



Association Between Denture Hygiene, Salivary Flow Rate, and Clinical Severity of Denture Stomatitis in Complete Denture Wearers: A Multicenter Study in Punjab

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Abstract

Objective:

This study aims to examine the clinical relationship between denture maintenance habits, physiological salivary flow, and the severity of denture stomatitis in complete denture wearers.

Methods:

An analytical cross-sectional study was conducted from August 2024 to February 2025 at Fatima Memorial Hospital (FMH), Lahore, and other affiliated dental teaching hospitals in Punjab, involving 120 complete denture wearers. Denture hygiene was evaluated using the Budtz-Jørgensen Plaque Index. Unstimulated whole salivary flow (ml/min) was measured using the spitting method. The clinical severity of denture stomatitis was assessed using Newton's Classification.

Results:

A significant inverse correlation ($r = -0.68$, $p < 0.001$) was found between salivary flow rate and stomatitis severity. Patients with hyposalivation (≤ 0.1 ml/min) and poor hygiene scores (≥ 2.0) were predominantly diagnosed with Newton Type III lesions, indicating severe mucosal inflammation.

Conclusion:

Reduced salivary flow is a significant physiological risk factor that exacerbates tissue damage caused by poor denture hygiene in the local population. Proper assessment of salivary flow rate in denture wearers is crucial for identifying individuals at high risk for severe denture stomatitis.

1. Introduction

Maintaining the health of the denture-bearing mucosa is essential for the long-term success of complete dentures. Denture stomatitis (DS) is a common inflammatory condition observed in denture wearers, clinically characterized by erythema, mucosal inflammation, and, in severe cases, papillary hyperplasia. It is frequently reported among elderly individuals and remains a significant concern in prosthodontic practice (1,2).

The etiology of denture stomatitis is multifactorial, involving an interaction of local and systemic factors. Among these, poor denture hygiene is considered a major behavioral contributor, as it promotes the accumulation of microbial plaque on denture surfaces. This microbial load leads to persistent mucosal irritation and inflammation beneath the denture base (1). However, hygiene alone does not fully explain the variation in disease severity observed in clinical practice.

Salivary flow rate plays a critical physiological role in maintaining oral homeostasis. Saliva provides a protective function through its antimicrobial properties, buffering capacity, and mechanical cleansing action. Adequate salivary flow helps in reducing microbial colonization and prevents prolonged contact of irritants with the oral mucosa. Conversely, reduced salivary flow (hyposalivation) compromises these defense mechanisms, thereby increasing susceptibility to mucosal inflammation and infection (2).

Hyposalivation is commonly observed in elderly populations due to age-related physiological changes and the widespread use of systemic medications, particularly those prescribed for chronic conditions such as hypertension and diabetes. In such conditions, the protective role of saliva is diminished, allowing microbial toxins and irritants to persist on the denture-bearing tissues, thereby accelerating the progression of denture stomatitis.

Despite the recognized roles of denture hygiene and salivary flow individually, limited clinical studies in the local context have evaluated their combined effect on the severity of denture stomatitis. Most available literature focuses on microbial or material-related factors, while the interaction between behavioral and physiological determinants remains underexplored in patient populations from developing regions.

Therefore, the present study was designed to evaluate the association between denture hygiene, salivary flow rate, and the clinical severity of denture stomatitis among complete denture wearers in Punjab, Pakistan. Understanding this relationship is essential for developing comprehensive clinical strategies that address both modifiable behavioral factors and underlying physiological risks.

2. Methodology

2.1 Study Design and Setting

This analytical cross-sectional study was conducted from August 2024 to February 2025 at Fatima Memorial Hospital (FMH), Lahore, along with affiliated dental teaching hospitals across Punjab, Pakistan. The multicenter design allowed inclusion of a diverse patient population representative of the regional demographic.

2.2 Study Population and Sampling

A total of 120 complete denture wearers were included in the study. Participants were selected using a non-probability consecutive sampling technique from patients attending prosthodontic outpatient departments.

