

# Detection loosening of total knee arthroplasty implant from plain radiograph using machine learning algorithm



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# Conflict of interest

**Kim MS, MD. Ph.D.**

**Choi KY, MD.**

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**Cho RK, MD.**

**Jang HJ, MD.**

**Yang SC, MD.**

**In Y, MD, Ph.D.**

We have no financial conflict to disclose.

# Introduction

- ◆ **Periprosthetic loosening of implant**
    - **One of most common cause of TKA failure**
  - ◆ **Detecting loosening of TKA implants**
    - **Challenging, even for experienced clinicians**
  - ◆ **Various imaging tools for diagnosis**
    - ◆ Plain radiograph
    - ◆ Scintigraphy, Arthrograms
    - ◆ FDG-PET scans, MRI
- } Invasive  
Expensive

# Purpose

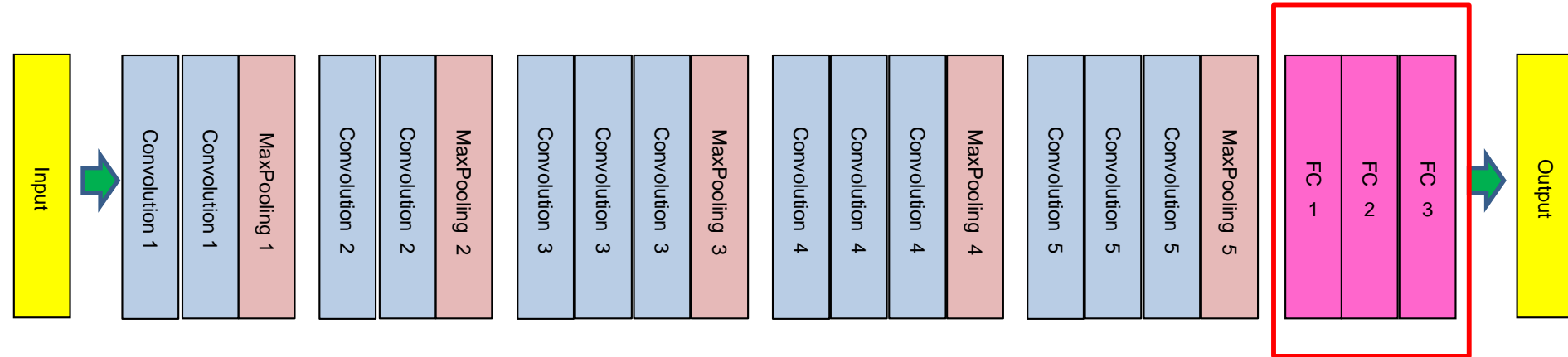
- ◆ **Still insufficient studies using machine learning to detect periprosthetic loosening after TKA**
- ◆ **To investigate whether the loosening of TKA implant could be detected on plain radiograph using deep convolution neural network (CNN)**

# Materials and Methods

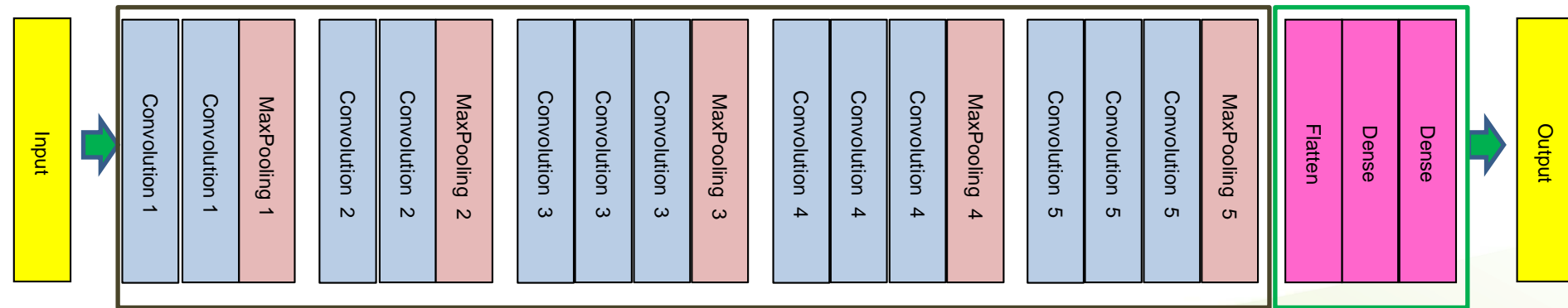
- ◆ **Dataset: Revision TKA for periprosthetic loosening in a single institution from 2012 to 2020**
- ◆ **Radiograph: Anteroposterior & lateral radiographs**
- ◆ **Labeling**
  - **100 revision TKA patients: “loosed”.**
  - **100 normal primary TKA patients: “fixed”.**
- ◆ **Propensity scored match**
  - **One to one match to minimize selection bias**
  - **Age, gender, body mass index, and operation side**

