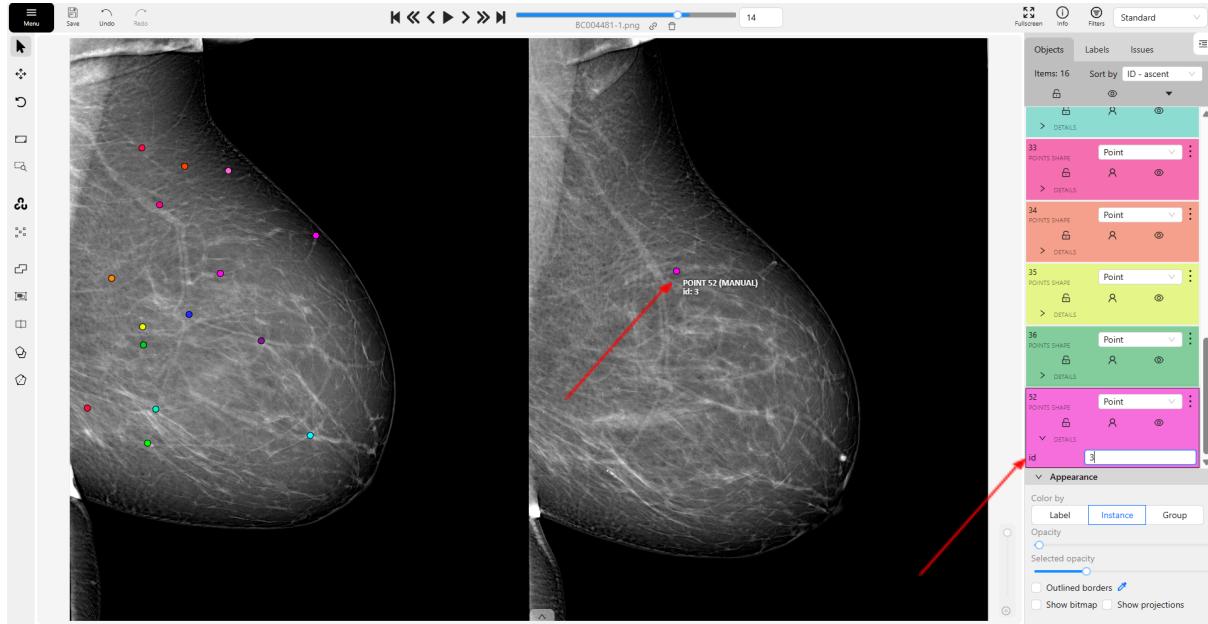
- Remember the ID obtained in the previous step. Place the point that you believe corresponds to the analyzed one. After placing it, the point will appear at the very end of the list in the right-side panel. For the new point, you must assign the same ID! To specify the ID, go to Details and enter the ID extracted in the previous step. Repeat this procedure for each point.



In the example below, I have hovered the cursor over the pink point number 24. The same point is highlighted on the left image. It can be seen that it has ID = 3.



