



SMART DENTAL UPDATES

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Dear Doctor,

Greetings from Micro Labs Limited. We are happy to bring you “**SMART DENTAL UPDATES**” which contain latest and interesting news in the field of Dentistry.

This issue contains:

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atmedicalservices@microlabs.in

Looking forward to your valuable feedback

Best Regards,
Medical Team, Micro Labs Limited



Effectiveness of clear aligner therapy in the prevention and management of gingivitis

INTRODUCTION

Orthodontics is a specialized field of dentistry focused on diagnosing and treating malocclusions, significantly enhancing facial aesthetics for patients. Traditional fixed appliances, such as metal braces, effectively correct misaligned teeth but are associated with aesthetic concerns, oral discomfort, and an increased risk of plaque accumulation and gingivitis.¹ Clear Aligner Therapy (CAT) has emerged as an advanced alternative, offering improved aesthetics, comfort, and convenience.



Clear Aligner Paradox

CAT utilizes computer-assisted design and manufacturing to achieve precise tooth movement while reducing the periodontal risks associated with fixed appliances. However, its success depends on patient compliance, with wear time exceeding 22 hours daily. While studies suggest that clear aligners generally result in lower plaque and gingivitis scores than fixed appliances, some findings indicate a comparable risk due to attachments and alterations in the oral microenvironment. Notably, adolescents exhibit a higher prevalence of gingivitis than adults, likely due to hormonal fluctuations, suboptimal oral hygiene, and lifestyle factors. Despite extensive research on the periodontal effects of orthodontic treatments, direct comparisons between clear aligners and fixed appliances across different age groups remain limited.² This study systematically assessed gingival health outcomes in adolescents and adults undergoing orthodontic treatment, providing evidence-based insights for optimizing periodontal management.

METHODS

This prospective observational study assessed the impact of clear aligner treatment on gingival health in adolescent and adult patients. About 120 participants (66 adolescents, 54 adults) received Invisalign aligners between June 2018 and September 2023, with participants randomly allocated to study or control groups. Inclusion criteria ensured participants had no systemic diseases, metal allergies, or smoking history. The study group received personalized oral hygiene education, while the control group maintained regular oral hygiene. Gingival health was evaluated using the Gingival Index (GI) at baseline, every 1.5 months during treatment, and after six months of orthodontic treatment. Data were recorded electronically for statistical analysis.

RESULTS



This study compared the incidence of gingivitis between adolescent and adult patients using clear aligners, where a higher incidence in adults (70.04%) compared to adolescents (39.39%) after treatment, with a statistically significant difference ($P < 0.05$). In adolescents, the Gingival Index (GI) significantly increased in the study group (from 0.17 before treatment to 1.49 during treatment) compared to the control group (from 0.15 before treatment to 0.59 during treatment), with a more pronounced increase in the study group after treatment ($P = 0.007$), indicating that adolescents face a higher risk of gingivitis early in treatment. In contrast, the GI increase in adults was not statistically significant ($P > 0.05$) for both groups, with similar effects observed from personalized hygiene education and basic periodontal treatment. These findings suggest that adolescents are more vulnerable to gingivitis during clear aligner treatment and may benefit from enhanced oral hygiene education, while adults show less variation in response to treatment interventions, as shown in figure 1.

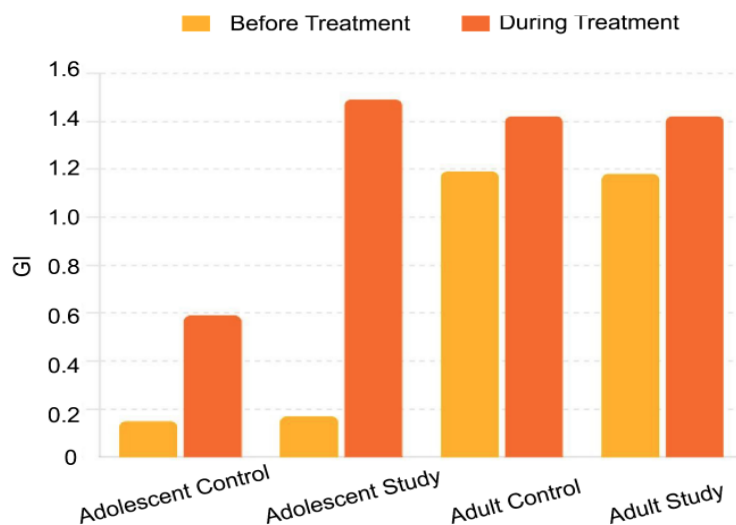


Figure 1. Gingival Index (GI) Before and During Treatment by Group

DISCUSSION

This study reveals that adolescents experienced a significantly higher incidence of gingivitis compared to adults, likely due to hormonal changes and poorer oral hygiene habits. This finding contrasts with another study that observed no significant differences in gingivitis rates among clear aligner users.³ Additionally, studies report that adolescents demonstrate inconsistent brushing techniques and less frequent use of interdental cleaning tools, contributing to increased plaque accumulation and gingival inflammation. In contrast, adults generally maintain better oral hygiene and adherence to follow-up care, resulting in lower gingivitis progression during treatment.³

