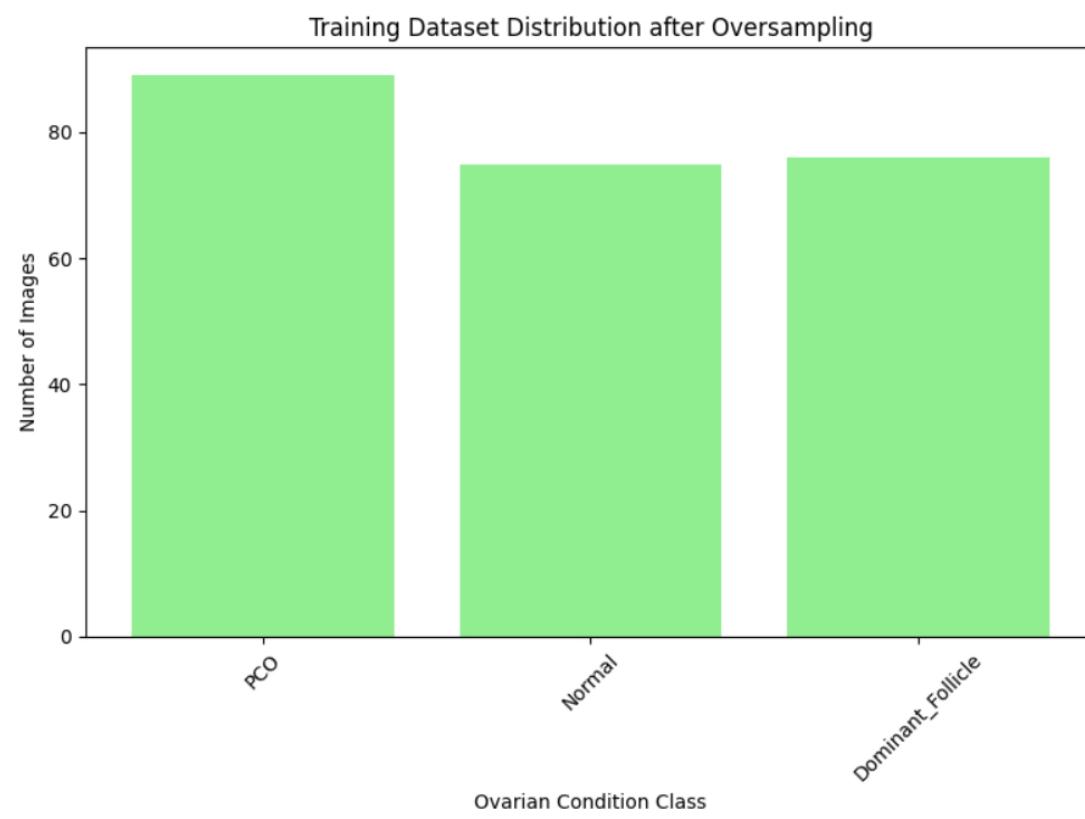
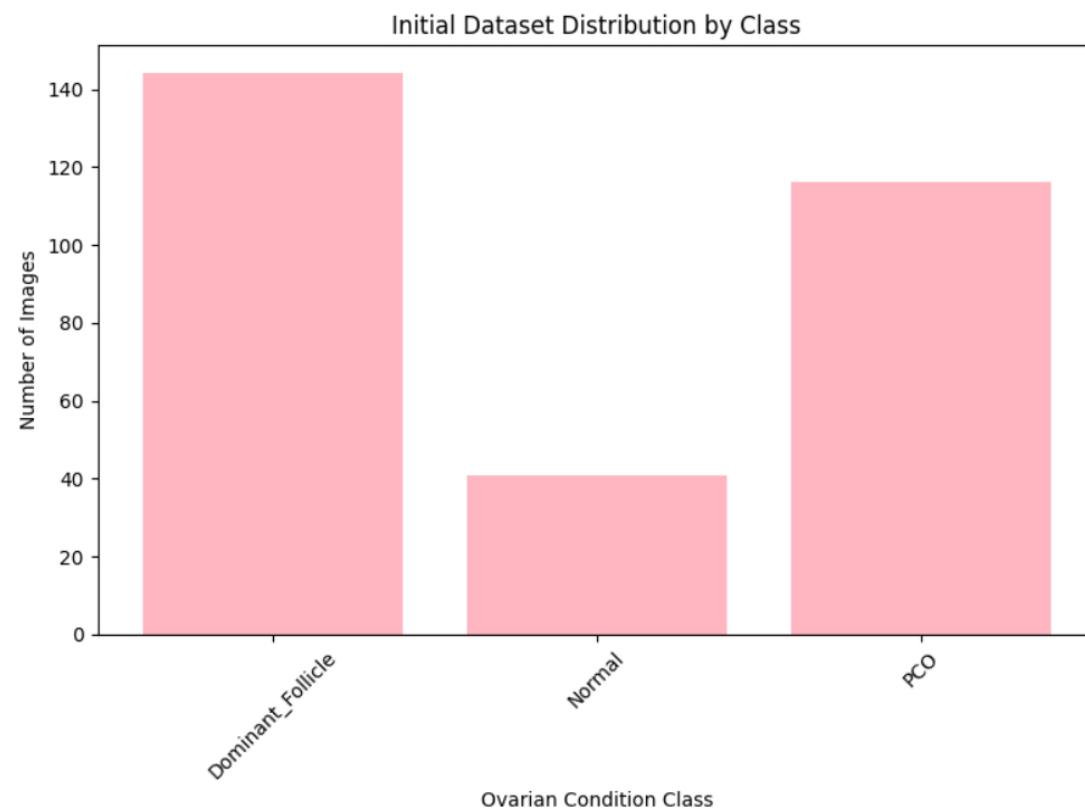