# Methods-Transfer learning 1

1. Remove the fully connected layers in pretrained VGG 19 model



2. Add new fully connected layer

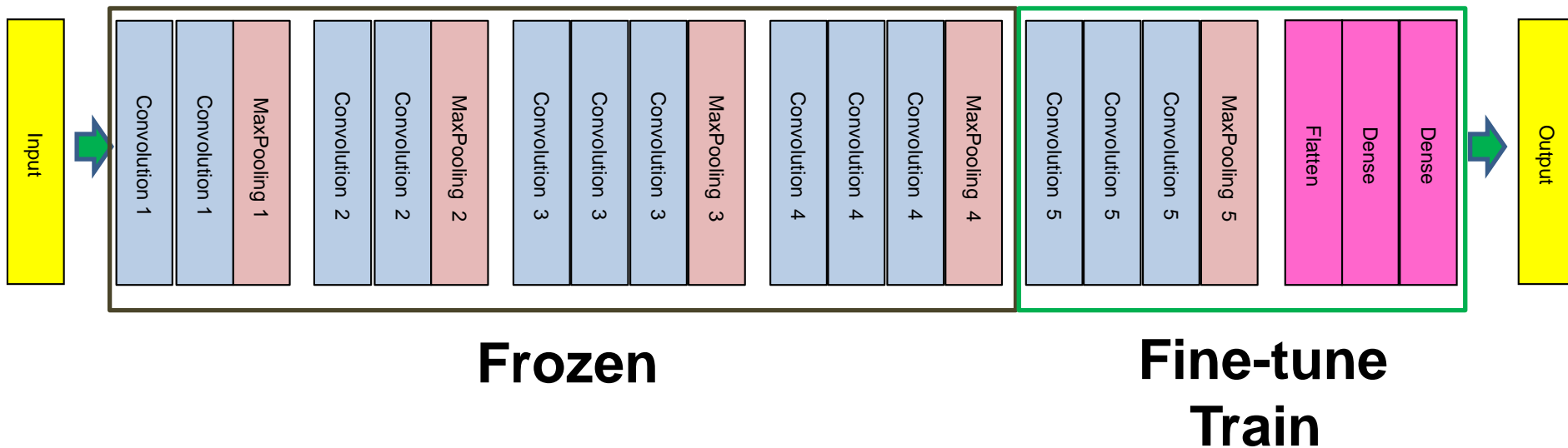


Frozen

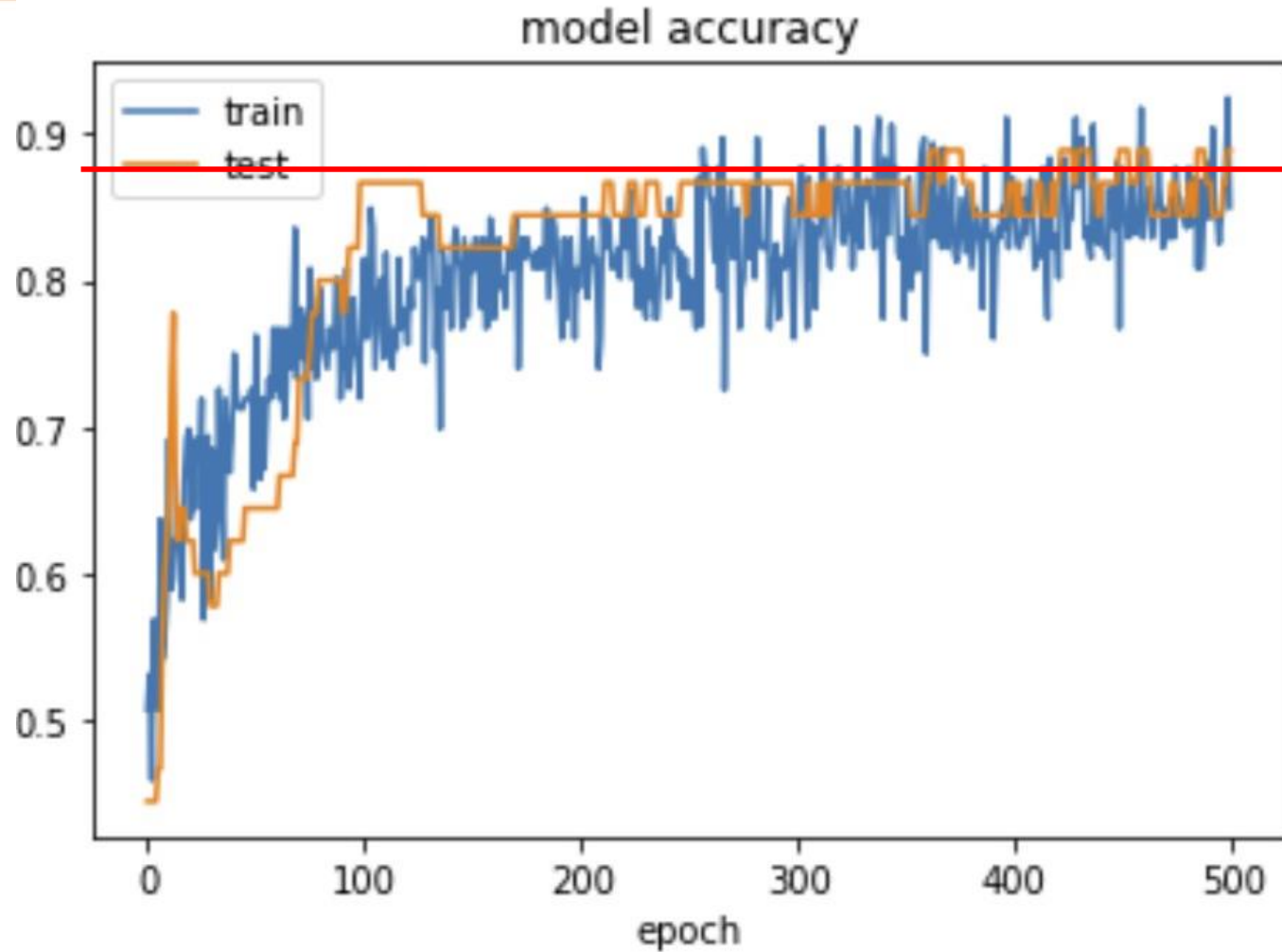
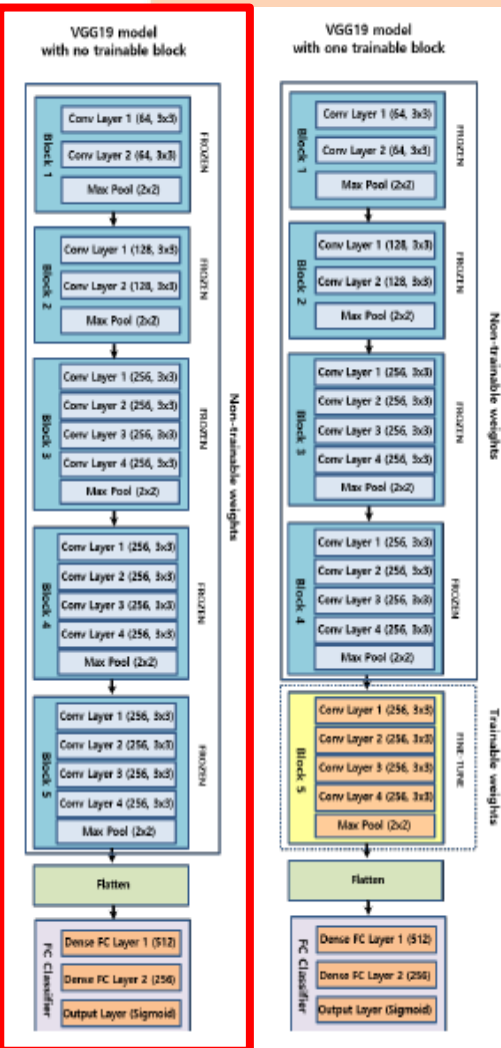
Train

