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Source:	Harvard School of Dental Medicine
Title:	Att.10 – Presentation - Prediction of post-traumatic neuropathy following impacted mandibular third molar removal based on dental macroanatomy using machine learning
Contact:	Balazs Feher E-mail: balazs_feher@hsdm.harvard.edu
Abstract:	This PPT contains a presentation on prediction of post-traumatic neuropathy following impacted mandibular third molar removal based on dental macroanatomy using machine learning given in the AI for Dentistry Symposium on 21 March 2023.

TG DENTAL SYMPOSIUM

Machine learning for risk prediction in mandibular third molar surgery

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Disclosures

AFFILIATION

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ADVISORY WORK

AI for Health
ITU-WHO Focus Group

EAO
EUROPEAN ASSOCIATION FOR OSSEOINTEGRATION

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ITI International Team for Implantology

Osteology Foundation

Background

Identifying high-risk mandibular third molars has been the subject of research for a century[1,2,3]

Most established classifications are of limited predictive value[4,5] and new classifications are emerging[6]

The majority of machine learning (ML) approaches in this field rely on older classifications and single-center datasets[7,8,9]

[1] Winter, 1926
[2] Pell, 1933
[3] Tetsch & Wagner, 1985
[4] Garcia et al., 2000
[5] Bali et al., 2013
[6] Juodzbalys & Daugela, 2013
[7] Vinayahalingam et al., 2019
[8] Sukegawa et al., 2022
[9] Liu et al., 2022

Background

We aim to establish a new ML approach based on a multicenter dataset of panoramic radiographs (OPGs) and electronic medical records (EMR)

Instead of an end-to-end approach, we first identify macroanatomical features based on a classification reliable for predicting complications[6,10]

We then use ML to predict neuropathy and validate the results of our previous prediction model[10]

[6] Juodzbalys & Daugela, 2013
[10] Feher et al., 2022

Methods

Two data centers confirmed,
more pending approval

Radiographic dataset:

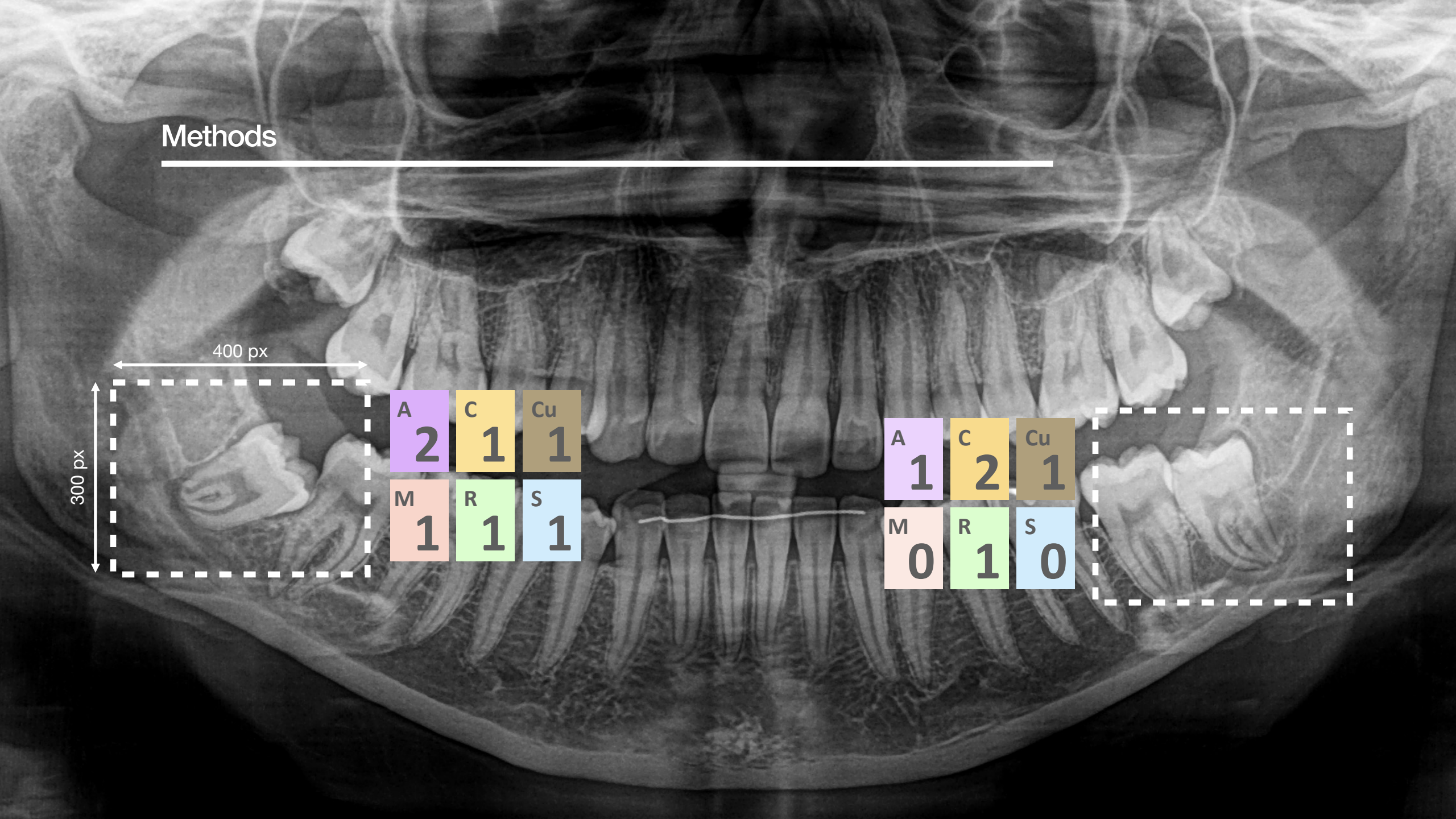
- OPGs with at least one mandibular third molar
- macroanatomical annotations[6]