In [1]:

Using device: cuda:0



```
Classes: ['Dominant_Follicle', 'Normal', 'PCO']
Training set size: 240
Validation set size: 61
Oversampled training set size: 240
```

```
model.safetensors: 100% [██████████] 354M/354M [00:01<00:00, 263MB/s]
```

```
Epoch 1/200
```

```
-----
```

```
train phase: 100%|██████████| 15/15 [00:36<00:00, 2.41s/it]
```

```
train Loss: 1.1565 Acc: 0.3083 F1: 0.2600 Precision: 0.2968 Recall: 0.2934
```

```
val phase: 100%|██████████| 4/4 [00:01<00:00, 2.31it/s]
```

```
val Loss: 1.0180 Acc: 0.3770 F1: 0.2131 Precision: 0.2384 Recall: 0.3030
```

```
Epoch 2/200
```

```
-----
```

```
train phase: 100%|██████████| 15/15 [00:34<00:00, 2.33s/it]
```

```
train Loss: 1.0080 Acc: 0.4958 F1: 0.4382 Precision: 0.5827 Recall: 0.4497
```

```
val phase: 100%|██████████| 4/4 [00:01<00:00, 2.38it/s]
```

```
val Loss: 0.9661 Acc: 0.4426 F1: 0.3933 Precision: 0.6384 Recall: 0.4231
```

```
Epoch 3/200
```

```
-----
```

```
train phase: 100%|██████████| 15/15 [00:34<00:00, 2.33s/it]
```

```
train Loss: 0.9570 Acc: 0.5417 F1: 0.5479 Precision: 0.5757 Recall: 0.5423
```

```
val phase: 100%|██████████| 4/4 [00:01<00:00, 2.36it/s]
```

```
val Loss: 0.8757 Acc: 0.6230 F1: 0.7038 Precision: 0.7464 Recall: 0.7283
```

```
Epoch 4/200
```

```
-----
```

```
train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]
```

```
train Loss: 0.8125 Acc: 0.6125 F1: 0.5950 Precision: 0.5987 Recall: 0.5925
```

```
val phase: 100%|██████████| 4/4 [00:01<00:00, 2.37it/s]
```

```
val Loss: 0.7543 Acc: 0.5246 F1: 0.6265 Precision: 0.6500 Recall: 0.6538
```

```
Epoch 5/200
```

```
-----
```

```
train phase: 100%|██████████| 15/15 [00:35<00:00,  2.33s/it]

train Loss: 0.7501 Acc: 0.6792 F1: 0.6647 Precision: 0.6978 Recall: 0.6615

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.35it/s]

val Loss: 0.7003 Acc: 0.6721 F1: 0.7290 Precision: 0.7168 Recall: 0.7480
Epoch 6/200
-----

train phase: 100%|██████████| 15/15 [00:34<00:00,  2.33s/it]

train Loss: 0.7311 Acc: 0.6625 F1: 0.6530 Precision: 0.7123 Recall: 0.6587

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.38it/s]

val Loss: 0.6969 Acc: 0.6557 F1: 0.7333 Precision: 0.7675 Recall: 0.7513
Epoch 7/200
-----

train phase: 100%|██████████| 15/15 [00:34<00:00,  2.33s/it]

train Loss: 0.7442 Acc: 0.6458 F1: 0.6547 Precision: 0.6846 Recall: 0.6469

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.37it/s]

val Loss: 0.6472 Acc: 0.7869 F1: 0.8349 Precision: 0.8451 Recall: 0.8340
Epoch 8/200
-----

train phase: 100%|██████████| 15/15 [00:34<00:00,  2.33s/it]

train Loss: 0.7147 Acc: 0.6875 F1: 0.6907 Precision: 0.7083 Recall: 0.6826

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.37it/s]

val Loss: 0.6397 Acc: 0.6885 F1: 0.7553 Precision: 0.8107 Recall: 0.7779
Epoch 9/200
-----

train phase: 100%|██████████| 15/15 [00:35<00:00,  2.33s/it]

train Loss: 0.5970 Acc: 0.7667 F1: 0.7652 Precision: 0.7729 Recall: 0.7656

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.39it/s]

val Loss: 0.6086 Acc: 0.7869 F1: 0.8221 Precision: 0.8149 Recall: 0.8432
Epoch 10/200
-----

train phase: 100%|██████████| 15/15 [00:35<00:00,  2.33s/it]
```