# Methods-Transfer learning 2

## 1. Fine-tune Convolutional block 5 & New FC layer



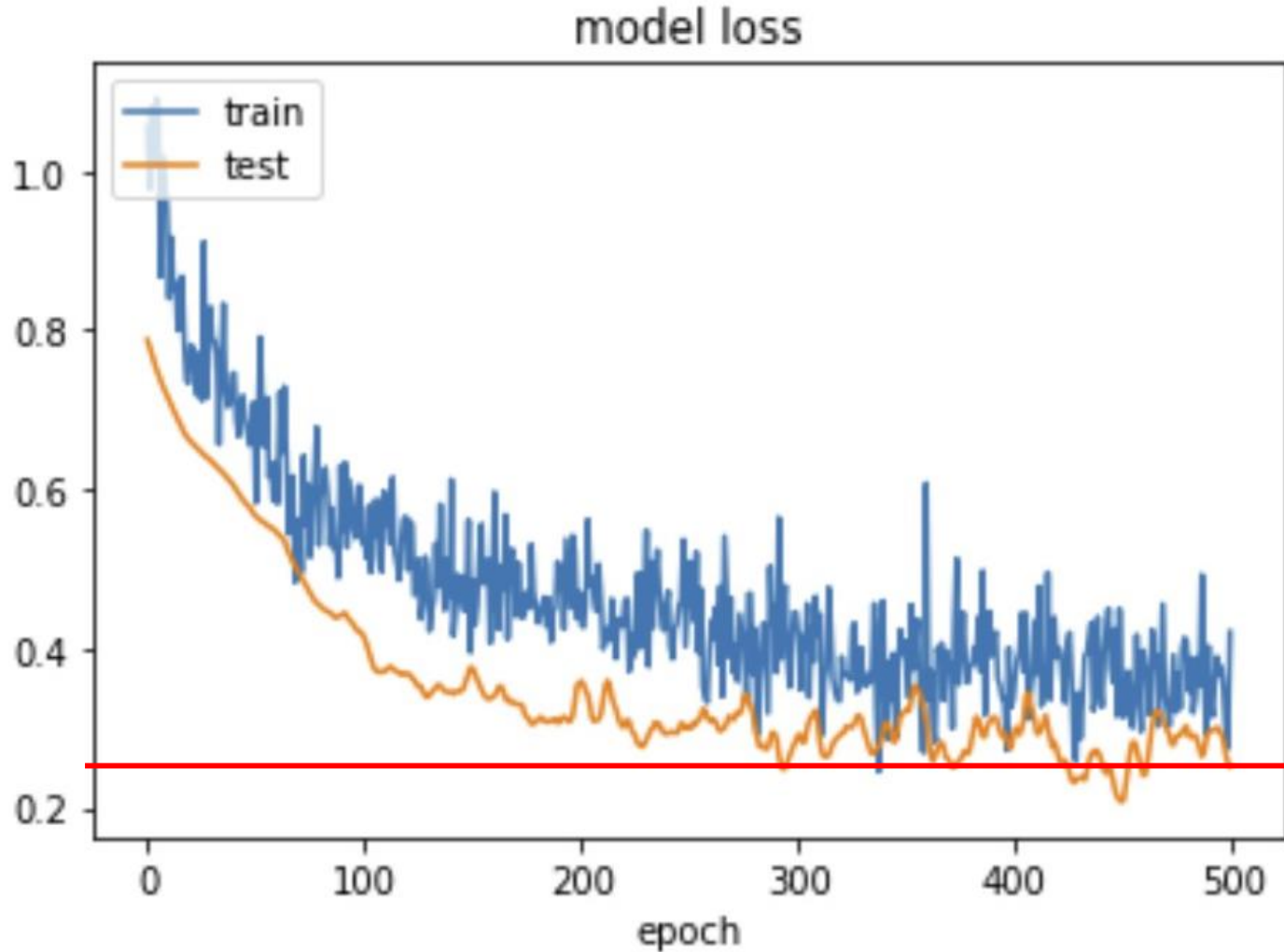
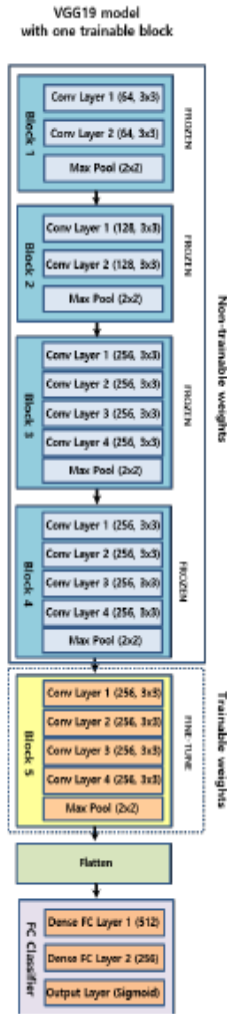
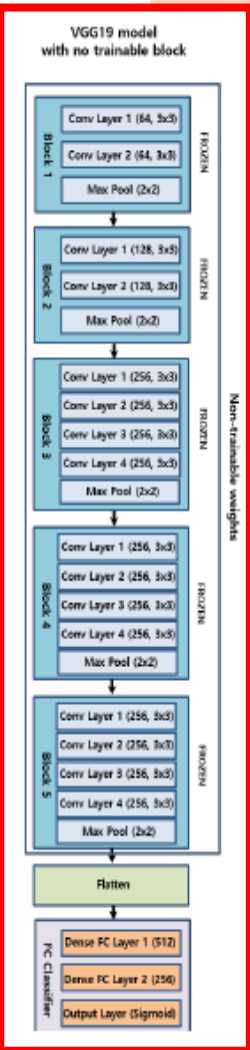
# Results-Transfer learning 1