I have paired it with point number 52 and assigned it the same ID = 3



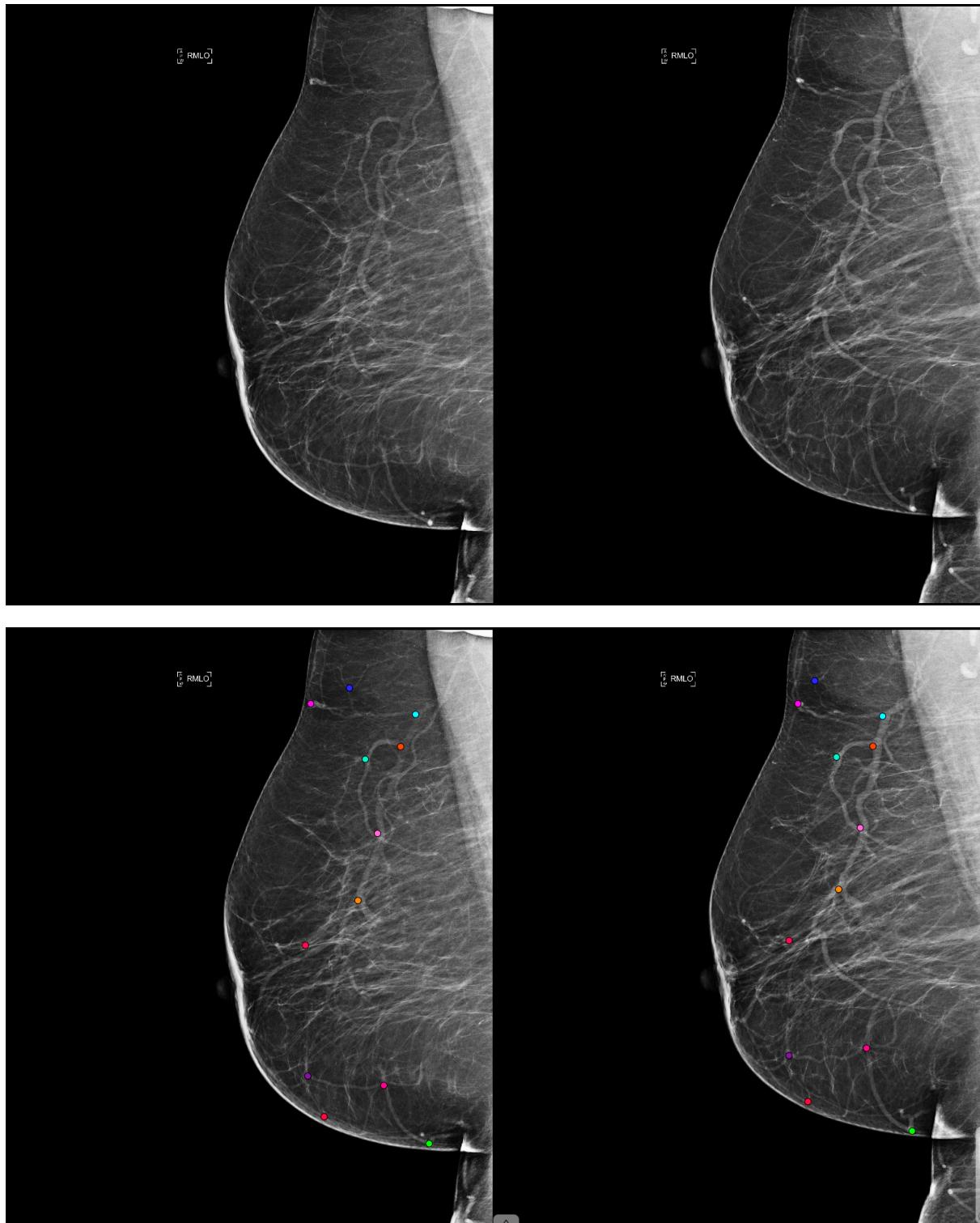
5. Carefully review the annotation! Ensure there is a one-to-one correspondence between the IDs of the original points and the IDs of the points you placed.
6. Save the annotation using Ctrl+S or by clicking the floppy disk icon, then proceed to the next image.

