MACHINE LEARNING PREDICTION OF PULPECTOMY FURCATION LESIONS USING RADIOGRAPHIC IMAGES

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INTRODUCTION

Pulpectomy is a common endodontic procedure in pediatric dentistry aimed at preserving primary teeth affected by pulpal pathology. One of the significant complications associated with pulpectomy-treated teeth is the development of furcation lesions, which occur due to the anatomical characteristics of primary molars, including accessory canals in the furcation region. Early and accurate detection of these lesions is essential to prevent treatment failure and ensure proper oral health outcomes.

Diagnosis of pulpectomy-related furcation lesions using conventional radiographic interpretation is often challenging due to overlapping anatomical structures, variations in radiographic quality, and subjective interpretation by clinicians. These limitations may lead to delayed diagnosis or misinterpretation, affecting treatment planning and prognosis.

Recent advancements in machine learning (ML) and artificial intelligence (AI) have shown promising applications in medical and dental imaging. ML-based predictive models can analyze radiographic patterns with high precision, enabling early detection and classification of pathological conditions. In pediatric endodontics, such tools can significantly enhance diagnostic accuracy and reduce operator dependency.

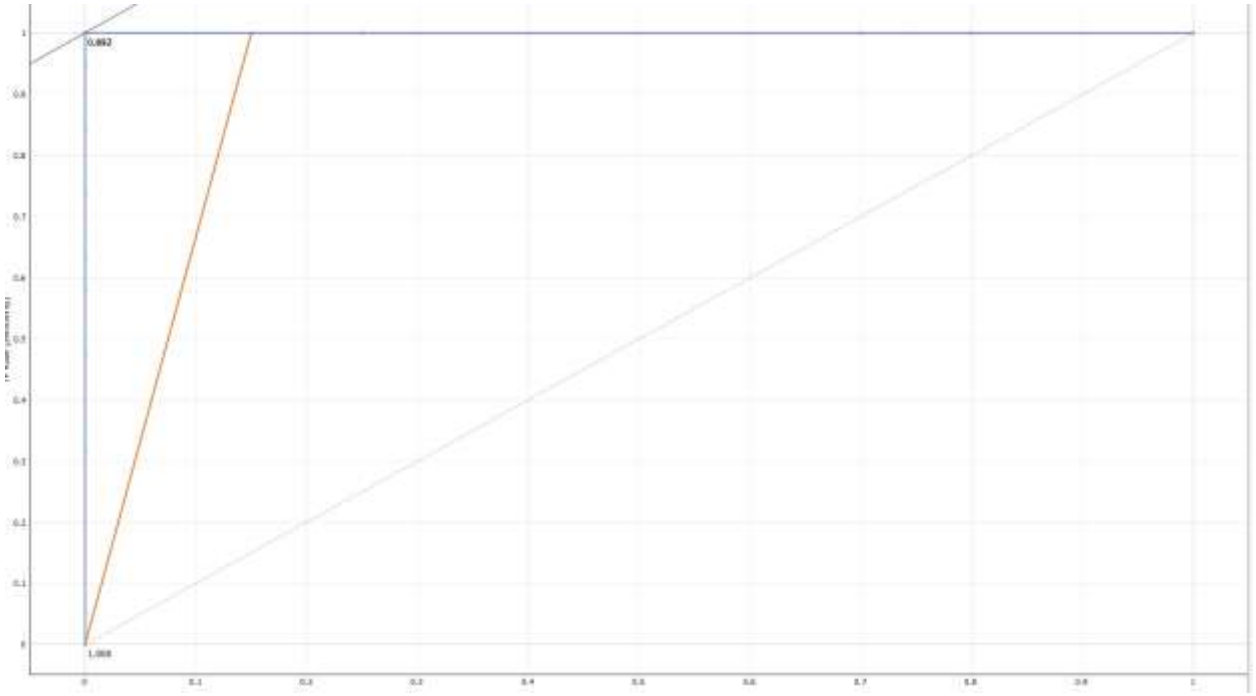
The present study aims to develop and evaluate machine learning models for the prediction of pulpectomy furcation lesions using radiographic images. By leveraging automated image analysis and classification algorithms, this study seeks to improve diagnostic efficiency and contribute to evidence-based clinical decision-making.

MATERIALS AND METHODS:

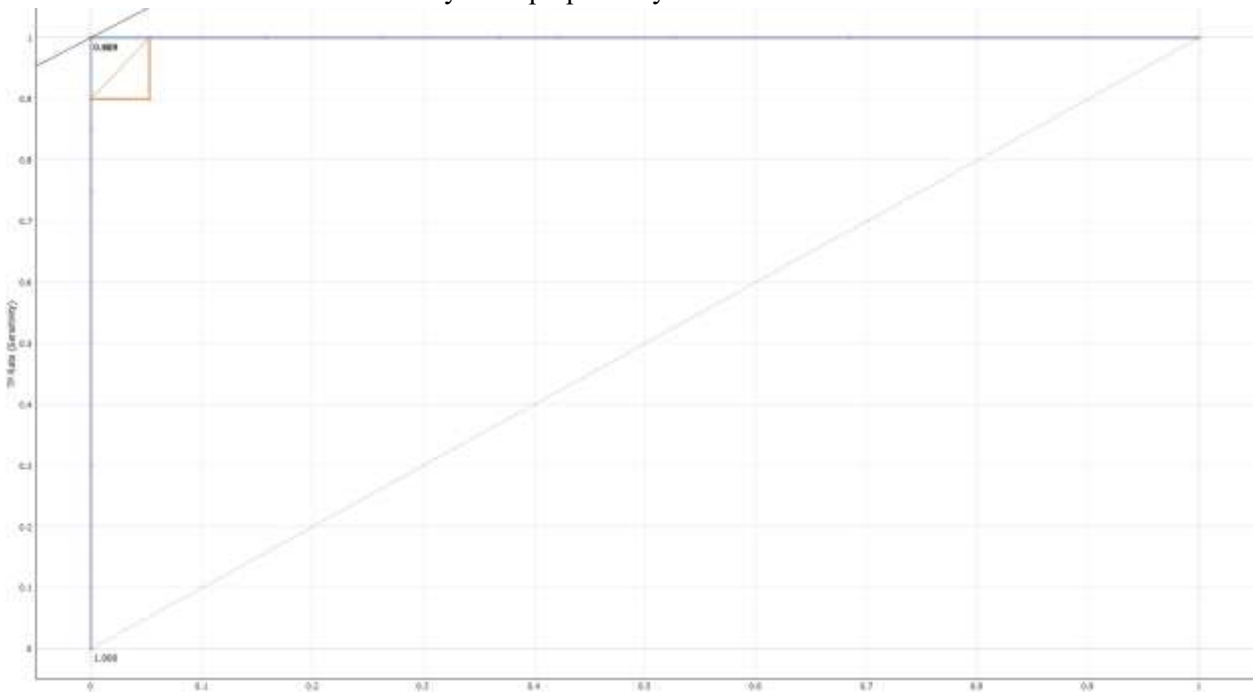
Using a dataset obtained from DIAS, 40 samples were obtained(pulpectomy furcation lesion-20, non-disease-20), and the data was preprocessed, customised and segmented. Using Orange, a machine learning squeeze net embedding models with Random Forest, and data . Naive Bayes and Logistic Regression algorithms were used to study the accuracy of prediction. Data was split into 80% training and

20% test data. Cross validation. Confusion matrix and an ROC analysis was done for evaluating and assessing the performance of the model. Precision and recall were also analysed in this study.

RESULTS:



ROC analysis of pulpectomy furcation lesion



ROC analysis of non- lesion

Table 1: Accuracy of Algorithms of logistic regression, Random Forest, Naive bayes

Model	AUC	CA	F1	Precision	Recall
Random Forest	1.000	1.000	1.000	1.000	1.000
Naive Bayes	0.995	0.923	0.923	0.934	0.923
Logistic Regression	1.000	1.000	1.000	1.000	1.000

Table 2: Confusion matrix of Naive Bayes

	pulpectomy furcation lesion\ pulpectomy all lesions	pulpectomy furcation lesion\ No lesion	Σ
pulpectomy furcation lesion\ pulpectomy all lesions	86.4%	0.0%	19
pulpectomy furcation lesion\ No lesion	13.6%	100.0%	20
Σ	22	17	39

Table 3: Confusion matrix of Random Forest

	pulpectomy furcation lesion\ pulpectomy all lesions	pulpectomy furcation lesion\ No lesion	Σ
pulpectomy furcation lesion\ pulpectomy all lesions	100.0%	0.0%	19
pulpectomy furcation lesion\ No lesion	0.0%	100.0%	20

Σ	19	20	39

Table 4: Confusion matrix of logistic regression

	pulpectomy furcation lesion\ pulpectomy all lesions	pulpectomy furcation lesion\ No lesion	Σ
pulpectomy furcation lesion\ pulpectomy all lesions	100.0%	0.0%	19
pulpectomy furcation lesion\ No lesion	0.0%	100.0%	20
Σ	19	20	39

DISCUSSION:

This study focused on the detection and classification of pulpectomy furcation lesions in radiographic images using machine learning techniques. The developed models demonstrated high accuracy and reliability, with AUC values reaching up to 100% for Random Forest and Logistic Regression, and 99.5% for Naive Bayes.

The ability of machine learning algorithms to accurately analyze radiographic images enables automated detection of furcation lesions, thereby reducing dependence on manual interpretation. This is particularly valuable in pediatric dentistry, where early diagnosis is critical for treatment success.

The superior performance of Random Forest and Logistic Regression models suggests their robustness in handling radiographic datasets. The slightly lower performance of Naive Bayes may be attributed to its assumption of feature independence, which may not fully capture complex image patterns.

CONCLUSION:

The application of machine learning in detecting pulpectomy furcation lesions offers significant advantages in dental diagnostics. It reduces false positives and false negatives, enhances detection accuracy, and minimizes human error.

These findings highlight the potential of AI-assisted diagnostic systems as reliable tools in pediatric endodontics, ultimately improving clinical outcomes and patient care.

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