Textual dataset:

- surgeries and complications from EMR

[6] Juodzbalys & Daugela, 2013

Methods



Methods

Model:

- VGG-16 pretrained on ImageNet

Hyperparameters:

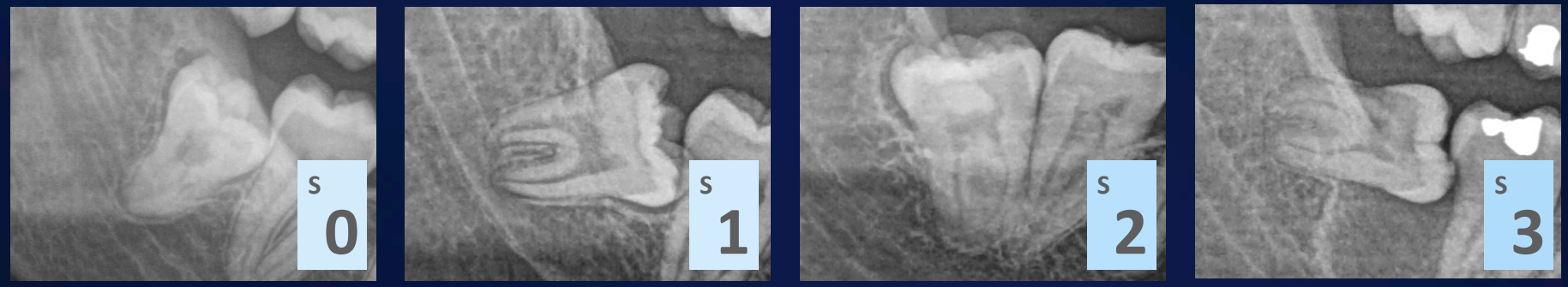
- batch size: 8
- learning rate: $5 \cdot 10^{-5}$
- epochs: 20
- optimizer: Adam

Data augmentation:

- horizontal flipping, rotation, and zoom

Preliminary results

Angulation



0.80

Accuracy

Preliminary results

Curving

0.82

Accuracy

Preliminary results

Relative position to mandibular canal

0.55

Accuracy

Methods

Patient feature matrix:

