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# Gender Identification Based on Dental Micro-Esthetics: A Study of Dental Professionals' Perceptions

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## ABSTRACT

Dental micro-aesthetic traits are linked to gender-specific features in dentistry, but their reliability for gender identification remains controversial. **Objectives:** To assess the correlation between accurate gender identification and micro-aesthetic dental traits through the evaluation of frontal intraoral photographs by observers, specifically dental undergraduates, graduates, and postgraduates. **Methods:** A cross-sectional study was conducted at Lahore Medical and Dental College (June 2024 to May 2025) with 376 participants (99% response rate). Participants evaluated 10 anonymous frontal intraoral photographs for gender identification via a questionnaire. Descriptive statistics, chi-square tests, and logistic regression analyzed associations between accuracy and clinical experience (>3 vs. ≤3 years), using SPSS version 25.0. Photographs were selected for variability in micro-aesthetic traits. **Result:** The mean accuracy score was 5.38 ± 1.72 out of 10, with 58.8% scoring 4-6. Accuracy varied significantly (23.94% for Q8 to 70.21% for Q3, $p<0.05$). Males had higher accuracy of achieving correct answers ($p=0.033$), indicating that males were more likely to score above the median score of 5. Experienced clinicians prioritized tooth size ($p=0.005$) and triangular canines ($p=0.017$). Logistic regression showed experience-based differences in the correct identification of specific female photographs (OR = 0.564 for Q7, $p=0.033$; OR = 2.583 for Q9, $p<0.001$). **Conclusions:** Dental micro-aesthetic traits provide only moderate accuracy for gender identification due to considerable overlap and observer bias. Targeted education on trait variability is recommended.

## INTRODUCTION

The study of dental morphology for gender determination has gained traction in recent years, offering applications in both forensic and clinical dentistry. Tooth morphology plays a key role in smile aesthetics and overall facial harmony. Treatment planning now increasingly considers societal standards of beauty—such as balance, proportion, and harmony—framed through macro-esthetic, mini-esthetic, and micro-esthetic elements. Dental micro-esthetics focus on tooth shape, size, color, alignment, gingival characteristics, and texture, which collectively influence smile attractiveness [1-3]. A key question is whether mini-aesthetic traits exhibit sexual dimorphism. The "theory of temperament" suggests that tooth shape may reflect emotional characteristics, such as sanguine (dynamic) or melancholic (sensitive), though its clinical validity is debated [2]. Gender-based stereotypes often associate women with rounded, ovoid teeth and men with angular, square forms, influencing dental education and prosthetic design, despite studies finding no consistent biological correlation between tooth morphology and