train Loss: 0.6033 Acc: 0.7500 F1: 0.7512 Precision: 0.7517 Recall: 0.7508

val phase: 100% |██████████| 4/4 [00:01<00:00, 2.39it/s]

val Loss: 0.5325 Acc: 0.8033 F1: 0.8519 Precision: 0.8547 Recall: 0.8547  
Epoch 11/200

train phase: 100% |██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.6168 Acc: 0.7417 F1: 0.7460 Precision: 0.7708 Recall: 0.7382

val phase: 100% |██████████| 4/4 [00:01<00:00, 2.36it/s]

val Loss: 0.4889 Acc: 0.8361 F1: 0.8676 Precision: 0.9145 Recall: 0.8667  
Epoch 12/200

train phase: 100% |██████████| 15/15 [00:35<00:00, 2.33s/it]

train Loss: 0.5702 Acc: 0.7875 F1: 0.7799 Precision: 0.7817 Recall: 0.7857

val phase: 100% |██████████| 4/4 [00:01<00:00, 2.34it/s]

val Loss: 0.5100 Acc: 0.8689 F1: 0.9000 Precision: 0.9028 Recall: 0.8989  
Epoch 13/200

train phase: 100% |██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.5122 Acc: 0.8000 F1: 0.8016 Precision: 0.8225 Recall: 0.7972

val phase: 100% |██████████| 4/4 [00:01<00:00, 2.34it/s]

val Loss: 0.4658 Acc: 0.8689 F1: 0.8961 Precision: 0.9279 Recall: 0.8933  
Epoch 14/200

train phase: 100% |██████████| 15/15 [00:34<00:00, 2.33s/it]

train Loss: 0.5936 Acc: 0.7417 F1: 0.7361 Precision: 0.7431 Recall: 0.7339

val phase: 100% |██████████| 4/4 [00:01<00:00, 2.38it/s]

val Loss: 0.5531 Acc: 0.8197 F1: 0.8528 Precision: 0.9083 Recall: 0.8533  
Epoch 15/200

train phase: 100% |██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.5826 Acc: 0.7500 F1: 0.7405 Precision: 0.7404 Recall: 0.7423

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.39it/s]

val Loss: 0.4525 Acc: 0.8689 F1: 0.8961 Precision: 0.9279 Recall: 0.8933  
Epoch 16/200

-----  
train phase: 100%|██████████| 15/15 [00:34<00:00, 2.33s/it]

train Loss: 0.5018 Acc: 0.8250 F1: 0.8255 Precision: 0.8345 Recall: 0.8221

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.34it/s]

val Loss: 0.4363 Acc: 0.8689 F1: 0.9000 Precision: 0.9028 Recall: 0.8989  
Epoch 17/200