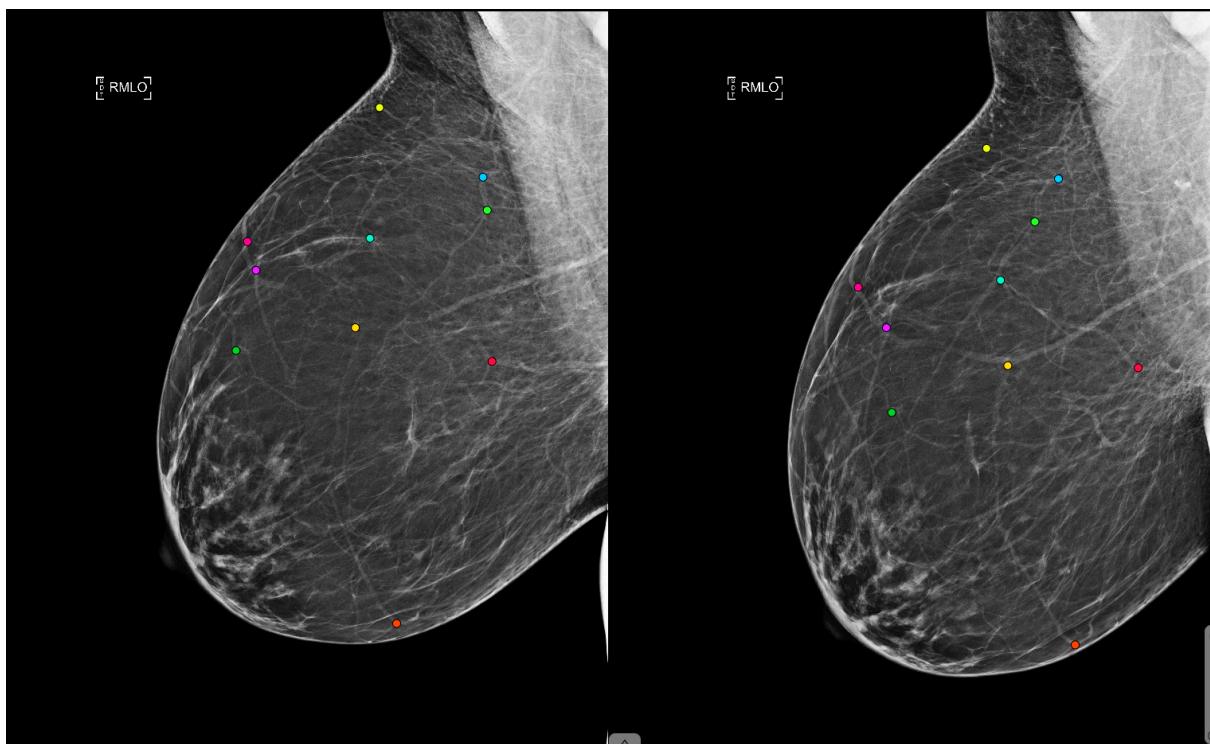
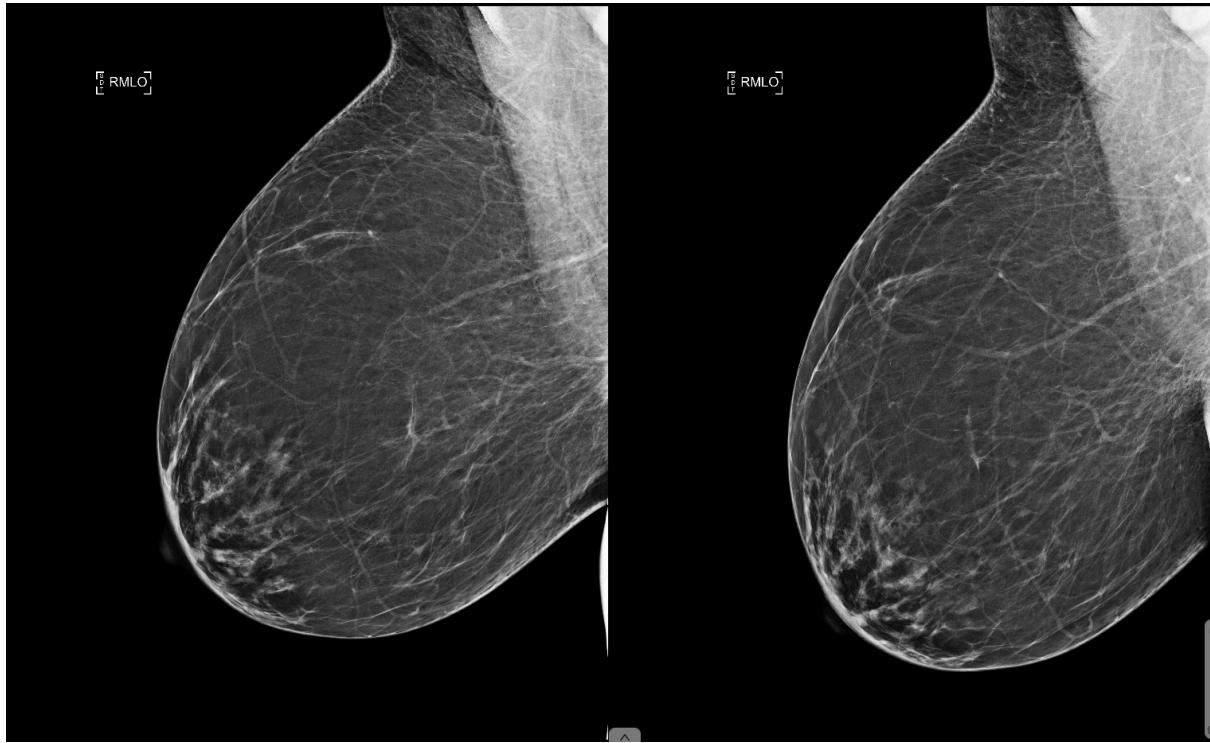
4.2. Exporting Annotations

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5. Applications

5.1. Markup examples





6. Conclusion

Follow this protocol to ensure the accuracy and consistency of annotations.