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gender [2, 4]. Specific micro-aesthetic features have been frequently investigated in relation to gender differentiation and aesthetic perception. Tooth size is generally larger in male than in female, with canines often regarded as the most sexually dimorphic teeth, although overlap limits their diagnostic value [5]. In addition, the morphology of the maxillary central and lateral incisors has also been examined, with males more frequently presenting larger crown dimensions in height and width compared to females, though variability remains substantial. Tooth color also contributes to esthetic perception, with female dental students more often preferring lighter shades, while male dental students tend to report a higher need for orthodontic treatment and ceramic veneers [6]. The presence of anterior restorations has also been noted in desired treatments, particularly tooth-colored restorations among students from lower-income households, though mismatched color or contour has not been explicitly identified as reducing esthetic acceptance. Other features, such as alignment and gingival display, significantly influence attractiveness ratings. Incisal alignment plays a critical role, as midline deviations combined with gingival display reduce esthetic scores, whereas coincident midlines yield higher ratings across both dentists and laypersons [7]. In a Romanian sample, gingival exposure between 0–3 mm was most frequently selected by dentists as ideal for an esthetic smile (70.4%), while excessive gingival exposure (median 4 mm) was considered the least attractive [8]. Gingival pigmentation significantly influences smile esthetics, with laypersons often rating smiles with less pigmentation as more attractive, potentially differing from dental professionals' more critical assessments [9]. In contrast, soft tissue features, such as lips and gingiva, play a critical role in gender differentiation, as deep learning analyses of intraoral photographs reveal that these features are more distinguishable than hard tissue features like teeth for identifying gender differences [10]. While oral hygiene conditions are not directly addressed in gender differentiation studies, Zhou *et al.* further demonstrated that gender-related morphological differences are more pronounced in the mandibular region compared to the maxillary region [10]. Oral pigmentation and dental conditions—including caries, crowding, missing teeth, and restorations—also reduce esthetic acceptance, with dental professionals being more critical than laypersons. Calheiros-Lobo *et al.* showed that dental professionals more accurately identify morphological anomalies like lateral incisor agenesis than laypeople, implying that training enhances sensitivity to aesthetic traits [11]. Negruțiu *et al.* stated that gingival exposure significantly affects smile perception, with varying preferences noted between dentists and laypersons [8]. However, Mahn *et al.* reported gender misidentification based on presumptions about tooth shape, such as rounded being feminine or squarish being masculine, highlighting the unreliability of morphology alone [4]. Najafi *et al.* additionally highlighted how different professional roles assess gingival display and midline discrepancies, reflecting varying degrees of aesthetic awareness [7]. Despite these associations, significant gaps remain in the literature. Results vary across populations and are often shaped by cultural expectations. Tooth morphology alone has shown only moderate predictive accuracy for gender identification, with some studies reporting results close to chance [4]. Due to these limitations, it is necessary to investigate not only biological dimorphism but also how dental professionals perceive and utilize these micro-aesthetic traits in practice. This study WAS designed to enhance dental education by determining whether specific morphological features should be prioritized in didactic and clinical training as gender-specific traits. Since gender-specific dental characteristics are not universally consistent—male may present with rounded teeth and female with squarish ones—overreliance on these distinctions could lead to misjudgments.

This study aimed to assess the correlation between accurate gender identification and micro-aesthetic dental traits through the evaluation of frontal intraoral photographs by dental undergraduates, graduates, and postgraduates.

## METHODS

This cross-sectional descriptive study was conducted from June 2024 to May 2025 in Lahore Medical and Dental College, Lahore. The study was approved by the college's Institutional Review Board, LMDC/FD/1549/23. The study population consisted of dental professionals, including dental undergraduates, graduates, and postgraduate trainees, who evaluated anonymous frontal intraoral photographs to determine the gender of the photographs based on dental micro-esthetics. Participants were eligible if they were aged 20- 30 years and provided informed consent. Those with previous training in forensic odontology were excluded. The study utilized a non-probability convenience sampling method. The study utilized a non-probability convenience sampling method. The single-proportion formula $n=Z21\text{-}\alpha/2p(1-p)/d^2$, where p was the anticipated proportion, d was the margin of error, and $Z1\text{-}\alpha/2$ the standard normal value for a two-sided 95% confidence level. Using p=0.538 (frequency of correct identification), d=0.05, and Z=1.96, the required sample was n= 382 [2]. Allowing for a 5% non-response/dropout, the adjusted target was 402 participants. The questionnaire used in this study was adapted from Qali *et al.* which

