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Commentry

Fracture Load of Ultra-Thin Occlusal Veneer

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Purpose

To evaluate fracture load of CAD-CAM fabricated lithium disilicate occlusal veneer with 2 different thicknesses after different surface conditioning.

Methods and Materials

Sixty molars were divided into 2 main groups (n=30) and prepared according to thickness of occlusal veneers either 0.5 mm or 1 mm. Veneers were fabricated using CAD-CAM system from lithium disilicate glass ceramic (e.max CAD, Ivoclar Vivadent). Veneers were divided into 3 subgroups (n=10) according to surface conditioning, HF acid plus universal primer (Mononbond N) (HF), Self-etching primer (Mononbond Etch & prime), (EP) and acidulated phosphate fluoride (APF) plus universal primer (Mononbond N). Adhesive resin cement (Multilinik Automix) was used for bonding. Six test groups were resulted, HF 1mm, HF 0.5mm / EP 1mm, EP 0.5mm, APF 1mm and APF 0.5mm. Specimens were stored in water bath for 75 days and subjected to cyclic loaded. Fracture load in (N) was recorded for each specimen using a universal testing machine. Statistical analyses were conducted with 2 and 1-way ANOVAs and Post Hoc Turkey' (HSD) test.

A total of 234 teeth from 178 patients were included in this study. We developed gradient boosting machine (GBM) and random forest (RF) models. For each model, 80% of the data were randomly selected for the training set and the remaining 20% were used as the test set. A stratified 5-fold cross-validation approach was used in model training and testing. Correlation analysis and importance ranking were conducted for feature selection. The predictive accuracy, sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), F1 score, and the area under the curve (AUC) of receiver operating characteristic (ROC) curves were calculated to evaluate the predictive performance.

Introduction

Apical surgery is one of the options when apical periodontitis is persistent after root canal treatment [3]. Since advanced surgical technology equipment and materials are used, the success rate of endodontic microsurgery has been improved much more than traditional surgery [2]. In the past 5 years, several studies have indicated that the success rate of endodontic microsurgery ranged from 80% to 94% [1]. The success rate is not so satisfying when wide inclusion criteria are used. A study revealed that with the inclusion of teeth with cracks and apicomarginal defects, endodontic microsurgery showed a slightly lower success rate of 78.3% [4]. Therefore, careful preoperative analysis and suitable case selection contribute to high success rates[5].

Results

Considering veneer thickness with the same surface treatment, there were statistically significant differences between the following test groups;

The statistical analysis revealed a 3-way interaction ($P < 0.0001$) between base monomer, filler and direction factors. For the translucency parameter, when comparing filler fraction within base monomers, there were statistically significant differences between the filler fraction within all base monomers. The analysis of color differences (ΔE00) of base monomers within filler fraction revealed that the comparison between experimental composites where beyond the acceptability threshold. The comparison of the differences in translucency parameter (ΔTP) of base monomers within filler fraction were beyond the perceptibility threshold, except between base monomers UT and FT.

However, there were no statistically significant differences between the other groups at the same thickness.

Discussion

Previous studies have shown that various factors such as age and lesion size are crucial for the prognosis of endodontic surgeries, making it time-consuming and easy to make mistakes in the prognosis prediction, especially for novices without sufficient clinical experience. Thus, new reliable tools for prognosis prediction are in deep need to help effective decision-making and developing optimal therapeutic strategies. ML models allow the analysis of multiple factors with non-linear relationships efficiently and even uncover new interactions. Moreover, once trained, the established models can be improved over time with

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new clinical data collected. Despite the challenging work, we established GBM and models predict the surgical outcomes for patients with the need of endodontic microsurgery and provide a reference for risk/benefit analysis in preoperative communication. In this study, we performed two ML models to simplify the process of surgical outcomes analysis. Despite showing promising results, the study was limited by the small datasets of unhealed cases, which is attributed to the relatively high success rate of endodontic microsurgery. The imbalanced datasets may lead to bias in measuring performance metrics. However, this problem could be overcome by using the synthetic minority over sampling technique (SMOTE) and enlarging the minority dataset continuously in the future. The available literature supported that the operator factor related to the prognosis of endodontic microsurgery. To ensure data credibility, both clinicians included in this study have ten years of experience in endodontic microsurgery to minimize bias. Future research should enroll a greater number of operators to determine the impact of surgical experience on the overall performance of the models.

Conclusion

Monobond Etch &Prime could be used for conditioning lithium disilicate occlusal veneer to avoid the health hazards of HF acid in the dental office.

Fracture load of lithium disilicate occlusal veneer with 0.5 mm thickness was significantly lower than that of 1mm thickness regardless of surface treatment.

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