-----  
train phase: 100%|██████████| 15/15 [00:34<00:00, 2.33s/it]

train Loss: 0.5783 Acc: 0.7542 F1: 0.7598 Precision: 0.7794 Recall: 0.7532

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.36it/s]

val Loss: 0.4915 Acc: 0.8361 F1: 0.8396 Precision: 0.8302 Recall: 0.8703  
Epoch 18/200

-----  
train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.4553 Acc: 0.8458 F1: 0.8483 Precision: 0.8549 Recall: 0.8460

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.34it/s]

val Loss: 0.4155 Acc: 0.8852 F1: 0.9133 Precision: 0.9130 Recall: 0.9140  
Epoch 19/200

-----  
train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.4237 Acc: 0.8250 F1: 0.8261 Precision: 0.8317 Recall: 0.8274

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.36it/s]

val Loss: 0.4629 Acc: 0.7869 F1: 0.8078 Precision: 0.8405 Recall: 0.8285  
Epoch 20/200

-----  
train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.4558 Acc: 0.8375 F1: 0.8346 Precision: 0.8380 Recall: 0.8341

```
val phase: 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]

val Loss: 0.3851 Acc: 0.8525 F1: 0.8885 Precision: 0.8883 Recall: 0.8892
Epoch 21/200
-----

train phase: 100%|██████████| 15/15 [00:35<00:00,  2.33s/it]

train Loss: 0.4457 Acc: 0.8250 F1: 0.8232 Precision: 0.8337 Recall: 0.8273

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.37it/s]

val Loss: 0.4932 Acc: 0.8033 F1: 0.8376 Precision: 0.9024 Recall: 0.8400
Epoch 22/200
-----

train phase: 100%|██████████| 15/15 [00:34<00:00,  2.33s/it]

train Loss: 0.3556 Acc: 0.8875 F1: 0.8888 Precision: 0.8934 Recall: 0.8859

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.39it/s]

val Loss: 0.3966 Acc: 0.8525 F1: 0.8841 Precision: 0.9074 Recall: 0.8818
Epoch 23/200
-----

train phase: 100%|██████████| 15/15 [00:34<00:00,  2.33s/it]

train Loss: 0.3619 Acc: 0.8875 F1: 0.8876 Precision: 0.8882 Recall: 0.8883

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.37it/s]

val Loss: 0.3550 Acc: 0.8689 F1: 0.9011 Precision: 0.9012 Recall: 0.9025
Epoch 24/200
-----

train phase: 100%|██████████| 15/15 [00:35<00:00,  2.34s/it]

train Loss: 0.3314 Acc: 0.9083 F1: 0.9063 Precision: 0.9073 Recall: 0.9072

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.38it/s]

val Loss: 0.3380 Acc: 0.8852 F1: 0.9121 Precision: 0.9176 Recall: 0.9103
Epoch 25/200
-----

train phase: 100%|██████████| 15/15 [00:35<00:00,  2.34s/it]

train Loss: 0.3816 Acc: 0.8542 F1: 0.8587 Precision: 0.8641 Recall: 0.8551

val phase: 100%|██████████| 4/4 [00:01<00:00,  2.37it/s]
```

val Loss: 0.3468 Acc: 0.8689 F1: 0.9007 Precision: 0.9007 Recall: 0.9007  
Epoch 26/200

-----

train phase: 100%|██████████| 15/15 [00:34<00:00, 2.33s/it]

train Loss: 0.4722 Acc: 0.8000 F1: 0.8004 Precision: 0.8045 Recall: 0.8000

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.35it/s]

val Loss: 0.4222 Acc: 0.8689 F1: 0.8977 Precision: 0.9158 Recall: 0.8952  
Epoch 27/200

-----

train phase: 100%|██████████| 15/15 [00:34<00:00, 2.33s/it]

train Loss: 0.4021 Acc: 0.8292 F1: 0.8306 Precision: 0.8557 Recall: 0.8190

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.37it/s]

val Loss: 0.3412 Acc: 0.8689 F1: 0.9007 Precision: 0.9007 Recall: 0.9007  
Epoch 28/200

-----

train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.4149 Acc: 0.8417 F1: 0.8428 Precision: 0.8465 Recall: 0.8399

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.37it/s]

val Loss: 0.3298 Acc: 0.8689 F1: 0.9007 Precision: 0.9007 Recall: 0.9007  
Epoch 29/200

