

# Mask2Lesion: Mask-Constrained Adversarial Skin Lesion Image Synthesis



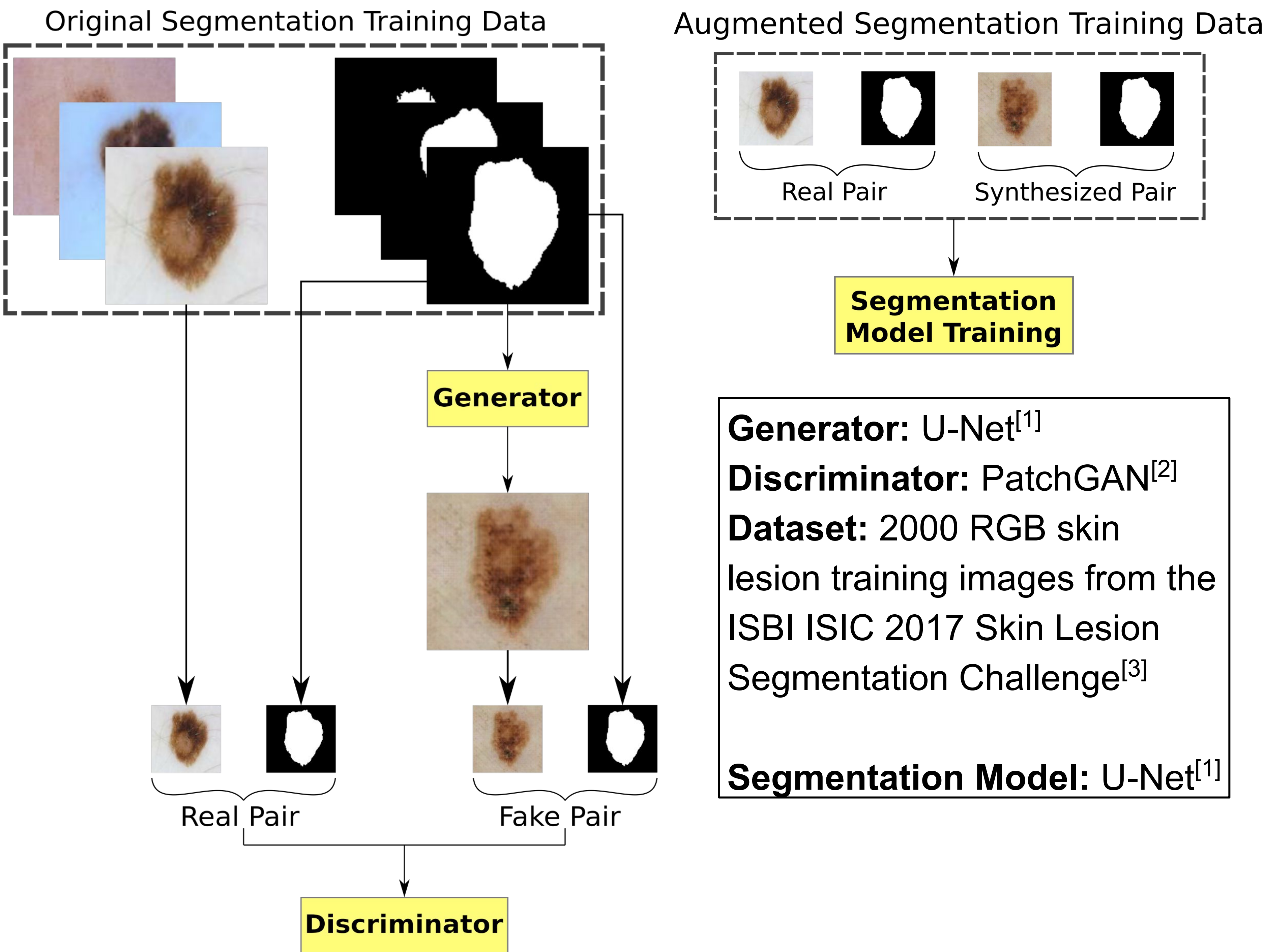
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**Question:** Can we generate realistic skin lesion images of desired shapes?