- demographic data
- macroanatomical classification
- surgical records
- miscellaneous information
- postoperative complications

Model:

- weighted Random Forest
- predict neuropathy from macroanatomical features
- 10-fold cross-validation

Identification		Patient related										Tooth related						Misc			Outcomes				
ID_Subject	ID_Tooth	Sex	Age	Smoking	PsychDis	DM	Osteo	Hyper	Anticoag	Antires	FDI	Angulation	Curving	RelPosToNerve	RelPosToBone	RetDepth	SeasonOld	Season	MeanTemp	Bleeding	Pain	NerveDmg	AnatDmg
1	1	F	20	NO	NO	NO	NO	NO	NO	NO	38	1	2	2	3	3	SUMMER	2	19,0	NO	NO	NO	NO
1	2	F	20	NO	NO	NO	NO	NO	NO	NO	48	2	2	3	2	2	FALL	3	14,0	NO	NO	NO	NO
2	3	M	34	LIGHT	NO	NO	NO	NO	NO	NO	48	3	2	0	2	3	WINTER	4	4,5	NO	NO	NO	NO
3	4	F	34	NO	NO	NO	NO	NO	NO	NO	48	1	2	2	3	2	WINTER	4	1,0	NO	NO	NO	NO
3	5	F	35	NO	NO	NO	NO	NO	NO	NO	38	1	2	3	3	2	SPRING	1	17,5	NO	NO	NO	NO
4	6	M	21	NO	NO	NO	NO	NO	NO	NO	48	1	2	0	2	2	WINTER	4	0,0	NO	NO	NO	NO
5	7	M	31	HEAVY	NO	NO	NO	NO	NO	NO	38	2	2	0	2	2	FALL	3	4,0	NO	NO	NO	NO
6	8	M	25	HEAVY	NO	NO	NO	NO	NO	NO	38	4	2	1	3	2	SUMMER	2	19,0	NO	YES	NO	NO
7	9	M	16	NO	NO	NO	NO	NO	NO	NO	38	1	2	0	2	1	SPRING	1	19,0	NO	NO	NO	NO
8	10	F	18	NO	NO	NO	NO	NO	NO	NO	48	1	2	0	2	3	WINTER	4	13,5	NO	NO	NO	NO
8	11	F	18	NO	NO	NO	NO	NO	NO	NO	38	1	2	2	3	3	SUMMER	2	15,5	NO	NO	NO	NO
9	12	M	33	NO	NO	NO	NO	NO	NO	NO	48	2	2	0	2	3	SPRING	1	21,5	NO	NO	NO	NO
10	13	M	19	NO	NO	NO	NO	NO	NO	NO	48	2	2	0	2	3	FALL	3	3,5	NO	NO	NO	NO
11	14	M	29	NO	NO	NO	NO	NO	NO	NO	38	2	2	2	3	2	WINTER	4	6,0	NO	NO	NO	NO
12	15	M	22	HEAVY	NO	NO	NO	NO	NO	NO	38	1	2	0	2	1	SUMMER	2	18,5	NO	YES	NO	NO
13	16	F	22	NO	NO	NO	NO	NO	NO	NO	48	2	1	2	3	1	FALL	3	14,0	NO	NO	NO	NO
13	17	F	22	NO	NO	NO	NO	NO	NO	NO	38	2	1	2	2	1	FALL	3	-3,5	NO	NO	NO	NO
14	18	F	23	NO	NO	NO	NO	NO	NO	NO	38	1	2	0	2	2	SPRING	1	17,0	NO	YES	NO	NO
15	19	M	23	HEAVY	NO	NO	NO	NO	NO	NO	38	2	2	1	3	3	FALL	3	-2,0	NO	NO	NO	NO
16	20	F	21	NO	NO	NO	NO	NO	NO	NO	48	3	2	1	2	3	SPRING	1	16,5	NO	NO	NO	NO
17	21	M	24	NO	NO	NO	NO	NO	NO	NO	48	2	2	0	2	3	SUMMER	2	19,0	NO	NO	NO	NO
18	22	M	27	NO	NO	NO	NO	NO	NO	NO	38	1	2	0	2	1	FALL	3	12,5	NO	NO	NO	NO
19	23	F	16	NO	NO	NO	NO	NO	NO	NO	38	1	1	2	3	1	SPRING	1	12,0	NO	NO	NO	NO
20	24	M	27	LIGHT	NO	NO	NO	NO	NO	NO	38	1	2	0	2	3	SPRING	1	13,0	NO	NO	NO	NO
20	25	M	27	LIGHT	NO	NO	NO	NO	NO	NO	48	2	2	0	2	2	SPRING	1	23,0	NO	NO	NO	NO
21	26	M	19	HEAVY	NO	NO	NO	NO	NO	NO	48	1	2	2	2	1	FALL	3	3,5	NO	NO	NO	NO
22	27	M	23	LIGHT	YES	NO	NO	NO	NO	NO	48	3	2	0	2	3	FALL	3	6,0	NO	NO	NO	NO
23	28	F	37	NO	NO	NO	NO	NO	NO	NO	38	1	3	2	3	2	SPRING	1	13,5	NO	NO	NO	NO
24	29	F	23	HEAVY	NO	NO	NO	NO	NO	NO	38	1	2	2	2	2	FALL	3	14,0	NO	NO	NO	NO