-----

train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.3893 Acc: 0.8583 F1: 0.8592 Precision: 0.8686 Recall: 0.8547

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.32it/s]

val Loss: 0.3588 Acc: 0.8689 F1: 0.8990 Precision: 0.9076 Recall: 0.8970  
Epoch 30/200

-----

train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.3790 Acc: 0.8750 F1: 0.8791 Precision: 0.8841 Recall: 0.8761

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.38it/s]

val Loss: 0.3217 Acc: 0.9016 F1: 0.9255 Precision: 0.9255 Recall: 0.9255

-----  
Epoch 31/200  
-----

train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.3034 Acc: 0.8833 F1: 0.8849 Precision: 0.8924 Recall: 0.8795

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.35it/s]

val Loss: 0.3426 Acc: 0.8852 F1: 0.9133 Precision: 0.9130 Recall: 0.9140

Epoch 32/200  
-----

train phase: 100%|██████████| 15/15 [00:34<00:00, 2.33s/it]

train Loss: 0.3043 Acc: 0.9000 F1: 0.9032 Precision: 0.9074 Recall: 0.9002

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.38it/s]

val Loss: 0.3030 Acc: 0.8852 F1: 0.9121 Precision: 0.9176 Recall: 0.9103

Epoch 33/200  
-----

train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.2693 Acc: 0.9083 F1: 0.9097 Precision: 0.9186 Recall: 0.9053

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.35it/s]

val Loss: 0.3051 Acc: 0.9016 F1: 0.9250 Precision: 0.9280 Recall: 0.9237

Epoch 34/200  
-----

train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.2854 Acc: 0.9167 F1: 0.9165 Precision: 0.9175 Recall: 0.9174

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.34it/s]

val Loss: 0.2788 Acc: 0.9180 F1: 0.9377 Precision: 0.9389 Recall: 0.9370

Epoch 35/200  
-----

train phase: 100%|██████████| 15/15 [00:35<00:00, 2.34s/it]

train Loss: 0.3447 Acc: 0.8833 F1: 0.8794 Precision: 0.8779 Recall: 0.8816

val phase: 100%|██████████| 4/4 [00:01<00:00, 2.39it/s]

