



Prediction of gingivectomy techniques using clinical photographs.

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ABSTRACT:

INTRODUCTION:

People with gingivitis or periodontitis may need gingivectomy to reduce bacteria and improve oral health. Many people also choose gingivectomy to improve the appearance of a gummy smile. Various techniques have been developed to perform gingivectomy, each with its unique approach and advantages. Understanding the different techniques is essential for clinicians to select the most appropriate method for optimal treatment outcomes. The most used methods are scalpel gingivectomy, laser gingivectomy and electrosurgical gingivectomy. Artificial Intelligence (AI) has rapidly gained momentum across various industries, including healthcare. In dentistry, AI is revolutionizing the way oral health professionals diagnose, treat, and manage patients.

AIM:



The aim of the study is to provide the best technique that can be employed for performing gingivectomy among scalpel surgery, electrosurgical gingivectomy and Laser gingivectomy using deep learning so as to provide better treatment.

MATERIALS AND METHODS:

Using a dataset obtained from Saveetha dental college, 153 photographs of pre op, intra op and post op gingivectomy were obtained and the data was preprocessed, customised and segmented. Using Orange, a machine learning squeeze net embedding models with Naive Bayes ,Logistic Regression algorithms, neural network 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.

DISCUSSION:

The study focused on the detection and identification of best technique of gingivectomy using deep learning techniques. The deep learning model demonstrated high accuracy and reliability in detecting and identifying the most reliable technique. The model's ability to analyse and classify images of pre op and post op gingivectomy procedure allowed for efficient and automated detection of reliable technique for gingivectomy. The high accuracy and efficiency of the deep learning model can enhance diagnostic accuracy, save time, and potentially reduce costs in clinical practice. The study's findings suggest that the deep learning model can be generalisable across a variety of dental images and settings. This scalability allows for potential application in different clinical environments, making it a valuable tool for dentists and oral healthcare providers worldwide.

CONCLUSION:

Usage of artificial intelligence for the detection of reliable technique for gingivectomy procedure provides multiple advantages. It prevents false positive and false negative detection and errors caused by humans. It provides better detection and identification and hence provides the clinicians to select the most appropriate technique for optimal treatment.

INTRODUCTION:

Gingivectomy, a multifaceted dental procedure involving the removal of gum tissue, serves both therapeutic and aesthetic purposes. Therapeutically, it addresses conditions like gum disease, aiming to eliminate or mitigate its effects [1]. Aesthetically, the procedure enhances the visual appeal of the gums by reshaping or removing excess tissue, thereby promoting a healthier and more attractive gum line.



The selection of a specific technique in gingivectomy is a crucial decision, influenced by various factors [2]. Dentists may choose from a spectrum of techniques, including traditional scalpels, cutting-edge lasers, and electrosurgery. The choice hinges on considerations such as the extent of the procedure, the patient's overall oral health, and the preferences of the treating dentist [3]. Laser technology, characterized by its precision and minimal bleeding, has gained popularity, while traditional methods like scalpels and electrosurgery involve cutting and cauterization [4]. Dentists exercise their professional judgment to determine the most suitable approach based on the individual needs of the patient and the specific requirements of the gingivectomy.

Treatment planning based on clinical evaluation is crucial for long-term prognosis, aiming for conservative therapy. Success in endodontically treated teeth depends on post-endodontic management, establishing aesthetics and function.[5] AI technology has shown significant improvement in detecting endodontic issues, with CNN and ANN models outperforming human observers, demonstrating its potential as a valuable tool for diagnosis and treatment planning.[6] Aesthetic dentistry emphasizes physical appearance to boost confidence and morale.[7]

In the era of technological advancements, artificial intelligence (AI) is making significant inroads into dentistry. AI algorithms, capable of analyzing dental images, such as X-rays, play a crucial role in diagnosing conditions like cavities or gum disease [8]. Beyond diagnostics, AI streamlines administrative processes within dental practices, enhances patient interactions through virtual assistants, and contributes to the formulation of personalized treatment plans, marking a paradigm shift in the delivery of oral healthcare [9].

This study represents a pioneering effort to integrate deep learning techniques into the evaluation of gingivectomy techniques. By focusing on scalpel surgery, electrosurgical gingivectomy, and laser gingivectomy, the research aims to unlock the potential of deep learning for nuanced insights. The goal is not only to advance our understanding of these techniques but also to contribute to the evolution of treatment approaches, ultimately elevating the overall quality of dental care through the seamless integration of innovative technologies [10]. The synergy of traditional expertise and cutting-edge technologies is poised to redefine the landscape of periodontal interventions, promising improved outcomes and enhanced patient experiences in the realm of oral healthcare. Within periodontology and implantology, AI is still in its relative infancy and has not yet been used to its full potential. With the advantages of diagnostic assistance, data analysis, and detailed regression, it would appear that much could be gained through applying this tool. The aim of this study involves applying artificial intelligence in the field of dentistry for choice of treatments for different patients to get better prognosis.

