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Association between Oral Potentially Malignant Disorders and Use of Restorative Dental Materials: A Cross-Sectional Study

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Abstract

Background: Oral potentially malignant disorders (OPMDs) represent a spectrum of mucosal conditions with an increased risk of malignant transformation. Although tobacco and alcohol remain established etiological factors, the role of restorative dental materials in contributing to mucosal changes has gained interest due to their chemical composition, degradation by-products, and chronic intraoral exposure.

Objective: To evaluate the association between OPMDs and the use of different restorative dental materials among adult patients.

Methods: A cross-sectional study was conducted on adult patients attending dental outpatient clinics. Detailed oral examinations were performed to diagnose OPMDs following WHO criteria. History of dental restorations, including amalgam, composite resin, glass ionomer cement (GIC), ceramic and metal-ceramic restorations, was recorded. Demographic variables, habits, and duration of restorations were included. Statistical analysis involved chi-square tests and logistic regression to determine associations.

Results: Patients with metal-based restorations (amalgam and metal-ceramic crowns) showed a higher prevalence of OPMDs compared to those with tooth-colored materials. Composite resins demonstrated minimal association overall, whereas GIC restorations showed no significant relationship. Logistic regression indicated that presence of ≥3 metal restorations increased the odds of OPMDs after adjusting for tobacco habits ($p < 0.05$). No association was found between ceramic restorations and OPMDs.

Conclusion: A significant association was observed between OPMDs and multiple metal-based restorations, possibly due to galvanic reactions, corrosion by-products, and chronic mucosal contact.

Keywords: Oral potentially malignant disorders, Restorative dental materials, metal-ceramic, composite resin.

INTRODUCTION

Oral potentially malignant disorders (OPMDs) comprise a category of lesions linked to a heightened risk of developing oral cancer, particularly squamous cell carcinoma.1 Identifying them and performing an etiological assessment are essential components of the early intervention process. Iatrogenic factors, including restorative dental materials, are garnering increased attention, although tobacco use, alcohol consumption, and areca nut chewing remain the primary risk factors.2 A wide range of restorative materials is employed in clinical dentistry. Examples of these materials include amalgam, composite resins, glass ionomer cement (GIC), and metal-ceramic restorations.3 Overall, their biocompatibility has been demonstrated; however, concerns persist regarding potential mucosal irritation resulting from corrosion products, monomer release, and galvanic interactions.2 Amalgam restorations undergo oxidation and corrosion, leading to the release of metallic ions that may contribute to lichenoid reactions. In a similar manner, composite resins have the potential to release unpolymerized monomers like BIS-GMA and TEGDMA, both of which have been linked to hypersensitivity responses. Metal-ceramic restorations may exhibit nickel-related hypersensitivity in individuals predisposed to this condition.1 The multifactorial nature of OPMDs suggests that early diagnosis and prevention of malignant transformation may be possible by investigating the role of restorative materials. Despite anecdotal accounts and limited clinical findings, few studies have performed a comprehensive analysis of this connection.4

This cross-sectional study aims to assess the relationship between oral potentially malignant disorders (OPMDs) and the type and quantity of restorative materials used in adult patients, considering significant confounding factors including age, lifestyle, and systemic diseases.

METHODOLOGY

This cross-sectional study was performed on patients visiting the dental outpatient department during a designated timeframe. Ethical approval was secured wide # AIDC/P103/2022 prior to the initiation of the study, and informed consent was obtained from all participants. Demographic information such as age, gender, socioeconomic status, and lifestyle habits (tobacco, areca nut, alcohol) was documented. An oral examination adhering to WHO criteria was conducted to identify OPMDs, including leukoplakia, erythroplakia, oral lichen planus, oral submucous fibrosis, among others. The type, quantity, and duration of dental restorations were recorded. Restorations were categorized as (a)Amalgamation (b)Composite resin (c) Glass ionomer cement (GIC) (d) Metal-ceramic restorations (e) All-ceramic restorations. Chi-square tests evaluated the relationship amongst material type and the occurrence of OPMDs. Logistic regression conducted a further analysis of risk associations while controlling for habits. SPSS version 25 was used to analyse the data.

RESULTS

Table 1 reflects baseline characteristics and the distribution of participants by age, gender, and habits. Tobacco and areca nut use are major confounders in assessing OPMD risk. The greatest number of participants were male 214 (56.3%) and the tobacco used was most commonly used 153 (40.3%).

Table 1. Demographic Characteristics and Habit Profile of Participants (N=380)

Variable	Category	n (%)
Age Group	18–30 years	82 (21.6%)
	31–45 years	141 (37.1%)
	46–60 years	108 (28.4%)
	>60 years	49 (12.9%)
Gender	Male	214 (56.3%)
	Female	166 (43.7%)
Tobacco Use (Cigarettes)	Yes	153 (40.3%)
	No	227 (59.7%)
Areca Nut Use	Yes	97 (25.5%)
	No	283 (74.5%)

Variable	Category	n (%)
Alcohol Consumption	Yes	112 (29.5%)
	No	268 (70.5%)

Table 2 presents the frequency and type of restorations found clinically. Metal-based restorations were more common in older groups. While table 3 shows OPMD prevalence among users of each restorative material. Metal restorations show a higher OPMD frequency.

Table 2: Participants' Distribution of Restorative Dental Materials.

