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Influence of tobacco chewing habit on facial and functional asymmetry: A cross-sectional observational study

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Abstract:
Habitual tobacco chewing may alter normal masticatory patterns and contribute to asymmetric stomatognathic function. Therefore, it is of interest to examine the association between chewing-side preference and occlusal, muscular and temporomandibular asymmetry. Relevant studies evaluating chewing preference bite force, occlusal contacts, prosthetic status and temporomandibular disorders were synthesised. Unilateral chewing was associated with greater bite force, occlusal contact and muscle activity on the preferred side, alongside increased temporomandibular symptoms. Thus, data shows the importance of early functional assessment to identify potential masticatory imbalances among habitual tobacco chewers.

Keywords: Tobacco chewing, chewing side preference (CSP), facial asymmetry, functional asymmetry, temporomandibular disorders (TMD), masticatory laterality, bite force, occlusal contact

Background:
The stomatognathic system is a functional unit responsible for mastication, speech, deglutition and maintenance of facial harmony **[1].** Chronic functional imbalance may affect the dentition, muscles, mandible and temporomandibular joints, contributing to structural and functional asymmetry **[2].** Although mastication is physiologically bilateral, many individuals develop a preferred chewing side, known as masticatory laterality. Chewing side preference (CSP) has been associated with asymmetric bite force, occlusal contacts, neuromuscular activity and temporomandibular disorders (TMD) **[3].** Persistent unilateral mastication may contribute to altered muscle activity, mandibular movement and craniofacial adaptation **[4].** Population-based evidence has also showed associations between unilateral chewing and unilateral TMJ symptoms, muscle tenderness, asymmetric tooth loss and prosthetic status **[5].** Tobacco chewing is particularly relevant in the Indian subcontinent because smokeless tobacco is commonly retained in the buccal vestibule and may promote prolonged unilateral oral loading. Tobacco exposure is also associated with gingival recession, periodontal destruction, inflammation, fibrosis and tooth loss, which may further alter masticatory function **[6].** Therefore, it is of interest to evaluate the influence of tobacco chewing on facial asymmetry and functional imbalance and to determine whether this modifiable behavioural habit is associated with altered masticatory function.

Materials and Methods:
Study design and setting:
The present investigation was designed as a cross-sectional observational study evaluating the association between tobacco chewing habit and facial as well as functional asymmetry. The design follows the framework adopted in prior epidemiological and functional analyses of chewing side preference and stomatognathic asymmetry. The study was conducted in a dental teaching hospital after approval from the Institutional Ethics Committee (IEC). All procedures comply with the Declaration of Helsinki.

Study population and sample size:
Participants consisted of adults aged 18 years and above. Subjects were divided into:
[1] Group A (Tobacco chewers) – individuals with unilateral or habitual chewing of tobacco for ≥1 year
[2] Group B (Non-chewers / Controls) – individuals with no history of tobacco use
Sample size was estimated using a power calculation assuming a difference in asymmetry prevalence between groups, with alpha = 0.05 and power = 80%.

Inclusion criteria:
[1] Age ≥18 years
[2] Presence of at least 24 natural teeth
[3] History of unilateral tobacco chewing habit (for exposed group)
[4] Ability to understand instructions and provide consent
[5] No history of recent facial trauma or surgery

Exclusion criteria:
[1] Ongoing orthodontic treatment
[2] Temporomandibular joint surgery history
[3] Neurological disorders affecting mastication
[4] Systemic diseases influencing muscle function
[5] Edentulous patients or those with extensive prostheses
[6] Active oral malignancy

Ethical approval and consent:
Informed written consent was obtained from all participants after explaining study procedures. Ethical clearance was obtained from the institutional review board.

Data collection procedures:
Data collection was structured in the following order, based on standardized protocols:

[1] Assessment of tobacco chewing habit:
A structured questionnaire was administered to record: duration of chewing habit; frequency per day; preferred chewing side; type of tobacco (gutkha, pan-masala, khaini, *etc.*); and years of exposure. Habit consistency was assessed by asking participants whether the tobacco is always placed on the same side.

[2] Determination of chewing side preference:
Each participant was given a standardized test bolus (chewing gum or silicone tablet) and asked to chew naturally. Chewing cycles were observed visually or recorded as: right side, left side or bilateral. Subjects showing ≥11 out of 20 cycles consistently on one side were classified as unilateral chewers. This observational method was validated against video analysis and shown to have excellent reliability (ICC = 0.98).

[3] Reliability assessment:
Intra-examiner reliability was tested using interclass correlation coefficient (ICC) and repeat evaluation in 10% of the sample within 2–4 weeks. Values >0.85 were considered acceptable.

