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Oral mucosal lesions and smokeless quid consumption: A clinical correlation

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Abstract:
Smokeless quid consumption containing tobacco, areca nut, or both is associated with oral potentially malignant disorders and oral cancer. Therefore, it is of interest to evaluate the association between quid type and oral mucosal lesions among 1,209 users aged 18–65 years. Habit history and oral examinations were assessed using modified WHO criteria, followed by statistical analysis. Oral mucosal lesions affected 78.49% of participants, with oral submucous fibrosis and tobacco pouch keratosis being the most prevalent and significantly associated with processed quid use. Thus, data shows the importance of quid-specific risk assessment and targeted screening for early detection and prevention of oral potentially malignant disorders.

Keywords: Smokeless quid, tobacco, areca nut, oral mucosal lesions, oral submucous fibrosis, tobacco pouch keratosis, oral potentially malignant disorders (OPMDs), quid-induced lesions

Background:
Smokeless tobacco and areca nut consumption constitute a major public health problem worldwide, particularly in South Asian countries such as India. Quid chewing, which involves the placement of substances containing areca nut, tobacco, lime and various flavouring agents in the oral cavity, is a culturally accepted practice among millions of people. The habit is deeply rooted in social traditions and has been associated with a variety of oral mucosal alterations and oral potentially malignant disorders (OPMDs) **[1, 2].** Areca nut, obtained from Areca catechu, is consumed either alone or in combination with tobacco in the form of betel quid, gutkha, pan masala and other commercially available products. The widespread availability, low cost, attractive packaging and aggressive marketing of these products have significantly increased their consumption, especially among adolescents and young adults **[3]**. Tobacco contains numerous carcinogenic compounds, including tobacco specific nitrosamines, polycyclic aromatic hydrocarbons and radioactive substances, which are known to induce cellular and genetic damage. Nicotine, the major psychoactive component of tobacco, is highly addictive and contributes to the continuation of the habit **[4].** Similarly, areca nut has been classified as a Group I human carcinogen by the International Agency for Research on Cancer (IARC). The alkaloid arecoline present in areca nut has been shown to induce fibrosis, oxidative stress and DNA damage, thereby contributing to oral carcinogenesis **[5].** The use of smokeless forms of quid has been strongly associated with a spectrum of oral mucosal lesions, including oral submucous fibrosis, leukoplakia, erythroplakia, tobacco pouch keratosis, betel chewer's mucosa, oral lichenoid lesions and oral squamous cell carcinoma **[6].** These lesions are of particular concern because many possess malignant transformation potential and significantly affect the quality of life of affected individuals. India bears a substantial burden of tobacco-related morbidity and mortality owing to the widespread use of both smoked and smokeless tobacco products. Several epidemiological studies have reported a high prevalence of quid chewing habits and a corresponding increase in oral mucosal lesions among habitual users **[7].** Therefore, it is of interest to evaluate the occurrence of oral mucosal lesions among users of smokeless quid and to establish their clinical correlation with different forms and patterns of quid consumption.

Methodology:
The present cross-sectional analytical study was conducted in the Department of Public Health Dentistry, Vyas Dental College and Hospital, Jodhpur, Rajasthan, over a period of one year after obtaining ethical clearance from the Institutional Scientific and Ethical Committee. The study included 1,209 smokeless quid users aged between 18 and 65 years. The sample size was calculated using the formula $n = Z^2 (P.Q)/E^2$, considering a 95% confidence interval and a margin of error of 5%. Participants were selected using a simple random sampling technique. Individuals of both sexes who consumed smokeless forms of quid containing areca nut, tobacco, or a combination of both were included in the study. Subjects who had discontinued the habit for more than two years, had a history of smoking, alcohol consumption, drug addiction, other harmful habits, metallic crowns, amalgam or composite restorations, previous graft insertion, treatment for oral cancer, or any pre-existing oral mucosal lesions were excluded from the study. After obtaining informed consent, a detailed case history was recorded in the local language. Information regarding chief complaints, medical history, demographic characteristics, socioeconomic status and detailed habit history was collected using a structured proforma based on the Modified WHO Oral Health Assessment Form. Socioeconomic status was assessed using the Kuppusamy Scale. Details regarding the type of quid consumed, frequency of use per day, duration of the habit in years and form of quid were documented. Participants were categorized into three groups according to the contents of the quid: Group I comprised users of areca nut-containing quid, Group II included users of tobacco-containing quid and Group III consisted of users consuming both areca nut and tobacco-containing quid. Furthermore, subjects were classified according to the form of quid consumed as processed, unprocessed, or both processed and unprocessed forms. Clinical examination was performed under artificial illumination using a sterile mouth mirror, probe, tweezer, gauze, cheek retractor, gloves, face mask and other standard diagnostic instruments. All oral mucosal surfaces were examined systematically following standard examination procedures. Oral