2.3 Inclusion Criteria

- Patients aged **40 years and above**
- Complete denture wearers for **at least one year**
- Willing to participate and provide informed consent

2.4 Exclusion Criteria

- Patients with active oral infections other than denture stomatitis
- History of oral malignancy
- Patients with systemic conditions severely affecting oral mucosa
- Patients currently undergoing antifungal therapy

2.5 Data Collection Procedure

All clinical examinations and measurements were performed under standardized conditions in dental operatories by trained clinicians to ensure consistency.

2.5.1 Denture Hygiene Assessment (Prosthodontics)

Denture hygiene was evaluated using the Budtz-Jørgensen Plaque Index, which assesses plaque accumulation on the fitting surface of the maxillary denture. Scores were assigned as follows:

0: No plaque (clean surface)

1: Thin plaque layer

2: Moderate plaque accumulation

3: Heavy plaque covering more than 50% of the surface

2.5.2 Salivary Flow Rate Measurement (Oral Medicine)

Participants were instructed to refrain from eating, drinking, or smoking for at least two hours before assessment.

Unstimulated whole saliva was collected using the spitting method over a period of 5 minutes, and the flow rate was calculated in ml/min.

Hyposalivation was defined as a salivary flow rate of ≤ 0.1 ml/min.

2.5.3 Clinical Severity Assessment (Oral Pathology)

The palatal mucosa was examined under standardized dental lighting conditions and graded according to Newton's Classification:

Type I: Localized inflammation (pinpoint erythema)

Type II: Generalized erythema (diffuse inflammation)

Type III: Inflammatory papillary hyperplasia (granular tissue changes)

2.6 Statistical Analysis

Data were entered and analyzed using SPSS version 26. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages.

The relationship between variables was assessed using Spearman rank correlation due to the ordinal nature of clinical severity grading.

A p-value of < 0.05 was considered statistically significant.

3. Results

3.1 Demographic Characteristics and Salivary Profile

A total of 120 complete denture wearers were included in the study. The mean age of the participants was 64.2 ± 8.4 years, indicating a predominantly elderly population.

The mean unstimulated salivary flow rate was 0.24 ± 0.11 ml/min. Based on the predefined cutoff value, 35% ($n = 42$) of participants were classified as having hyposalivation (≤ 0.1 ml/min), while the remaining 65% ($n = 78$) had normal salivary flow.

Table 1: Distribution of Participants According to Salivary Flow Rate

Salivary Flow Category	Flow Rate (ml/min)	Number of Patients (%)
Normal	> 0.1	78 (65%)
Hyposalivation	≤ 0.1	42 (35%)

3.2 Relationship Between Salivary Flow, Hygiene, and Clinical Severity

The distribution of salivary flow rate and denture hygiene scores across different grades of denture stomatitis is presented in Table 2.

Patients with Newton Type I (mild) lesions demonstrated the highest mean salivary flow (0.38 ± 0.06 ml/min) and the lowest plaque index scores (0.8 ± 0.4).

In contrast, patients with Newton Type III (severe) stomatitis exhibited the lowest salivary flow (0.08 ± 0.03 ml/min) and the highest plaque index scores (2.6 ± 0.5).

A progressive trend was observed, where decreasing salivary flow and increasing plaque accumulation were associated with increasing disease severity.

Table 2: Correlation of Salivary Flow and Hygiene with Clinical Severity

Newton Classification	Patients (n)	Mean Salivary Flow (ml/min)	Mean Plaque Index (0–3)
Type I (Mild)	34	0.38 ± 0.06	0.8 ± 0.4
Type II (Moderate)	56	0.21 ± 0.09	1.9 ± 0.6
Type III (Severe)	30	0.08 ± 0.03	2.6 ± 0.5

3.3 Correlation Analysis

Spearman rank correlation analysis was performed to evaluate the relationship between salivary flow rate, denture hygiene, and the clinical severity of denture stomatitis.

