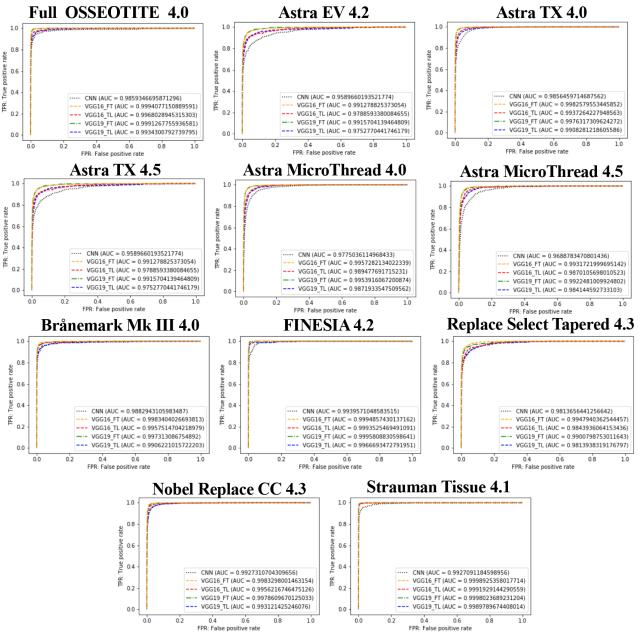
Deep Neural Networks for Dental Implant System Classification

Shintaro Sukegawa ^{1,2,*}, Kazumasa Yoshii ³, Takeshi Hara ³, Katsusuke Yamashita ⁴, Keisuke Nakano ², Norio Yamamoto ⁵, Hitoshi Nagatsuka ² and Yoshihiko Furuki ¹

- ¹ Department of Oral and Maxillofacial Surgery, Kagawa Prefectural Central Hospital, 1-2-1, Asahi-machi, Takamatsu, Kagawa, 760-8557, Japan; gouwan19@gmail.com
- ² Department of Oral Pathology and Medicine, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama, 700-8558, Japan
- ³ Department of Electrical, Electronic and Computer Engineering, Faculty of Engineering, Gifu University, 1-1 Yanagido, Gifu, Gifu, 501-1193, Japan
- ⁴ Polytechnic Center Kagawa, 2-4-3, Hananomiya-cho, Takamatsu, Kagawa 761-8063, Japan
- Department of Orthopaedic Surgery, Kagawa Prefectural Central Hospital, Takamatsu, Kagawa, 760-8557, Japan
- * Correspondence: gouwan19@gmail.com; Tel.: +81 87 811 3333, Fax: +81 87 835 8363

Appendix

Figure S1. Mean ROC curves of each CNN models for 11 types of dental implant classification



Abbreviation in Figure S1

CNN; Basic CNN model with three convolutional layers (basic CNN)

VGG16_FT; Fine-tuning VGG16 model with pre-trained weights (VGG16 fine tuning)

VGG16 TL; Transfer-learning VGG16 model with pre-trained weights (VGG16 transfer)

VGG19_FT; Fine-tuning VGG19 model with pre-trained weights (VGG19 fine tuning)

VGG19_TL; Transfer-learning VGG19 model with pre-trained weights (VGG19transfer)

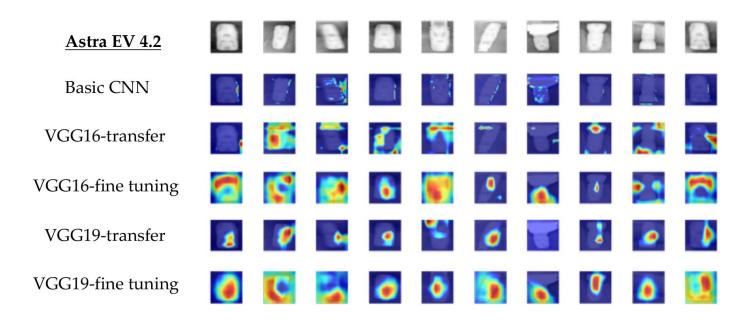
Figure S2. Visualization of Model Classification

Figure S2 shows ten representative images of 11 types of dental implants classified using each CNN model, visualized using Grad-CAM.

Full OSSEOTITE 4.0

| Full OSSEOTITE 4.0 | 2 | 9 | A | - | - | ¥ | 1 | | A | 1 |
|--------------------|------------|---|------------|-----|---|----|----|------------|-----|---|
| Basic CNN | 罪 | 夏 | F | | 1 | | | 1 | 1 | |
| VGG16-transfer | ~ | • | | • | • | | | 60 | | |
| VGG16-fine tuning | | | | 4 | | | | () | N. | • |
| VGG19-transfer | . 7 | ~ | V . | , N | • | -• | • | e | , e | ¥ |
| VGG19-fine tuning | <u>(6)</u> | • | Č | 4 | • | 9 | R. | | • | ě |

Astra EV 4.2



Astra TX 4.0

| Astra TX 4.0 | 0 | A | 8 | 8 | 8 | P | 8 | * | ğ | 8 |
|-------------------|-----|----|---|---|----|---|---|------------------|----------------------|------------|
| Basic CNN | | 3 | | 1 | 1 | | - | 3 | 8 | 8 |
| VGG16-transfer | | æ. | 1 | C | 30 | 1 | | • | $\boldsymbol{\zeta}$ | O |
| VGG16-fine tuning | 100 | | | 5 | * | £ | | ۲. | œ. | A i |
| VGG19-transfer | | 6 | - | | | | | \mathbb{S}^{*} | | |
| VGG19-fine tuning | • | N | 5 | | • | • | | • | iõ | |