CONCLUSION

Adolescents undergoing clear aligner orthodontic treatment exhibit a higher susceptibility to gingivitis compared to adults. Furthermore, basic periodontal therapy provides a moderate reduction in the incidence of gingivitis in clear aligner patients during treatment, surpassing the effectiveness of verbal oral health education alone.

Adolescents face a higher risk of gingivitis during clear aligner treatment, with basic periodontal therapy offering moderate preventive benefits.



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Development of a risk prediction model for elderly patients with cardiovascular diseases during tooth extraction

INTRODUCTION

With the global increase in the aging population, cardiovascular disease (CVD) has become the most prevalent chronic illness among the elderly, significantly contributing to morbidity and mortality. Many elderly patients with CVD require noncardiac surgical procedures, including tooth extractions, which pose potential cardiovascular risks due to stress-induced hemodynamic fluctuations. However, existing cardiac risk assessment tools focus on major surgeries and do not account for the unique challenges associated with minor procedures like tooth extraction in this population. Given the absence of a standardized clinical evaluation system for assessing cardiovascular risk in elderly patients undergoing tooth extraction, this study developed a risk prediction model based on the biopsychosocial medical framework.¹ This model seeks to enhance preoperative risk assessment, improve patient safety, and optimize clinical decision-making for dental procedures in elderly individuals with CVD.

Mental status and blood pressure are critical risk factors for adverse events in elderly cardiovascular patients undergoing tooth extraction.

METHODS

This prospective study included 774 patients aged ≥ 60 with cardiovascular disease (CVD) who underwent tooth extraction between January 2021 and July 2022. Patients who refused extraction were excluded. Data on general characteristics, clinical history, imaging, psychological assessments, and adverse events (AEs) were collected. A total of 62 potential risk factors were evaluated in the test group ($n=674$) for model development, with a validation group ($n=100$) used for model verification. Univariate and multivariable logistic regression models identified significant risk factors, and three predictive models were compared based on their discriminant abilities using receiver operating characteristic (ROC) curves and area under the ROC curve (AUC). Sensitivity, specificity, accuracy, and other related statistics were calculated for both the test and validation groups. The best model was selected and used to construct a nomogram. Statistical analyses were performed using SAS software (version 9.4), with a significance level of $P < 0.05$.



RESULTS

A total of 774 cardiovascular disease (CVD) patients, with a median age of 70 years and an average BMI of 22.93 kg/m², were included in the study. The majority had low educational levels ($\leq$ junior). In the test group (n=674), 23.15% developed adverse events (AEs) following tooth extraction. Patients with AEs had significantly higher blood pressure, a history of hypertension, pacemaker use, stroke, chronic kidney disease, and valvular insufficiency, along with lower ejection fraction and fibrinogen levels. Additionally, higher GHQ-28 scores and more extracted teeth were associated with AEs.

Univariate and multivariable logistic regression identified 11 key factors for predicting AEs: age, systolic blood pressure (SBP), severe hypertension, pacemaker use, stroke, ejection fraction (EF), valvular insufficiency, atrial premature beats (APB), ventricular premature beats (VPB), number of extracted teeth, and GHQ-28 score. Three predictive models were developed, with model 1 showing the highest performance. In the test group, model 1 had an AUC of 0.893, sensitivity of 0.878, specificity of 0.735 and accuracy of 0.768. In the validation group, the AUC was 0.857, sensitivity of 0.938, and specificity of 0.524. Based on model 1, a nomogram was created to predict AE risk, highlighting the importance of mental health and blood pressure in predicting AEs during tooth extraction in CVD patients (Figure 1).