val Loss: 0.3181 Acc: 0.9016 F1: 0.9250 Precision: 0.9280 Recall: 0.9237

Epoch 36/200

```
-----  
train phase: 100%|██████████| 15/15 [00:34<00:00,  2.33s/it]  
  
train Loss: 0.2613 Acc: 0.9167 F1: 0.9143 Precision: 0.9135 Recall: 0.9162  
  
val phase: 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]  
  
val Loss: 0.3000 Acc: 0.8852 F1: 0.8948 Precision: 0.8850 Recall: 0.9103  
Epoch 37/200  
-----  
  
train phase: 100%|██████████| 15/15 [00:35<00:00,  2.34s/it]  
  
train Loss: 0.3279 Acc: 0.8792 F1: 0.8773 Precision: 0.8776 Recall: 0.8780  
  
val phase: 100%|██████████| 4/4 [00:01<00:00,  2.35it/s]  
  
val Loss: 0.3109 Acc: 0.8852 F1: 0.9121 Precision: 0.9176 Recall: 0.9103  
Epoch 38/200  
-----  
  
train phase: 100%|██████████| 15/15 [00:35<00:00,  2.33s/it]  
  
train Loss: 0.3010 Acc: 0.8958 F1: 0.8966 Precision: 0.9031 Recall: 0.8945  
  
val phase: 100%|██████████| 4/4 [00:01<00:00,  2.34it/s]  
  
val Loss: 0.3426 Acc: 0.8852 F1: 0.8948 Precision: 0.8850 Recall: 0.9103  
Epoch 39/200  
-----  
  
train phase: 100%|██████████| 15/15 [00:34<00:00,  2.33s/it]  
  
train Loss: 0.2942 Acc: 0.8750 F1: 0.8748 Precision: 0.8755 Recall: 0.8747  
  
val phase: 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]  
  
val Loss: 0.2676 Acc: 0.8852 F1: 0.9121 Precision: 0.9176 Recall: 0.9103  
Epoch 40/200  
-----  
  
train phase: 100%|██████████| 15/15 [00:34<00:00,  2.33s/it]  
  
train Loss: 0.2535 Acc: 0.9208 F1: 0.9174 Precision: 0.9175 Recall: 0.9178  
  
val phase: 100%|██████████| 4/4 [00:01<00:00,  2.28it/s]  
  
val Loss: 0.3432 Acc: 0.8361 F1: 0.8544 Precision: 0.8546 Recall: 0.8703  
Epoch 41/200  
-----
```

```
train phase: 100%|██████████| 15/15 [00:35<00:00, 2.33s/it]
```

```
train Loss: 0.2992 Acc: 0.9125 F1: 0.9130 Precision: 0.9180 Recall: 0.9108
```

```