A strong negative correlation was observed between salivary flow rate and disease severity ($r = -0.68$, $p < 0.001$), indicating that lower salivary flow is associated with increased severity of denture stomatitis.

In addition, a moderate positive correlation was found between denture hygiene scores and disease severity ($r = 0.54$, $p = 0.003$), suggesting that poor hygiene contributes to worsening clinical outcomes.

Table 3: Statistical Correlation Matrix

Variable Pair	Correlation (r)	p-value
Salivary Flow vs. Severity	-0.68	$< 0.001^*$
Hygiene Score vs. Severity	0.54	0.003^*

3.4 Key Findings

- I. Hyposalivation was present in 35% of participants, indicating a substantial burden in the study population.
- II. Salivary flow showed a stronger correlation with disease severity compared to denture hygiene.
- III. Patients with low salivary flow and poor hygiene consistently presented with severe (Type III) lesions.
- IV. A clear dose-response relationship was observed, where worsening hygiene and reduced salivary flow were associated with increasing clinical severity.

4. Discussion:

This study evaluated the relationship between denture hygiene, salivary flow rate, and the clinical severity of denture stomatitis (DS) among complete denture wearers in Punjab. The findings demonstrate a significant association between reduced salivary flow, poor denture hygiene, and

increasing severity of mucosal inflammation. Notably, salivary flow rate emerged as a stronger predictor of disease severity compared to denture hygiene, highlighting the critical role of physiological factors in the progression of denture stomatitis.

Denture stomatitis is widely recognized as a multifactorial condition, with both local and systemic determinants contributing to its development. Poor denture hygiene has consistently been identified as a major contributing factor, as it facilitates microbial accumulation on denture surfaces, leading to chronic irritation of the underlying mucosa (1). In the present study, a moderate positive correlation ($r = 0.54$) was observed between plaque index scores and disease severity, confirming that increased plaque accumulation is associated with worsening clinical presentation. These findings are in agreement with previous studies that have emphasized the role of biofilm formation in initiating and sustaining mucosal inflammation (1,2).

However, an important observation in this study is that denture hygiene alone does not fully explain the variation in clinical severity. Patients with similar hygiene scores often presented with different grades of stomatitis, suggesting the influence of additional modifying factors. This supports the concept that DS is not purely a hygiene-related condition but rather the result of an interaction between behavioral and physiological variables.

Salivary flow rate plays a central role in maintaining oral homeostasis and mucosal integrity. Saliva acts as a natural defense mechanism through its antimicrobial properties, buffering capacity, and mechanical cleansing action. It helps in reducing microbial colonization and prevents prolonged exposure of the mucosa to irritants. In this study, a strong negative correlation ($r = -0.68$) was found between salivary flow rate and disease severity, indicating that reduced salivary flow is significantly associated with more severe forms of denture stomatitis. This finding suggests that hyposalivation is a key physiological determinant that accelerates disease progression.

These results are consistent with previous literature, which has shown that reduced salivary flow compromises mucosal defense mechanisms and increases susceptibility to inflammation and infection (2). In conditions of hyposalivation, the absence of adequate cleansing leads to the accumulation of microbial toxins and debris on the denture-bearing tissues. This prolonged exposure enhances the inflammatory response, eventually resulting in advanced pathological changes such as papillary hyperplasia (Newton Type III).

An important clinical insight from this study is the interaction between denture hygiene and salivary flow. Patients with both poor hygiene and low salivary flow consistently exhibited the most severe clinical presentations. Interestingly, some patients with moderate hygiene but reduced salivary flow presented with more severe lesions than those with poor hygiene but normal salivary flow. This finding underscores the dominant influence of salivary flow as a modifying factor. It suggests that while hygiene provides the source of irritation, salivary flow determines the extent to which this irritation is neutralized or allowed to persist.