Astra TX 4.5

| Astra TX 4.5 | 8 | 8 | 1 | | | 8 | 1 | | 8 | B |
|-------------------|---|--------------|----------|----------|----------|----------|-----|----------|-------|----------|
| Basic CNN | 1 | A | | E | Š | 急 | 4.1 | | VIII. | 1 |
| VGG16-transfer | A | - | M | * | • | 8 | • | • | 1 | ·A |
| VGG16-fine tuning | 1 | V | % | • | † | 4 | 6 | 4 | | |
| VGG19-transfer | • | \(\) | 6 | | | 0 | * | • | 1 | * |
| VGG19-fine tuning | • | • | 1 | 6 | ? | Ē | - 🔑 | 4 | | 6 |

Astra MicroThread 4.0

| Astra MicroThread 4.0 | 8 | 8 | 1 | B | · B | | A | 8 | 1 | |
|-----------------------|---|-----|-----|---|-----|----|----|---|----|-----|
| Basic CNN | | • M | 7 / | | 4 | | | B | | |
| VGG16-transfer | • | 4 | • | | · E | 7 | | | 44 | 5 |
| VGG16-fine tuning | | 45 | 5 | 0 | | | 4 | 2 | 3 | U |
| VGG19-transfer | | | Ħ | | | | | 1 | 6 | J |
| VGG19-fine tuning | S | A | Q. | 9 | O | D. | Z, | | 0 | II. |

Astra MicroThread 4.5

| Astra MicroThread 4.5 | 8 | 8 | Á | 8 | # | # | - | 1 | 1 | A |
|-----------------------|-----|-----|----|------------|----------|---|-------------|----------|-----|-----|
| Basic CNN | 1-1 | 17 | | A. | - | 1 | | 1 | T | A |
| VGG16-transfer | 4 | | | e. | 4 | | C. | 2 | * 4 | 7 |
| VGG16-fine tuning | 4 | | ₹; | (4) | | 1 | (5 - | P | • | 7 |
| VGG19-transfer | 4 | ے, | 5 | (2) | 7 | | ? | M | Y | . Č |
| VGG19-fine tuning | | (4) | | 6 | . | 1 | Ç. | • | 4 | 7 |

Brånemark Mk III 4.0

| Brånemark Mk III 4.0 | 8 | 1 | 1 | | 8 | 1 | Æ | 1 | ŧ. | # |
|----------------------|---|---|----------|---|-------------|---|----------|---|------------|---|
| Basic CNN | | | A | | 12 light | 1 | E | | 4 | # |
| VGG16-transfer | | | 4 | | % | 3 | F | * | 1 | 1 |
| VGG16-fine tuning | S | | C | 7 | | C | <u> </u> | | ő. | |
| VGG19-transfer | - | - | V | • | | 1 | 6 | | <u>ø</u> . | • |
| VGG19-fine tuning | 9 | V | 6 | ? | % | • | | • | 8 | 0 |

FINESIA 4.2

| FINESIA 4.2 | W. | 8 | | U | ē | 1 | | * | | |
|-------------------|----|---|----------|-----|----------|----------|-----------------------------|----|---|---|
| Basic CNN | | | | 100 | 6 | 7 | $\mathcal{F}_{\mathcal{F}}$ | 13 | | 1 |
| VGG16-transfer | | | | 8 | ~ | | 9 | 9 | | |
| VGG16-fine tuning | 1 | | • | | 10 | 6 | 7 | 8 | 6 | |
| VGG19-transfer | 1 | | | • | 8 | • 5 | 8 | | | |
| VGG19-fine tuning | | | ~ | | 9 | 6 | (*) | 60 | 2 | |

Replace Select Tapered 4.3

| Replace Select Tapered 4.3 | 8 | A | A | 6 | F | 9 | 8 | 9 | | 8 |
|----------------------------|----|---|------|---|----------|---|----------|---|----------|---|
| Basic CNN | 19 | | 是以 | 1 | A | | The same | 5 | 8 | - |
| VGG16-transfer | 1 | | J. " | 7 | A, | | 1 | 曼 | | 圖 |
| VGG16-fine tuning | | 0 | 0 | 5 | <u> </u> | | 1 | 1 | 6 | 7 |
| VGG19-transfer | X) | | 5 | | J. | | J | | 7 | 7 |
| VGG19-fine tuning | F | • | • | • | 8 | • | Ď | • | • | • |

Nobel Replace CC 4.3

| Nobel CC 4.3 | B | 8 | W | | 4 | | 1 | 8 | - | Ē |
|-------------------|---|----------|----|----------|----------|----|----------|-----|------------|----------|
| Basic CNN | 3 | g. | 11 | | (a) | | 7 | | 47 | 0 |
| VGG16-transfer | | | P | 3 | 3 | | 1 | | | 4 64 |
| VGG16-fine tuning | 0 | | | | ď | ₫" | 1 | (4) | !!! | 5 |
| VGG19-transfer | | 4 | | 2 | 4 | 7 | 7 | | 8 | |
| VGG19-fine tuning | • | 7 | 0 | 0 | <u> </u> | | 6 | • | • | |

Strauman Tissue 4.1

| Straumann Tissue 4.1 | | | | 1 | 4 | | Ü | E. | | |
|----------------------|---|---|---|---|----|----|----|--------------|---|----------|
| Basic CNN | 8 | I | | | 18 | | D. | \mathbb{Z} | 8 | # |
| VGG16-transfer | | | | | 1 | 79 | | 2. | | |
| VGG16-fine tuning | • | • | • | | 0 | I | • | • | | 0 |
| VGG19-transfer | L | 8 | | | | | | | 3 | |
| VGG19-fine tuning | 0 | • | | • | • | | • | P | 4 | 4 |