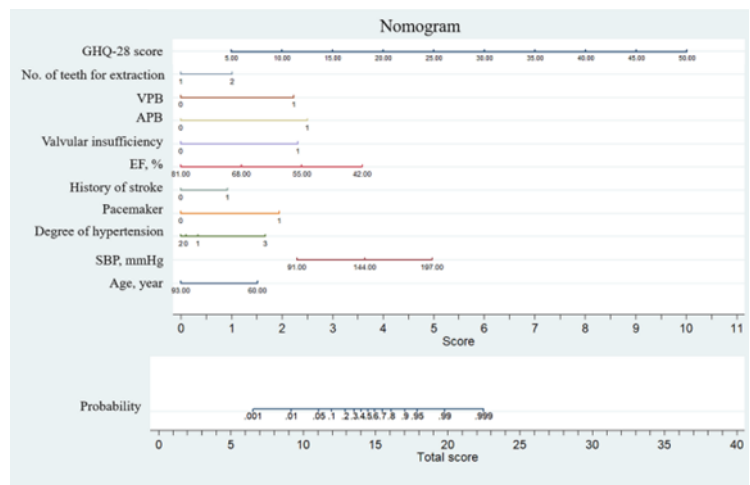


Figure 1. Nomogram predicting adverse event risk during tooth extraction in elderly cardiovascular patients (test group). The total score, derived from 11 risk factors, corresponds to the probability of adverse events occurring intraoperatively or within 7 days post-extraction.

DISCUSSION

This study highlights that both mental health and blood pressure are significant predictors of AEs during tooth extraction in elderly patients with CVD. Mental status, assessed by the GHQ-28, was found to significantly impact AEs, aligning with previous research that suggests psychological factors like anxiety and stress can exacerbate cardiovascular events through mechanisms such as psychoneuroimmunology.² Additionally, blood pressure, particularly elevated systolic and diastolic levels, also played a crucial role, consistent with prior studies linking blood pressure fluctuations during dental procedures to cardiovascular complications.³

CONCLUSION

This prospective study developed and validated a predictive model with 11 risk factors for adverse events during tooth extraction in elderly patients with cardiovascular disease. The model demonstrated strong utility and efficiency, though its applicability to other populations requires further validation in future studies.



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Assessment of alveolar bone loss and individualized periodontal prognoses from AI-driven panoramic radiographs

INTRODUCTION

Periodontal disease, including gingivitis and periodontitis, is a chronic inflammatory condition that leads to the destruction of tooth-supporting structures, ultimately resulting in tooth loss. Its progression is influenced by genetic, environmental, and behavioral factors, with clinical manifestations such as deep periodontal pockets and alveolar bone loss.¹ Accurate diagnosis is crucial but remains challenging due to the subjective nature of conventional clinical and radiographic assessments. Advancements in artificial intelligence (AI), particularly Convolutional Neural Networks (CNNs), offer promising solutions for automating and enhancing periodontal diagnostics. AI-driven models can improve the accuracy and efficiency of alveolar bone loss detection by analyzing panoramic radiographs with greater precision and consistency.² This study developed a CNN-based model for objective periodontal assessment, addressing the limitations of traditional diagnostic methods and improving individualized prognostication and treatment planning.

AI-driven analysis enhances alveolar bone loss assessment and periodontal prognostication with superior speed, accuracy, and efficiency.

METHODS

This retrospective study analyzed 2,000 panoramic radiographs collected between January 2015 and December 2023, using the SIDEXIS Next Generation Program. Individuals aged 18 and older diagnosed with periodontitis, identified via diagnosis codes, were included. Poor-quality images, improper positioning, uncommon bone morphologies, and craniofacial anomalies were excluded. The radiographs underwent preprocessing steps including image sharpening, contrast adjustment, and Gaussian filtering to enhance clarity. Object segmentation was performed with the LabelMe tool, and data conversion was achieved using Labelme2yolo. A Convolutional Neural Network (CNN) model, based on YOLOv8, was developed to detect regions of interest, specifically the cemento-enamel junction (CEJ) and alveolar bone level. The model's performance was evaluated using mean Average Precision (mAP50) and key metrics such as Precision, Recall, and F1-Score, with accuracy assessed through a confusion matrix. The workflow included data segmentation (70% training, 10%



validation, 20% test), localization of CEJ and alveolar bone, and thresholding to detect abnormalities.

RESULTS

A total of 2,000 panoramic radiographs were included in the study, randomly split into training, validation, and test sets in a 70:10:20 ratio. The performance of two segmentation models—CEJ and bone level vs. teeth segmentation—was evaluated. The CEJ and bone level model outperformed the teeth segmentation model across all metrics. The CEJ and bone level model achieved a precision of 0.90, F1 score of 0.90, sensitivity of 1.0, specificity of 0.98, and accuracy of 0.98. In contrast, the teeth segmentation model had precision of 0.80, F1 score of 0.80, sensitivity of 0.90, specificity of 0.96, and accuracy of 0.97. The Mean Average Precision (mAP50) was also higher for the CEJ and bone level model (0.995 vs. 0.92). The CEJ and bone level model correctly predicted 18,385 instances with only 234 false positives, while the teeth segmentation model identified 983 teeth instances but had a higher false positive rate (589) (Table 1). Both models demonstrated strong performance, with low false negatives and high classification accuracy.