val phase: 100%|██████████| 4/4 [00:01<00:00, 2.37it/s]
```

```
val Loss: 0.3252 Acc: 0.8525 F1: 0.8681 Precision: 0.8644 Recall: 0.8837
```

```
Epoch 42/200
```

```
-----
```

```
train phase: 100%|██████████| 15/15 [00:34<00:00, 2.33s/it]
```

```
train Loss: 0.2721 Acc: 0.9208 F1: 0.9221 Precision: 0.9242 Recall: 0.9217
```

```
val phase: 100%|██████████| 4/4 [00:01<00:00, 2.34it/s]
```

```
val Loss: 0.2994 Acc: 0.8689 F1: 0.8816 Precision: 0.8745 Recall: 0.8970
```

```
Epoch 43/200
```

```
-----
```

```
train phase: 100%|██████████| 15/15 [00:35<00:00, 2.33s/it]
```

```
train Loss: 0.3454 Acc: 0.8792 F1: 0.8784 Precision: 0.8787 Recall: 0.8782
```

```
val phase: 100%|██████████| 4/4 [00:01<00:00, 2.32it/s]
```

```
val Loss: 0.3026 Acc: 0.8852 F1: 0.9121 Precision: 0.9176 Recall: 0.9103
```

```
Epoch 44/200
```

```
-----
```

```
train phase: 100%|██████████| 15/15 [00:35<00:00, 2.33s/it]
```

```
train Loss: 0.2595 Acc: 0.9042 F1: 0.9010 Precision: 0.9025 Recall: 0.9005
```

```
val phase: 100%|██████████| 4/4 [00:01<00:00, 2.37it/s]
```

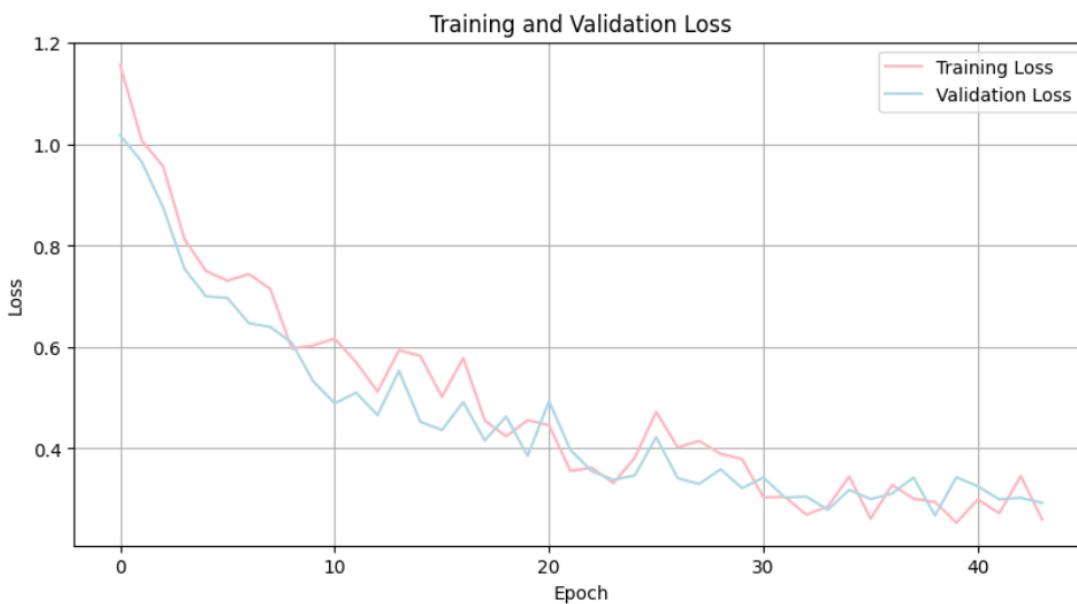
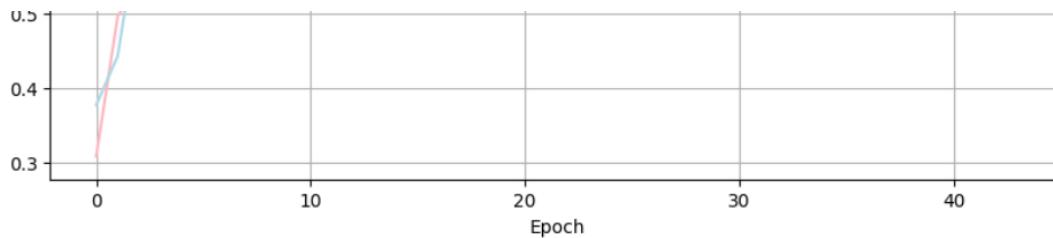
```
val Loss: 0.2925 Acc: 0.8852 F1: 0.9128 Precision: 0.9139 Recall: 0.9122
```

```
Early stopping triggered at epoch 44 due to no improvement in validation loss.
```

```
Best validation accuracy: 0.8852
```

```
Model saved to best_model.pth
```





```
Final Evaluation: 100%|██████████| 4/4 [00:01<00:00,  2.36it/s]
```

```
--- Final Evaluation Metrics ---
```

```
Accuracy: 0.8852
Macro F1-Score: 0.9121
Macro Precision: 0.9176
Macro Recall: 0.9103
```

```
Confusion Matrix:
```

```
[[27  0  2]
 [ 0  7  0]
 [ 5  0 20]]
```

```
--- Per-Class Metrics ---
```

```
Class: Dominant_Follicle
    Accuracy: 0.9310
    Precision: 0.8438
    Recall: 0.9310
    F1-Score: 0.8852
```