**Accuracy: 87.5%**

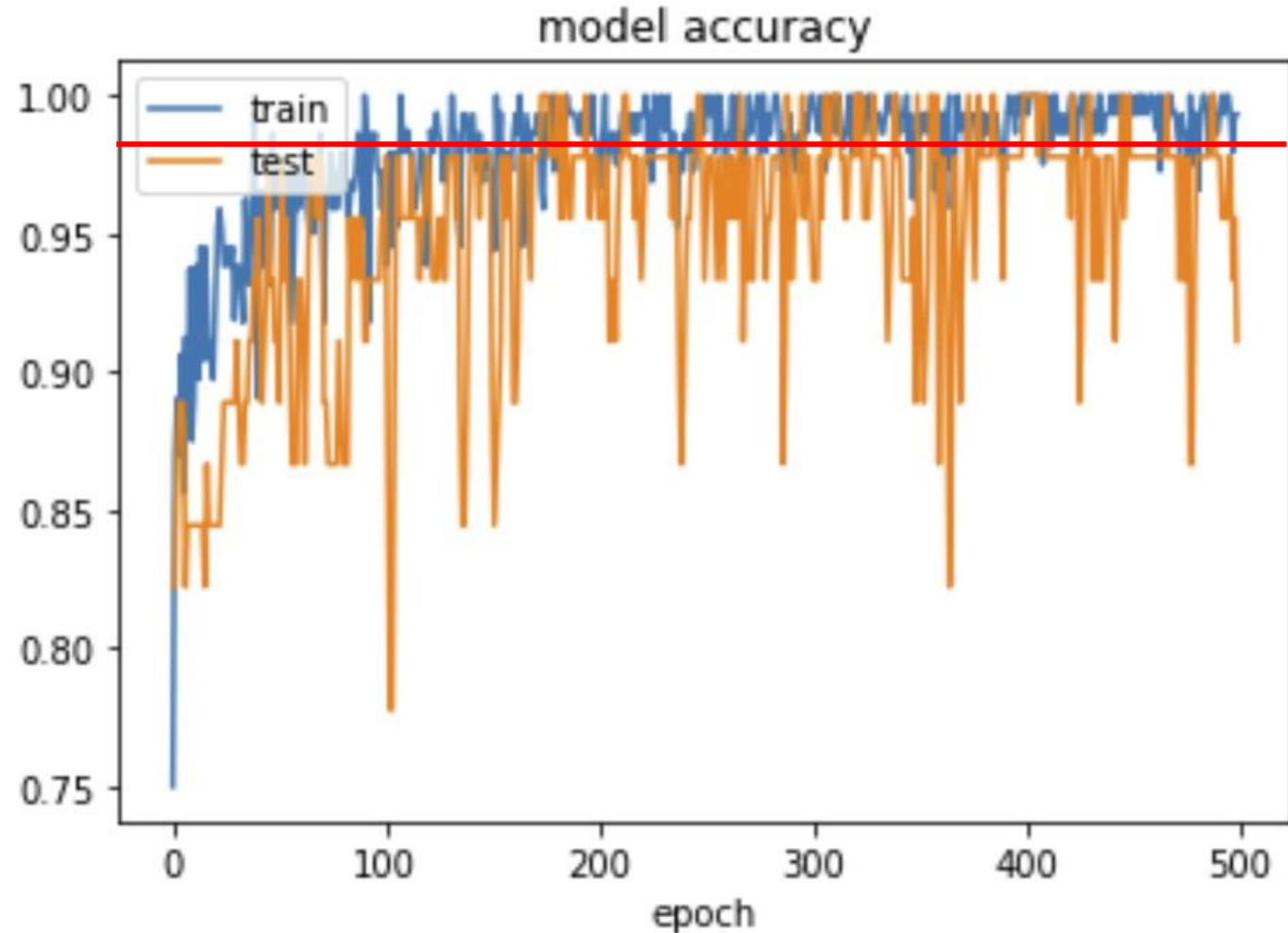
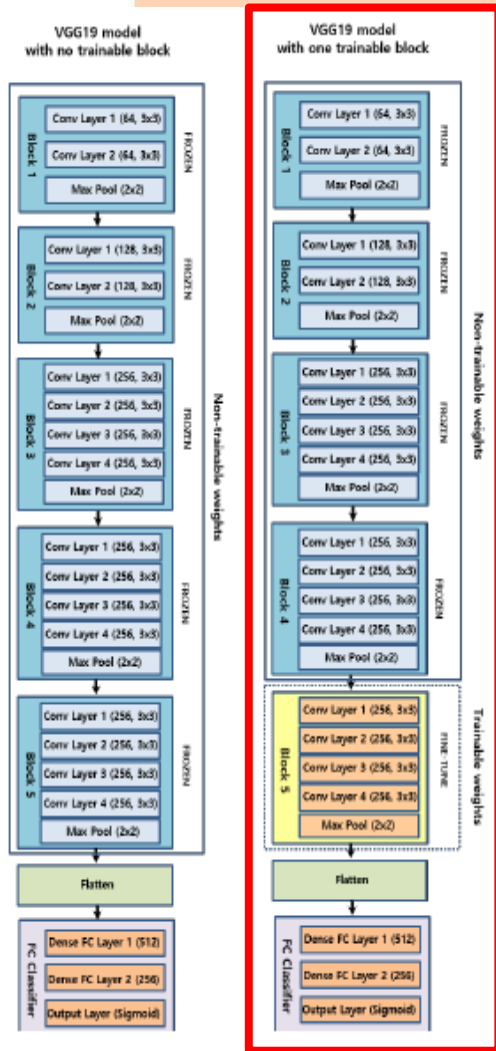