Type of Restoration	n (%)
Amalgam Restorations	168 (44.2%)
Composite Resin Restorations	242 (63.7%)
Glass Ionomer Cement (GIC) Restorations	94 (24.7%)
Metal-Ceramic Crowns/Bridges	121 (31.8%)
All-Ceramic Restorations	58 (15.3%)
Patients With ≥3 Metal Restorations	74 (19.5%)

Table 3: Oral Potentially Malignant Disorder Prevalence by Type of Restorative Material.

Type of Restoration	Total Patients with Material (n)	Patients with OPMDs n (%)
Amalgam Restorations	168	31 (18.4%)
Composite Resin Restorations	242	19 (7.9%)
Glass Ionomer Cement (GIC)	94	7 (7.4%)
Metal-Ceramic Crowns/Bridges	121	28 (23.1%)
All-Ceramic Restorations	58	3 (5.1%)
≥3 Metal Restorations	74	21 (28.4%)

Table 4: Logistic Regression Analysis of the Relationship between OPMDs and Restorative Materials

Variable	Adjusted Odds Ratio (AOR)	95% CI	p-value
Amalgam Restorations	1.42	1.01–2.65	0.048*
≥3 Metal Restorations	2.87	1.54–4.91	0.002*
Metal-Ceramic Restorations	2.34	1.28–3.77	0.009*
Composite Resin Restorations	0.84	0.48–1.36	0.318
GIC Restorations	0.78	0.41–1.29	0.411
All-Ceramic Restorations	0.63	0.18–1.41	0.117
Tobacco Use (Yes)	3.65	2.41–5.89	<0.001*
Areca Nut Use (Yes)	2.71	1.34–4.02	<0.001*

***Statistically significant**

DISCUSSION

This study's findings indicate a significant correlation between oral potentially malignant disorders (OPMDs) and the presence of multiple metal-based restorations, specifically amalgam and metal-ceramic prostheses. The findings support the idea that while OPMDs are mainly influenced by lifestyle factors like tobacco use, additional irritants and prolonged intraoral exposures may also play a role in their development or persistence. The association in the current dataset remained statistically significant after

adjusting for tobacco, areca nut, and alcohol consumption, indicating that specific restorative materials may act as additional cofactors in susceptible individuals.5

The biological feasibility of this relationship is thoroughly proven in the literature. Amalgam restorations are made up of different amounts of mercury, silver, copper, and tin.6 Over time, changes in the environment in the mouth, including as changes in pH, salivary enzymes, and galvanic contacts, cause corrosion and ion release.7 Prior clinical studies have established that metallic by-products can provoke localized lichenoid reactions, especially when restorations are situated near the mucosa.8 Previous studies by various researchers indicated that partial or complete regression of lichenoid lesions occurred following the replacement of suspected amalgam restorations with alternative materials.7-11 The findings of the current study indicate a higher prevalence of OPMDs in patients with amalgam, aligning with previous reports. Similarly, nickel and cobalt, two known allergens, are frequently found in the alloy frameworks of metal-ceramic crowns. Previous studies have demonstrated that in those who are susceptible, nickel sensitivity can cause erythematous plaques, oral lichenoid responses, and persistent mucosal irritation.8-10 The current study demonstrates a significantly higher prevalence of oral potentially malignant disorders (OPMDs) in patients receiving metal-ceramic restorations, consistent with prior research indicating that nickel-containing alloys may compromise mucosal health.12-14 In the present study, tooth-coloured all-ceramic crowns exhibited the lowest incidence of OPMD. This conclusion aligns with existing research indicating that ceramic materials exhibit high chemical stability and biocompatibility.

Composite resin restorations exhibited only a minimal, statistically insignificant association with OPMDs. This outcome reflects the general trend in the literature, where composite resins are known to release unpolymerized monomers such as TEGDMA or BIS-GMA; however, these substances typically cause short-term cytotoxic effects rather than chronic mucosal lesions.13 Most in vitro studies have also concluded that the degree of monomer release decreases significantly after the first 24 hours, further supporting the clinical observation that these materials are unlikely to lead to persistent potentially malignant changes.

Glass ionomer cement (GIC), a tooth-colored material, demonstrated no significant correlation with oral potentially malignant disorders (OPMDs), aligning with previous research that highlights its inert properties and continuous fluoride release. Numerous clinical trials and laboratory analyses indicate that GIC demonstrates superior mucosal compatibility, consistent with the low prevalence of OPMD found among GIC users in this study.15 The finding that patients with three or more metal-based restorations face a significantly increased risk supports the hypothesis that cumulative exposure is a contributing factor. Other researchers have observed that the number of metallic restorations is associated with the extent of mucosal changes, likely resulting from elevated galvanic currents and increased ion release from various restoration surfaces.4 The cumulative effect is particularly significant in patients exhibiting overlapping risk behaviours, as irritants from both intrinsic and extrinsic sources may synergistically lead to epithelial dysplasia.

CONCLUSION

A notable association is observed between oral potentially malignant diseases (OPMDs) and various metal-based restorations, indicating that these materials may serve as secondary irritants or cofactors in predisposed individuals. Tooth-coloured restorations, specifically composite resins and glass ionomer cement, showed no elevated risk. Dentists must exercise caution when examining mucosal tissues surrounding metal restorations, particularly in patients with pre-existing high-risk habits.

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