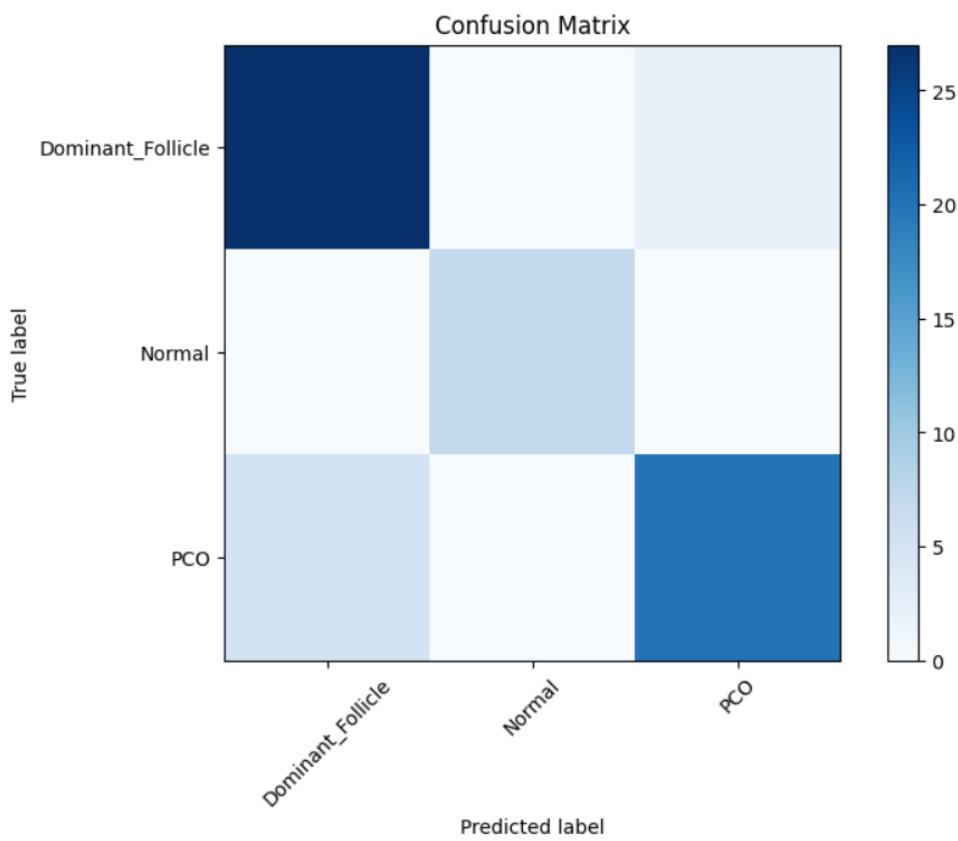
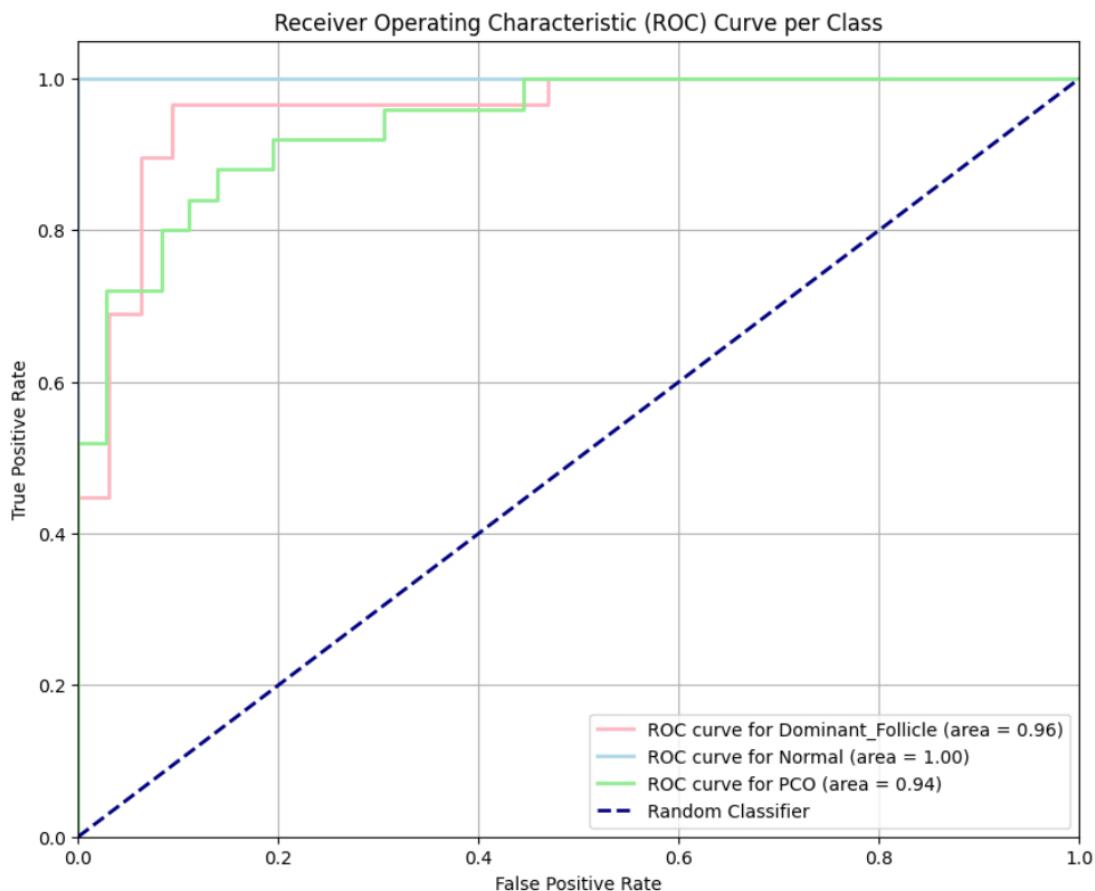
```
-----
```

```
Class: Normal
    Accuracy: 1.0000
    Precision: 1.0000
    Recall: 1.0000
    F1-Score: 1.0000
```

```
-----
```

```
Class: PCO
    Accuracy: 0.8000
    Precision: 0.9091
    Recall: 0.8000
```

F1-Score: 0.8511



```
/usr/local/tid/python3.11/dist-packages/torch/nn/modules/module.py:1830: FutureWarning: Using a non-full backward hook when the forward contains multiple autograd Nodes is deprecated and will be removed in future versions. This hook will be missing some grad_input. Please use register_full_backward_hook to get the documented behavior.
```

```
self._maybe_warn_non_full_backward_hook(args, result, grad_fn)
```