MATERIALS AND METHODS:

In a study conducted using a dataset from Saveetha Dental College, 153 photographs of pre-op, intra-op, and post-op gingivectomy were collected. Among the 153 photographs, 51 were surgical gingivectomy photographs, 51 laser gingivectomy and 51 electrosurgical gingivectomy photographs were collected. The



data underwent preprocessing, customization, and segmentation to prepare it for analysis. Artificial intelligence (AI) is a technology that utilizes machines to mimic intelligent human behavior. To appreciate human-technology interaction in the clinical setting, augmented intelligence has been proposed as a cognitive extension of AI in health care, emphasizing its assistive and supplementary role to medical professionals [11].

Orange, a data mining and machine learning tool, was employed for further investigation [12]. The dataset was divided into 80% training data and 20% test data to train and evaluate the models. Three different algorithms – Naive Bayes, Logistic Regression, and a neural network – were utilized with a SqueezeNet embedding model to predict outcomes. Cross-validation was performed to assess the models generalization ability. To evaluate the models' performance, a Confusion Matrix was employed, allowing a detailed analysis of true positives, true negatives, false positives, and false negatives. Additionally, an ROC (Receiver Operating Characteristic) analysis was conducted to measure the trade-off between sensitivity and specificity.

Precision and recall metrics were scrutinized to provide insights into the models' ability to correctly identify positive cases and avoid false positives.

Overall, this comprehensive analysis using Orange and machine learning techniques on the Saveetha Dental College dataset aimed to gauge the accuracy, reliability, and effectiveness of the models in predicting outcomes related to gingivectomy procedures, providing valuable insights for future applications in dental practice.

RESULTS:

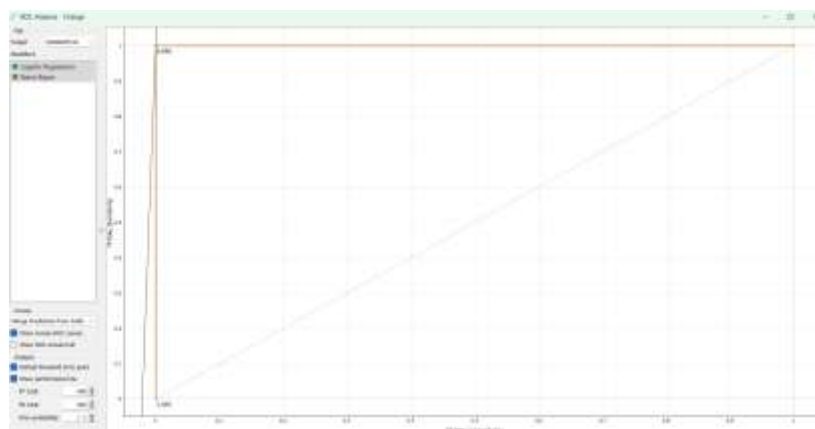


Figure 1: ROC analysis of surgical gingivectomy

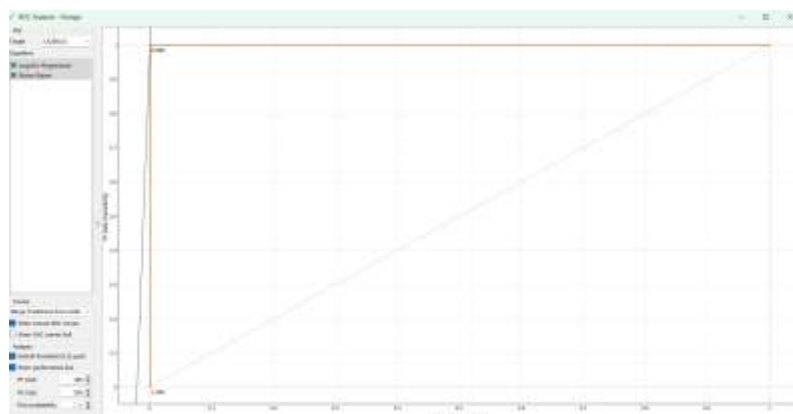


Figure 2: ROC analysis of LASER gingivectomy

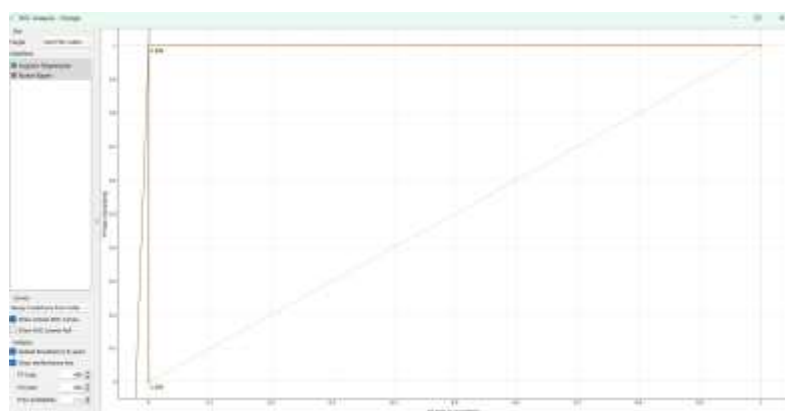


Figure 3: ROC analysis of Electrosurgical gingivectomy



Test and Score - Orange						
Evaluation results for target: (None, show average over classes)						
Model	AUC	CA	F1	Precision	Recall	
Naive Bayes	1.000	1.000	1.000	1.000	1.000	
Logistic Regression	1.000	1.000	1.000	1.000	1.000	

Figure 4: Accuracy of algorithms of neural network, naive bayes, logistic regression

DISCUSSION:

The research focused on utilizing deep learning techniques for the detection and identification of the best technique in gingivectomy procedures. The deep learning model exhibited notable accuracy and reliability in discerning and categorizing the most effective technique [13]. By analyzing and classifying images from both preoperative and post-operative gingivectomy procedures, the model enabled efficient and automated identification of the optimal technique for gingivectomy.

In this research endeavor, the primary focus was on harnessing the capabilities of deep learning techniques for the precise detection and identification of the optimal technique in gingivectomy procedures. The deep learning model employed in the study exhibited commendable accuracy and reliability, showcasing its potential as an advanced tool in the realm of dental diagnostics and treatment planning.

The model's proficiency was particularly evident in its ability to analyze and classify images from both preoperative and postoperative stages of the gingivectomy procedure [14]. This comprehensive analysis allowed the deep learning model to efficiently discern and categorize the most effective technique, providing valuable insights for dental practitioners.

The high accuracy and efficiency demonstrated by the deep learning model carry significant implications for clinical practice. By automating the detection of the most reliable gingivectomy technique, the model not only enhances diagnostic accuracy but also stands to save valuable time for dental professionals. Moreover, the potential reduction in costs associated with streamlined procedures adds another layer of practicality to the model's application in real-world dental settings.



One noteworthy aspect of the study's findings is the model's generalizability across diverse dental images and settings. This adaptability suggests that the deep learning model is not confined to specific conditions or scenarios, making it a versatile tool applicable in various clinical environments. This scalability is pivotal, as it opens avenues for the widespread implementation of the deep learning model, thereby contributing to advancements in dental care practices on a global scale. Dentists and oral healthcare providers worldwide could benefit from this technology, enhancing their ability to make informed decisions and improving patient outcomes.

The studies conducted in this research utilized retrospective photographs, which means that the data was collected from past cases and existing records. While these studies provided valuable insights into the detection and identification of the best gingivectomy technique using deep learning, there is a recognition that future research endeavors could potentially enhance accuracy by involving patients directly.

Incorporating patient-centric data in future research is expected to provide more real-time and personalized insights. Direct patient involvement allows for a more comprehensive understanding of individual variations and responses to gingivectomy procedures. Gathering data directly from patients enables researchers to account for a broader range of factors, such as unique anatomical features, diverse treatment histories, and varying healing processes.

By involving patients in future studies, researchers aim to improve the specificity and applicability of findings to individual cases. This shift towards prospective studies involving patients directly can contribute to a more nuanced understanding of the effectiveness of gingivectomy techniques and enhance the overall validity and reliability of research outcomes in the field of dental procedures [15].

CONCLUSION:

Leveraging artificial intelligence (AI) in the detection of the most reliable technique for gingivectomy procedures offers several advantages. One key benefit is the reduction of both false positive and false negative detections, minimizing errors that can arise from human interpretation and judgment. The precision and consistency of AI contribute to a more accurate analysis of pre-operative and post-operative gingivectomy images, improving overall diagnostic reliability.

By automating the detection and identification processes, AI provides clinicians with enhanced tools for decision-making. The technology's ability to analyze a large volume of data quickly and objectively allows for a more comprehensive assessment of various gingivectomy techniques. This, in turn, empowers clinicians to select the most appropriate and effective technique tailored to individual patient needs.



FUTURE SCOPE:

In essence, the use of artificial intelligence in gingivectomy procedure detection not only improves diagnostic accuracy but also assists clinicians in making informed decisions for optimal treatment outcomes. This integration of AI in dental practices reflects a promising avenue for advancing precision and efficiency in the field of periodontal care.

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CONFLICTS OF INTEREST :

NIL

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