This concept has important implications for clinical practice. Traditional management of denture stomatitis often focuses primarily on improving denture hygiene through patient education and cleaning protocols. While these measures remain essential, the findings of this study indicate that such approaches may be insufficient in patients with underlying hyposalivation. In these individuals, addressing the physiological deficit becomes equally important. Interventions such as salivary stimulants, saliva substitutes, and modification of xerogenic medications should be considered as part of a comprehensive management plan.

The high prevalence of hyposalivation (35%) observed in this study reflects the demographic characteristics of the study population, which consisted predominantly of elderly individuals. Aging is associated with physiological changes that may reduce salivary gland function. In addition, many elderly patients are on long-term medications for chronic conditions such as hypertension and diabetes, which are known to reduce salivary flow. This highlights the need for clinicians to adopt a more holistic approach when managing denture wearers, particularly in regions like Punjab where such comorbidities are common.

From an oral pathology perspective, the progression from Newton Type I to Type III represents a continuum of inflammatory response. In the early stages, localized erythema reflects mild irritation. However, in the absence of adequate defense mechanisms, this progresses to diffuse inflammation and eventually to papillary hyperplasia, which represents a chronic and more advanced pathological state. The findings of this study suggest that reduced salivary flow accelerates this progression by allowing continuous exposure of the mucosa to irritants.

Another important aspect highlighted by this study is the concept of a “dose-response” relationship. As salivary flow decreases and plaque accumulation increases, the severity of denture stomatitis also increases. This gradient pattern strengthens the biological plausibility of the observed associations and supports the hypothesis that both factors act synergistically in disease progression. The findings of this study also contribute to the existing body of knowledge by providing data from a local population in Pakistan. Most previous studies have been conducted in developed settings, and there is limited data from developing regions. The present study addresses this gap and provides context-specific evidence that can inform local clinical practices and public health strategies. Despite its strengths, this study has certain limitations. The cross-sectional design limits the ability to establish a causal relationship between salivary flow, denture hygiene, and disease severity. Additionally, the study was conducted in selected teaching hospitals in Punjab, which may limit the generalizability of the findings to other populations. Furthermore, microbiological factors such as *Candida* colonization, which are known to play a role in denture stomatitis, were not directly assessed in this study. Future research should consider longitudinal designs and include microbiological analysis to further elucidate the complex interactions involved in the pathogenesis of denture stomatitis.

5. Limitations

This study has several limitations that should be considered.

First, the cross-sectional design limits the ability to establish a causal relationship between denture hygiene, salivary flow rate, and the severity of denture stomatitis.

Second, the study was conducted in selected teaching hospitals in Punjab, which may limit the generalizability of the findings to other populations and settings.

Third, microbiological factors, particularly *Candida* colonization, were not assessed, although they are known contributors to denture stomatitis.

Future studies should adopt longitudinal designs, include larger and more diverse populations, and incorporate microbiological analysis to better understand the multifactorial nature of the disease.

6. Conclusion:

This study demonstrates a significant association between denture hygiene, salivary flow rate, and the clinical severity of denture stomatitis among complete denture wearers. While poor denture hygiene contributes to the initiation and progression of mucosal inflammation, reduced salivary flow was identified as a stronger predictor of severe clinical presentations.

Patients with hyposalivation were more likely to develop advanced forms of denture stomatitis, even in the presence of moderate hygiene levels. This finding highlights the critical role of saliva as a protective factor in maintaining oral mucosal health. The interaction between behavioral factors (hygiene) and physiological factors (salivary flow) determines the overall disease burden.

From a clinical perspective, the management of denture stomatitis should not be limited to improving denture hygiene alone. Routine assessment of salivary flow rate is essential for identifying high-risk patients. A comprehensive management approach that includes hygiene reinforcement, salivary stimulation, and modification of contributing systemic factors is necessary for effective prevention and treatment.

These findings emphasize the need for an integrated clinical approach in prosthodontic care, particularly in elderly populations where hyposalivation is common.

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