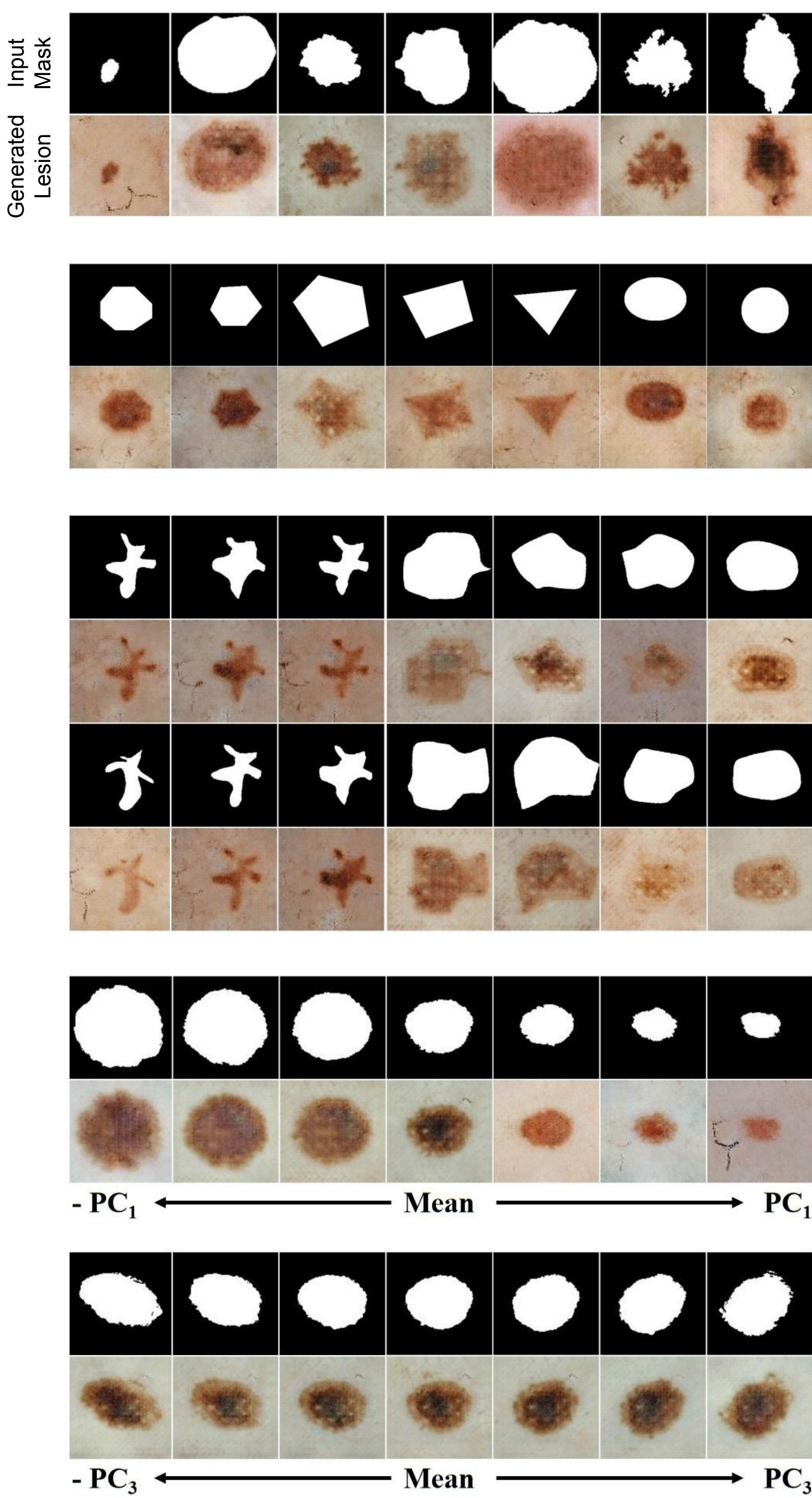
**Motivation:** Pixel level annotations for medical image segmentation are limited, and GANs have been used to generate realistic images of natural objects from sketches.