Actual \ Predicted	Positive (Bone Loss Present)	Negative (No Bone Loss)
Positive (Bone Loss Present)	True Positive (TP): 983	False Negative (FN): 11
Negative (No Bone Loss)	False Positive (FP): 589	True Negative (TN): 18,687

Table 1. Confusion Matrix for Teeth Segmentation Performance

DISCUSSION

This study presents an AI model using CNNs for assessing alveolar bone loss and predicting periodontal prognosis from panoramic radiographs. The CEJ and bone level segmentation model demonstrated superior performance (precision 0.90, accuracy 0.98) compared to the teeth segmentation model (precision 0.80, accuracy 0.97), contrasting with previous studies by Krois et al. and Bayrakdar et al., which showed lower performance in bone structure segmentation.^{3,4} Additionally, the study aligns with findings from Schwendicke et al. and Topol, who highlighted AI's ability to reduce human error and standardize diagnoses. However, this model offers more targeted and accurate results, particularly for periodontal assessments, thus improving diagnostic capabilities in dental practice.^{5,6}

CONCLUSION

This AI model presents an advanced method for assessing alveolar bone loss and determining periodontal prognosis. It offers a faster, more accurate, and less labor-intensive alternative to traditional approaches.

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Case Report on Septic Arthritis of the Temporomandibular Joint

INTRODUCTION

The temporomandibular joint (TMJ) is a synovial hinge joint crucial for functions such as chewing, swallowing, and speaking.¹ Septic arthritis of the TMJ is a rare condition, with fewer than 100 reported cases, often caused by *Staphylococcus aureus* but also other microorganisms. It typically arises from hematogenous spread, local infections, autoimmune disorders, trauma, or surgical procedures. While it can affect both children and adults, it is more common in older individuals with underlying comorbidities. Symptoms include limited jaw mobility, preauricular edema, headaches, fever, and general weakness.² This case report highlights a rare instance of TMJ septic arthritis in a 52-year-old female, emphasizing diagnostic and therapeutic challenges.

Early diagnosis and multidisciplinary management are crucial for optimizing outcomes in rare cases of TMJ septic arthritis.

CASE PRESENTATION

A 58-year-old woman with a history of osteoarthritis, including knee replacements and a hysterectomy, presented to the emergency department with severe left facial and ear pain, swelling, tinnitus, and difficulty opening her mouth. These symptoms had developed three days prior, without any prior temporomandibular joint (TMJ) disorder history. Clinical examination revealed left preauricular swelling, limited mouth opening, tenderness in the masseter and temporalis muscles, and unbalanced occlusion. Laboratory tests showed leukocytosis and elevated C-reactive protein (CRP).



Figure 1. Panoramic radiograph showing left condylar prominence with an enlarged intra-articular space compared to the right



Radiographic exams revealed asymmetry in the left condyle, a subperiosteal abscess on the left mandibular condyle, and signs of bone involvement (Figure 1). Magnetic resonance imaging (MRI) confirmed edema and inflammation in the left TMJ. The diagnosis of severe infectious TMJ was made, and empirical antibiotic therapy (Amoxicillin and clavulanic acid) was started. Despite negative PCR results for pathogens, the clinical suspicion remained high for septic arthritis.

The patient underwent joint decompression and aspiration, with analysis of the aspirated fluid yielding negative microbiological results. A second antibiotic regimen (Metronidazole and Ceftriaxone) resulted in marked clinical improvement, including reduced pain, edema, and improved mouth opening. CRP and leukocyte levels significantly decreased. At discharge, she was prescribed a continued antibiotic regimen and attended follow-up appointments with improvements in TMJ mobility and reduced pain. Six months later, her condition showed notable recovery.

DISCUSSION

TMJ septic arthritis is a rare condition often confused with other temporomandibular disorders (TMDs) due to overlapping symptoms. This case emphasizes the need to differentiate it from conditions like osteoarthritis and rheumatoid arthritis, which lack the acute inflammatory signs of septic arthritis. The negative PCR results contrast with other studies where pathogens are commonly identified, suggesting that the timing of fluid aspiration may affect detection.² Advanced imaging (MRI and CT) for effusions and bone involvement aligns with standard practice and highlights the importance of multidisciplinary collaboration for early diagnosis and treatment to prevent complications like joint destruction or sepsis.³

CONCLUSION

Septic arthritis of the TMJ is a rare, challenging condition that requires careful diagnosis through clinical assessment, lab tests, and imaging. This case underscores the value of multidisciplinary collaboration in effective treatment. Early recognition and intervention are crucial to improving outcomes and preventing complications.

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