mucosal lesions associated with quid use, including homogeneous leukoplakia, non-homogeneous leukoplakia, erythroplakia, quid-induced lichenoid reaction, betel chewer's mucosa, oral submucous fibrosis, tobacco pouch keratosis and oral cancer, were identified and recorded according to the modified World Health Organization diagnostic criteria. Habit cessation counselling was provided to all participants, followed by periodic recall visits whenever required. The collected data were coded and entered into Microsoft Excel and subsequently analyzed using the Statistical Package for Social Sciences (IBM SPSS Statistics, Version 22.0). Descriptive statistics were used to summarize demographic and clinical characteristics. Continuous variables were expressed as mean ± standard deviation for normally distributed data and median with interquartile range for skewed data. Categorical variables were presented as frequencies and percentages. Inferential statistical analysis was performed using Pearson's Chi-square test, One-Way Analysis of Variance (ANOVA), multiple regression analysis and Spearman's correlation test. A p-value of less than 0.05 was considered statistically significant.

Results:

A total of **1,209 smokeless quid users** aged 18–65 years were included in the study. The largest proportion of participants belonged to the **30–35 years** age group (358, 29.7%), followed by the **24–29 years** age group (328, 27.0%). Participants aged **36–41 years** constituted 22.1%, while the remaining age groups individually accounted for less than 10% of the study population **(Table 1)**. The study population was predominantly **male,** with **989 (81.8%)** participants, whereas **220 (18.2%)** were female **(Table 2)**. With respect to the type of smokeless quid consumed, **582 (48.1%)** participants reported using a combination of **tobacco and arecanut**, making it the most common quid type. This was followed by t**obacco-only** users (352, 29.1%) and **arecanut only** users (275, 22.7%) **(Table 3)**. Regarding the form of quid consumption, **processed products** were overwhelmingly preferred by **1,095 (90.6%)** participants, whereas **50 (4.1%)** consumed only unprocessed quid and **64 (5.3%)** used both processed and unprocessed forms **(Table 4)**. Among the oral mucosal lesions identified, **Oral Submucous Fibrosis (OSMF)** was the most prevalent lesion, affecting **379 (32.44%)** participants, closely followed by **Tobacco Pouch Keratosis** in **373 (31.93%)** participants. **Homogenous leukoplakia** was observed in **244 (20.8%)** individuals, while **Quid-Induced Lichenoid Reaction** was reported in **115 (9.84%)** participants. Less common lesions included **Betel Chewer's Mucosa** (31, 2.6%), **Non-Homogenous Leukoplakia** (22, 1.92%) and **Carcinoma** (4, 0.34%), whereas **Erythroplakia** was not detected. A total of **260 (21.5%)** participants did not exhibit any oral mucosal lesion **(Table 5)**. Chi-square analysis demonstrated a statistically significant association between **age and oral mucosal lesions** ($\chi^2 = 494.742$, $p < 0.001$), indicating that lesion occurrence varied significantly across different age groups **(Table 6)**. Similarly, **gender** showed a significant association with oral mucosal lesions ($\chi^2 = 35.398$, $p < 0.001$) suggesting differences in lesion prevalence between males and females **(Table 7)**. A highly significant association was also observed between the **type of quid consumed** and oral mucosal lesions ($\chi^2 = 516.920$, $p < 0.001$), with OSMF being predominantly associated with combined tobacco and arecanut use, whereas Tobacco Pouch Keratosis was more frequently observed among tobacco users **(Table 8)**. Likewise, the **form of quid consumption** was significantly associated with the occurrence of oral mucosal lesions ($\chi^2 = 293.138$, $p < 0.001$) **(Table 9)**. One-way ANOVA further showed that **age (F = 14.511, $p < 0.001$), gender (F = 5.156, $p < 0.001$), socioeconomic status (F = 4.246, $p < 0.001$), quid type (F = 26.203, $p < 0.001$), quid form (F = 15.619, $p < 0.001$), frequency of usage (F = 6.155, $p < 0.001$), duration of habit (F = 2.617, $p = 0.011$) and duration of quid retention in the mouth (F = 17.020, $p < 0.001$)** were all significantly associated with the occurrence of oral mucosal lesions **(Table 10)**.