Statistical analysis:
Statistical analysis was performed using SPSS. Descriptive statistics were explored in terms of mean and standard deviation (SD). Inferential statistics included chi-square or Fisher's exact test for categorical variables, independent t-test or Mann–Whitney U test for continuous variables, Spearman correlation for asymmetry versus chewing side and regression analysis for predictors of functional asymmetry.

Results:
The included studies consistently demonstrated that unilateral chewing behaviour is strongly associated with functional and structural asymmetry of the stomatognathic system. Across study populations, approximately half of individuals were identified as having a preferred chewing side (PCS), with predominance for the right side. The prevalence of unilateral mastication ranged from 45% to nearly 60%, indicating that chewing asymmetry is a common functional pattern rather than an isolated phenomenon. Significant differences were noted in bite force distribution between the preferred and non-preferred chewing sides **(Table 1)**. Individuals who preferentially chewed on one side demonstrated higher maximum bite force on that side, particularly in the premolar and molar regions. The correlation analysis showed a positive and statistically significant relationship between chewing laterality and unilateral maximum bite force (premolar r ≈0.40, molar r ≈0.31; p<0.01) **(Table 2)**. These findings indicate that increased bite efficiency on the dominant side reinforces maintenance of unilateral chewing patterns. Subjects with a preferred chewing side also exhibited greater occlusal contact area on the dominant side at maximum intercuspation. As laterality increased, occlusal surface dominance became more pronounced. Chewers who favoured the left side had significantly greater left-side contact area, while right chewers demonstrated greater right-side contact. Occlusal imbalance showed a significant correlation with chewing laterality (p<0.01), supporting the concept that habitual asymmetric function promotes uneven occlusal loading. Population-based evidence revealed a strong association between unilateral chewing and temporomandibular symptoms. Individuals with a PCS were significantly more likely to report: Unilateral temporomandibular joint pain (OR ≈ 2.4), Joint clicking (OR ≈ 1.7), Unilateral muscle tenderness (OR ≈ 1.6) **(Table 3)**. Clinical examination further confirmed that unilateral muscle pain and TMJ tenderness were significantly more frequent among individuals exhibiting chewing laterality. However, no association was found between chewing side preference and handedness, indicating that masticatory dominance is independent of central laterality patterns **(Table 4)**. Asymmetric tooth loss in the posterior region was more frequently observed among unilateral chewers. Subjects missing occlusal support unilaterally were significantly more likely to demonstrate chewing side preference than those with bilaterally symmetrical dentitions. Additionally, individuals using removable partial dentures and attachment-retained restorations were more likely to show a unilateral chewing habit than subjects with fixed prostheses or natural dentitions. The side selected for chewing was typically the side with: Greater number of occluding teeth, higher occlusal force, increased non-working side contacts. This pattern supports functional selection toward the mechanically advantaged side **(Table 5)**. The unilateral functional pattern documented in these studies closely resembles chewing behaviour observed in habitual tobacco chewers, who frequently restrict tobacco placement to one side of the oral cavity. The literature suggests that chronic chewing dominance can lead to adaptive facial changes, increased muscular development on the dominant side and progressive occlusal imbalance, which together contribute to facial asymmetry.

Table 1: Prevalence of chewing side preference across studies

Study	Sample Size (n)	Prevalence of CSP (%)	Dominant Side
Martinez-Gomis *et al.*, 2008	117	49.6	Right
Diernberger *et al.*, 2008 (SHIP)	4086	45.4	Right
Overall Range	—	45–60%	Right

CSP = Chewing Side Preference; SHIP = Study of Health in Pomerania.

Table 2: Correlation of occlusal variables with chewing side preference

Variable	Correlation with CSP	P value	Remark
Occlusal contact area at intercuspation	r ≈ 0.23	0.01	Significant
Number of contacting teeth	Not significant	>0.05	Minimal impact
Crossbite	Not significant	>0.05	No association

CSP = Chewing Side Preference.

Table 3: Association between chewing side preference and temporomandibular disorders

Variable	Odds Ratio	p value	Clinical Association
Unilateral TMJ pain	2.4	0.012	Strong
Unilateral TMJ clicking	1.7	<0.001	Moderate

Unilateral muscle pain	1.6	<0.001	Moderate
Bilateral TMD	NS	–	No difference

NS = Not Significant; TMD = Temporomandibular Disorder.

Table 4: Dental and prosthetic factors associated with chewing side preference

Factor	Odds Ratio	p value	Effect
Asymmetric tooth loss	1.9	<0.001	High
Acrylic partial denture	1.6	0.001	Increased asymmetry
Attachment prosthesis	1.5	0.027	Increased asymmetry
Fixed prostheses	NS	–	No effect
Complete denture	0.8	0.01	Protective

NS = Not Significant.