## Proposed Approach

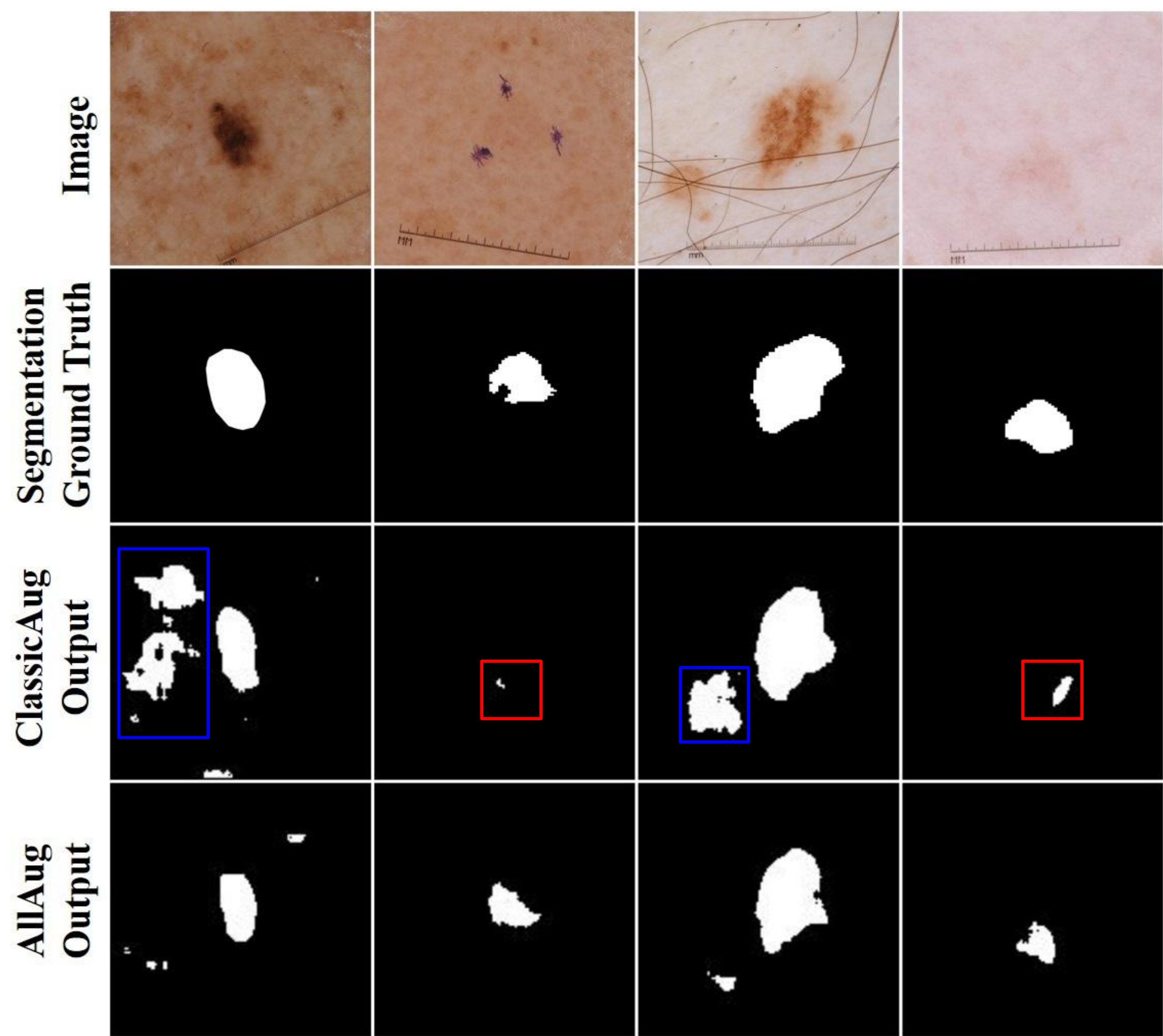


$$\mathcal{L}_{cGAN}(G, D) = \mathbb{E}_{x,y} [\log D(x, y)] + \mathbb{E}_{x,z} [\log (1 - D(x, G(x, z)))]$$

## Mask2Lesion Outputs



## Lesion Segmentation Results



Quantitative results for segmentation (Mean  $\pm$  standard error)

Method	NoAug	ClassicAug	Mask2LesionAug	AllAug
Aug. Method	Classical	✓	✗	✓
Method	Mask2Lesion	✗	✓	✓
Dice	0.7723 $\pm$ 0.0185	0.7743 $\pm$ 0.0203	0.7849 $\pm$ 0.0160	<b>0.8144 <math>\pm</math> 0.0160</b>
Accuracy	0.9316 $\pm$ 0.0089	0.9321 $\pm$ 0.0086	0.9311 $\pm$ 0.0087	<b>0.9375 <math>\pm</math> 0.0091</b>
Sensitivity	0.7798 $\pm$ 0.0211	0.8094 $\pm$ 0.0222	0.8197 $\pm$ 0.0186	<b>0.8197 <math>\pm</math> 0.0182</b>
Specificity	0.9744 $\pm$ 0.0035	0.9672 $\pm$ 0.0047	0.9698 $\pm$ 0.0045	<b>0.9762 <math>\pm</math> 0.0038</b>

### Summary of contributions:

- First work to generate realistic skin lesion images from binary masks.
- Synthesized lesions confined to the masks, regardless of their complexity.
- Generated images used to augment segmentation data, leading to improved skin lesion segmentation performance with lower false positives (□) and false negatives (□).

## References

- [1] Ronneberger et al., "U-net: Convolutional networks for biomedical image segmentation," MICCAI 2015.  
[2] Isola et al., "Image-to-image translation with conditional adversarial networks," CVPR 2017.  
[3] Codella et al., "Skin Lesion Analysis Toward Melanoma Detection: A Challenge at the 2017 International Symposium on Biomedical Imaging (ISBI), Hosted by the International Skin Imaging Collaboration (ISIC)", ISBI 2018.