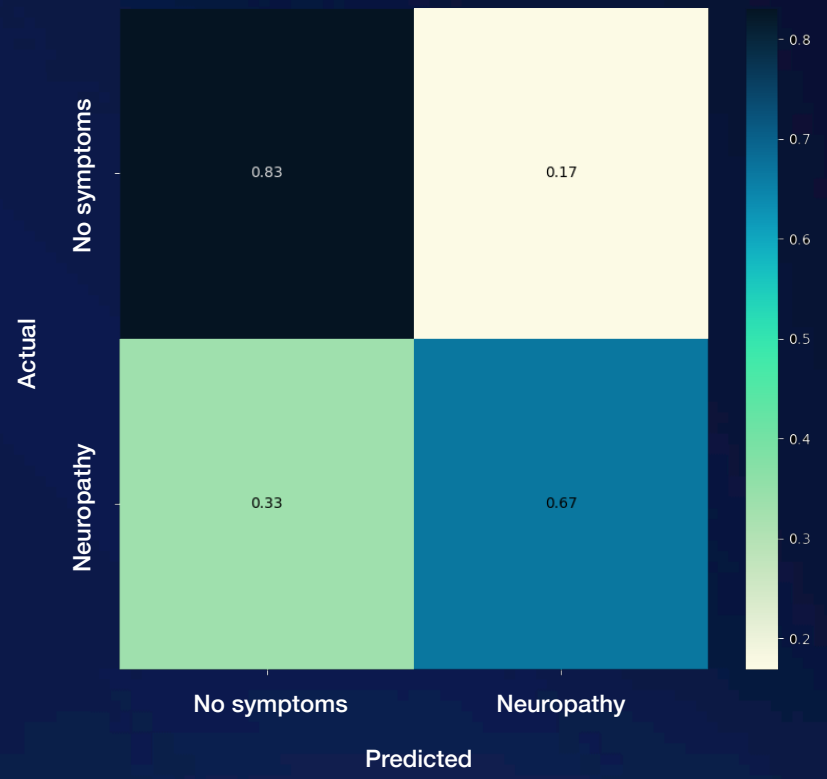
Preliminary results

0.74 ± 0.18
Area under the receiver operating characteristic curve (AUC)

0.98
Weighted average precision

0.83
Weighted average recall

0.89
Weighted average F_1-score



Discussion

Different macroanatomical features show varying predictability without segmentation

The predictive performance of our ML approach is largely comparable to our previous prediction model[10]

This study is still ongoing and recruiting academic partners to participate as study centers

[10] Feher et al., 2022

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