Table 1: Distribution of study subjects according to age

Age Group (Years)	Number (n)	Percentage (%)
18–23	12	1
24–29	328	27
30–35	358	29.7
36–41	267	22.1
42–47	103	8.5
48–53	74	6.1
54–59	46	3.8
60–65	21	1.7
Total	1209	100

Table 2: Distributions of study subjects according to gender

Gender	Number (n)	Percentage (%)
Male	989	81.8
Female	220	18.2
Total	1209	100

Table 3: Distribution of study subjects according to type of quid usage

Quid Type	Number (n)	Percentage (%)
Arecanut	275	22.7
Tobacco	352	29.1
Tobacco + Arecanut	582	48.1
Total	1209	100

Table 4: Distribution of study subjects according to form of quid usage

Quid Form	Number (n)	Percentage (%)
Processed	1095	90.6
Unprocessed	50	4.1
Processed + Unprocessed	64	5.3
Total	1209	100

Table 5: Distribution of quid-induced oral mucosal lesions

Oral Lesion	Number (n)	Percentage (%)
Oral Submucous Fibrosis	379	32.44
Tobacco Pouch Keratosis	373	31.93
Homogenous Leukoplakia	244	20.8
Quid Induced Lichenoid Reaction	115	9.84
Betel Chewer's Mucosa	31	2.6
Non-Homogenous Leukoplakia	22	1.92
Carcinoma	4	0.34
Erythroplakia	0	0
No Lesions	260	21.5

Table 6: Association between age and oral mucosal lesions

Variable	χ^2 Value	p-value	Significance
Age vs Oral Lesions	494.742	0	Significant

Table 7: Association between gender and oral mucosal lesions

Variable	χ^2 Value	p-value	Significance

Gender vs Oral Lesions	35.398	0	Significant

Table 8: Association between quid type and oral mucosal lesions

Variable	χ^2 Value	p-value	Significance
Quid Type vs Oral Lesions	516.92	0	Significant

Table 9: Association between quid form and oral mucosal lesions

Variable	χ^2 Value	p-value	Significance
Quid Form vs Oral Lesions	293.138	0	Significant

Table 10: One-Way ANOVA showing relationship of variables with oral lesions

Variable	F-value	p-value	Significance
Age	14.511	0	Significant
Gender	5.156	0	Significant
Socioeconomic Status	4.246	0	Significant
Quid Type	26.203	0	Significant
Quid Form	15.619	0	Significant
Frequency of Usage	6.155	0	Significant
Duration of Habit (Years)	2.617	0.011	Significant
Duration in Mouth (Minutes)	17.02	0	Significant

Discussion:

The present cross-sectional analytical study was conducted among 1,209 smokeless quid users to evaluate the association between different types and forms of smokeless quid consumption and the occurrence of oral mucosal lesions. The findings of the present study are comparable with those reported by Ali SA *et al* **[8],** who demonstrated a significant relationship between smokeless quid consumption and the occurrence of oral mucosal lesions. Similar to their findings, the present study observed a high prevalence of oral lesions among individuals consuming tobacco, areca nut, or a combination of both products. The widespread use of processed smokeless tobacco products observed in the present study can be explained by the observations of the 3rd International Conference on Smokeless Tobacco **[9],** which reported that commercially manufactured smokeless tobacco products have gained popularity because of their affordability, attractive packaging, easy availability and social acceptability. This may explain why 90.6% of the study population consumed processed forms of quid. The occurrence of oral mucosal lesions among smokeless tobacco users in the present study is in agreement with the systematic review conducted by Acharya *et al.* **[10],** who reported that smokeless tobacco consumption significantly increases the risk of oral cancer and oral potentially malignant disorders. The authors emphasized that different forms of smokeless tobacco vary in carcinogenic potential, which may account for the varying prevalence of lesions observed among different quid types in the present study. The prevalence of tobacco consumption observed in the present study is comparable with the findings of Kashyap *et al.* **[11],** who reported that tobacco use remains a major public health challenge in India, particularly among economically productive age groups. Similarly, the World Health Organization fact sheet on tobacco identifies smokeless tobacco as a significant contributor to morbidity and mortality worldwide due to its strong association with oral cancer and other chronic diseases **[12].** The findings of the present study also support data reported by the National Family Health Survey (NFHS-5) **[13],** which documented a substantial burden of tobacco use among Indian adults. Similarly, the Global Adult Tobacco Survey (GATS) India reported that smokeless tobacco use is more prevalent than smoking in many parts of India, particularly in rural populations. The younger age profile of many users observed in the present study is comparable with observations from Veena **[14],** who linked tobacco consumption among youth with increased future risk of tobacco-related diseases. Similar concerns were highlighted in the Global Youth Tobacco Survey (GYTS) India Report**,** which demonstrated continued initiation of tobacco use among adolescents. Gupta *et al.* **[15]** reported a high prevalence of tobacco consumption among adolescents in rural Rajasthan and identified smokeless tobacco as the most commonly used form. These findings support the present observation that smokeless tobacco consumption remains highly prevalent in Rajasthan and continues to pose a significant public health concern. Likewise, Singh and Gupta **[16]** reported considerable tobacco use among school children in Jaipur, indicating that tobacco habits often begin at an early age. Early initiation may contribute to prolonged exposure and a higher risk of developing oral mucosal lesions later in life. The high prevalence of Oral Submucous Fibrosis and other potentially malignant disorders observed in the present study can be explained by the carcinogenic properties of tobacco and areca nut. The International Agency for Research on Cancer (IARC) monograph **[17]** classified smokeless tobacco and tobacco-specific nitrosamines as carcinogenic to humans and highlighted their strong association with oral cancer and premalignant lesions. Furthermore, Siddiq *et al.* **[18]** reported that smokeless tobacco consumption contributes substantially to the global burden of disease and is responsible for a large number of disability-adjusted life years and deaths worldwide. The present study supports these findings by demonstrating a significant association between smokeless quid consumption and oral mucosal lesions, particularly Oral Submucous Fibrosis and Tobacco Pouch Keratosis. Overall, the findings of the present study are consistent with previous national and international studies and reinforce the evidence that smokeless quid consumption, especially processed products containing tobacco and areca nut, is strongly associated with the development of oral mucosal lesions **[19]**. Early diagnosis, regular oral screening, habit cessation counselling and public health interventions are essential to reduce the burden of oral potentially malignant disorders and oral cancer **[20, 21]**.

Conclusion:

Smokeless quid consumption was strongly associated with oral mucosal lesions, particularly among users of processed quid containing tobacco and areca nut. Oral submucous fibrosis and tobacco pouch keratosis were the most prevalent lesions, especially among middle-aged males from lower socioeconomic groups. Early screening, habit cessation counselling, and targeted awareness programs are essential to reduce oral potentially malignant disorders and oral cancer.

Advancement of knowledge:

The present study provides additional evidence regarding the association between different types and forms of smokeless quid consumption and the occurrence of oral mucosal lesions. It identifies processed quid containing both tobacco and areca nut as the form most commonly associated with oral mucosal alterations. The study also emphasizes the high prevalence of Oral Submucous Fibrosis and Tobacco Pouch Keratosis among habitual quid users and contributes valuable epidemiological data from Western Rajasthan. These findings may assist clinicians and public health authorities in developing targeted screening, prevention and tobacco cessation programs.

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