# Results-Transfer learning 1



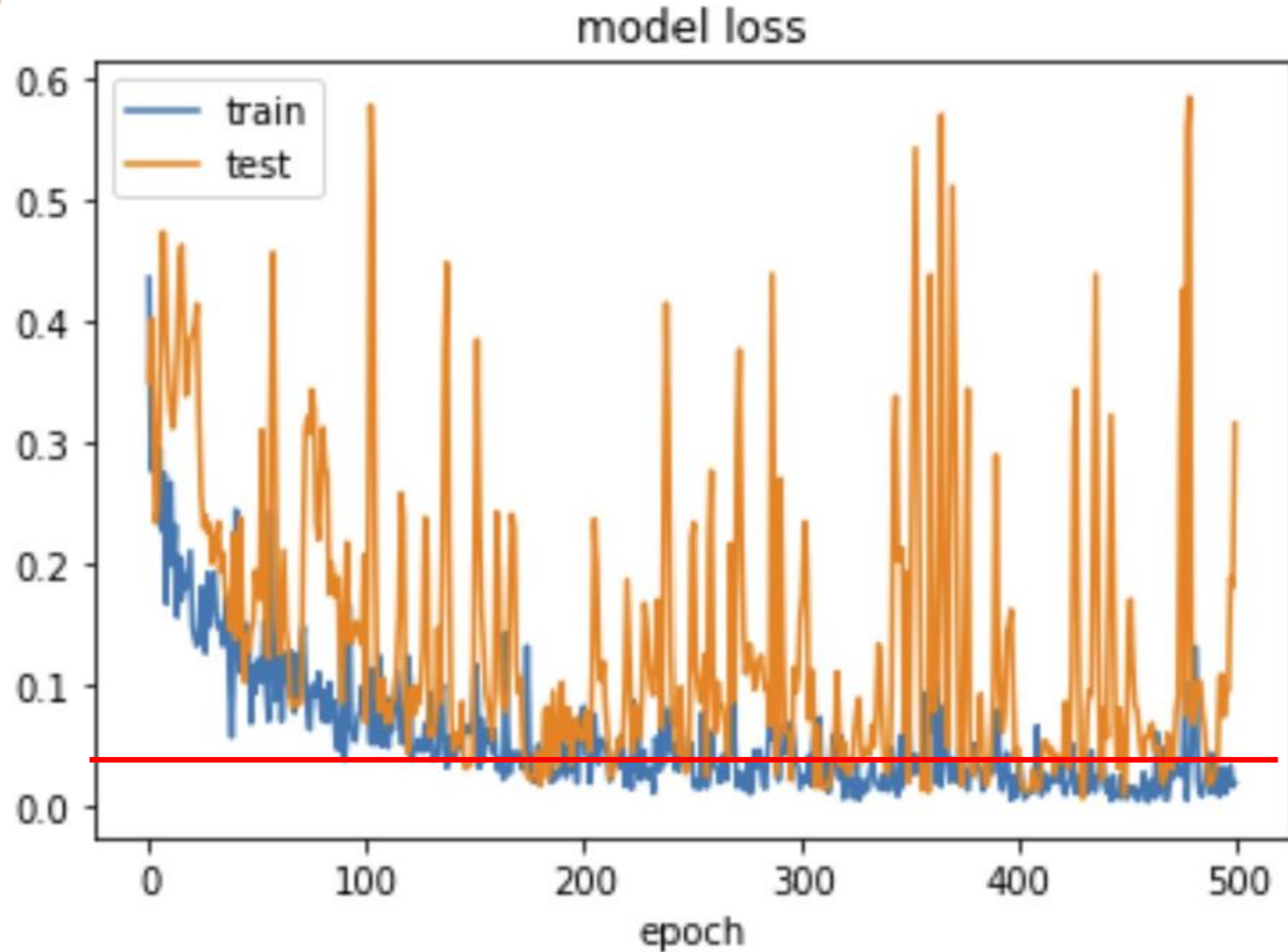
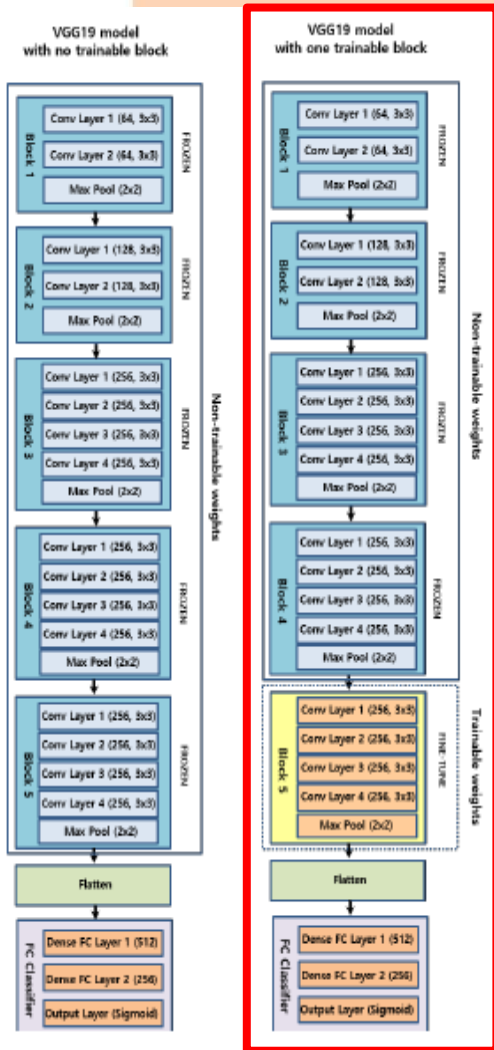
Loss : 0.2527

# Results-Transfer learning 2



**Accuracy: 97.5%**

# Results-Transfer learning 2



**Loss: 0.0307**

# Conclusion

- ◆ *CNN algorithm through transfer learning*
- *High accuracy* in detecting loosening of TKA implant through plain radiograph
- ◆ *Utilized as an auxiliary tool*
- In the decision making process in diagnosing loosening of TKA implant by orthopedic surgeons

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