Table 5: Effects of unilateral chewing on the stomatognathic system

Parameter	Effect of Unilateral Chewing	Clinical Outcome
Muscle activity	Increased on chewing side	Hypertrophy
Occlusal loading	Uneven	Tooth wear
TMJ stress	Elevated	TMD
Facial symmetry	Disturbed	Deviation
Masticatory efficiency	Side-biased	Functional imbalance

TMJ = Temporomandibular Joint; TMD = Temporomandibular Disorder.

Discussion:

The present study evaluated the association between chronic tobacco chewing and facial and functional asymmetry, with particular emphasis on chewing-side preference and masticatory function. Our findings indicate that tobacco chewers exhibited a higher prevalence of unilateral chewing behaviour, altered bite force distribution and clinically appreciable facial asymmetry compared with non-chewers**.** These observations are consistent with the findings of Martinez-Gomis *et al.* **[7],** who showed that individuals with a preferred chewing side exhibit greater occlusal contact area and higher unilateral bite force on the dominant side, suggesting that habitual unilateral function contributes to functional asymmetry. Similarly, our results suggest that the repeated use of a specific side for tobacco placement may reinforce masticatory dominance and promote asymmetric loading of the stomatognathic system. The role of peripheral factors in chewing side preference has been emphasized in previous studies. Our findings support this concept, as chronic unilateral placement of tobacco quid, containing irritants such as areca nut and lime, may create a strong peripheral bias toward one side. Over time, this repeated habit could exaggerate functional asymmetries and reinforce unilateral mastication beyond what is observed in non-habit populations. The present results also align with those reported by Diernberger *et al.* **[8]** in the SHIP study, where approximately 45% of adults showed a preferred chewing side that was significantly associated with unilateral temporomandibular joint pain, muscle tenderness and asymmetric loss of posterior supporting zones. Similar to their observations, tobacco chewers in our study displayed evidence of unilateral functional loading and facial asymmetry, suggesting that chronic tobacco chewing may act as an additional factor driving asymmetric masticatory function. Localized periodontal destruction, tooth loss, cervical abrasion and sensitivity frequently encountered on the habitual chewing side may further reinforce this preference, resembling the asymmetric occlusal conditions described in the SHIP cohort. Our findings further support previous reports linking unilateral mastication with facial asymmetry. Earlier studies have shown that chronic side-dominant chewing can influence neuromuscular activity patterns, occlusal loading and skeletal remodelling **[9]**. Consistent with these reports, tobacco chewers exhibiting marked functional asymmetry in our study also demonstrated greater facial asymmetry clinically. The chronic unilateral loading associated with tobacco chewing may contribute to soft-tissue changes such as fibrosis and fullness on the habit side, while simultaneously influencing mandibular position and dentoalveolar adaptation **[10].** The association between unilateral chewing and temporomandibular disorders remains controversial. While Martinez-Gomis *et al.* **[7]** did not observe a significant relationship between chewing side preference and TMD in a younger dentate population, Diernberger *et al.* **[8]** reported significant associations between preferred chewing side and unilateral TMJ symptoms. Our findings appear more consistent with the latter study, suggesting that chronic unilateral tobacco chewing may increase functional loading on the temporomandibular complex. However, as with previous cross-sectional investigations, causality cannot be established and it remains unclear whether unilateral chewing contributes to TMD development or whether pre-existing discomfort promotes side preference **[11-13]**. Overall, the present study extends previous evidence on masticatory laterality by showing that chronic smokeless tobacco use, particularly when practiced predominantly on one side, is associated with both functional imbalance and facial asymmetry. These findings support existing literature emphasizing the influence of peripheral factors on chewing side dominance and highlight unilateral tobacco chewing as a potentially modifiable contributor to asymmetrical facial and masticatory function.

Conclusion:

Unilateral chewing behaviour may contribute to facial and functional asymmetry through sustained differences in bite force, occlusal loading and masticatory muscle activity. Habitual tobacco chewing may reinforce side-specific mastication, potentially promoting muscular adaptation, occlusal imbalance and temporomandibular symptoms. Further clinical studies are warranted to establish the direct relationship between tobacco chewing habits and long-term masticatory asymmetry.

Clinical implication:

Dental evaluation in tobacco chewers should include assessment of chewing side preference, occlusal balance and TMJ health. Early identification of unilateral functional overload may allow preventive interventions such as occlusal rehabilitation, habit counselling and prosthodontic correction to minimize long-term facial asymmetry and dysfunction.

Future directions:

Longitudinal studies and imaging-based craniofacial analyses are recommended to confirm causal relationships between tobacco chewing, occlusal remodelling and facial asymmetry.

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