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assessed gender identification using intraoral photographs [2]. The adapted tool retained the core structure of Qali *et al.* (10 anonymized frontal intraoral photographs) but was expanded with additional demographic and clinical experience items to suit our educational context [2]. Face and content validity were established by subject experts, who reviewed all items for relevance and clarity. The questionnaire was pilot-tested on 20 dental professionals; minor wording changes were made based on their feedback. Internal consistency reliability was assessed using Cronbach's alpha and showed acceptable values ($\alpha \geq 0.71$). The final questionnaire consisted of four sections: (1) demographic data (age, gender), (2) current academic level (undergraduate, graduate, postgraduate) and years of clinical experience, (3) 10 unlabeled frontal intraoral photographs in which participants selected whether each dentition was male or female, and, (4) 10 statements on morphological features distinguishing male and female dentitions that participants reported using in routine practice. Section 3- Gender-identification photographs: 10 anonymized frontal intraoral photographs of maxillary and mandibular anterior teeth (5 male and 5 female dentitions), cropped to show only teeth and gingiva, were presented in random order to the participants. For each photograph (Q1–Q10), participants answered the question: "In your opinion, this dentition belongs to:" with response options "Male" and "Female." Each correct response was scored as 1 and each incorrect response as 0, giving a total accuracy score ranging from 0 to 10, where higher scores indicate greater accuracy. For interpretation, scores of 0–3 were classified as low accuracy, 4–6 as moderate accuracy, and 7–10 as high accuracy. Section 4- Morphological feature use: Ten items addressed, which micro-aesthetic features participants routinely use to distinguish male from female dentitions in everyday practice. Items covered the following features: tooth color, tooth size, pigmentation of mucosa, canine shape, incisal alignment, incisal crowding, presence of diastema, anterior restorations, poor oral hygiene, and maxillary central/lateral crown morphology. Each statement was phrased in the form "I use [feature] to help differentiate between male and female dentitions" and rated on a 3-point Likert scale (agree, neutral, disagree). All participants provided informed consent before enrollment, with the right to withdraw from the study at any time. The survey was distributed both physically within the department and digitally through online platforms. Participants had seven days to complete the questionnaire, with a reminder sent after one week for non-respondents. Once collected, the data were entered into SPSS statistical software for analysis. Data were analyzed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., NY, USA). Descriptive statistics (frequencies, percentages, means, and standard deviations) were computed for participant characteristics and questionnaire responses. For the 10-item accuracy score, scores 0–3 was classified as low, 4–6 as moderate, and 7–10 as high accuracy. For inferential analyses, the total accuracy score was further dichotomized at the median ($\leq 5$ vs. $>5$) to create a binary accuracy variable. Chi-square tests were used to examine associations between this dichotomized accuracy variable and categorical participant characteristics (gender, age group, qualification, and clinical experience). For questionnaire photograph-specific performance, the proportion of participants who correctly identified each photograph (Q1–Q10) was calculated. Two-sided binomial tests against a 50% expected accuracy (chance level) were used to obtain p-values, and 95% confidence intervals were computed for each proportion. For each of the 10 photographs in the questionnaire, separate binary logistic regressions were performed with clinical experience (>3 years vs. ≤3 years) as the dependent variable and correct/incorrect responses for each intraoral photograph as independent variables. Thus, for each photograph, a 2×2 contingency structure (correct vs. incorrect by >3 vs. ≤3 years of experience) underpinned the odds ratios. Odds ratios (ORs) with 95% confidence intervals (CIs) and p-values were reported. Associations between clinical experience (>3 vs. ≤3 years) and responses to each of the 10 morphological feature items (agree, neutral, disagree) were also examined using chi-square tests of independence.

## RESULTS

A total of 376 responses were received, giving a response rate of 94%. 190 (50.5%) undergraduates, 131 (34.8%) graduates, and 55 (14.6%) postgraduates. Out of the total participants, 258 (68.6%) were female, and 118 (31.4%) were male. The mean age of participants was 24.05 ± 2.83 years. 290 (77%) participants had 3 years or less of clinical experience, and 86 (23%) had more than 3 years' experience. The average mean score of correct answers of the participants was 5.38 ± 1.72 (range 0–10). Using the predefined categories, 56 (14.9%) had low accuracy (scores 0–3), 221 (58.8%) had moderate accuracy (scores 4–6), and 99 (26.3%) had high accuracy (scores 7–10). Overall, when dichotomized at the median, 189 (50.3%) participants scored 5 or less, and 187 (49.7%) scored more than 5. The results present the distribution of participant characteristics according to accuracy scores dichotomized at ≤5 and >5. Chi-square test for gender showed a significant association, p=0.033, indicating that males are more likely to score above the median score of 5 (Table 1).

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**Table 1:** Association Between Participant Characteristics and Dichotomized Accuracy Score

| Variables | Low Accuracy (>5), n (%) | High Accuracy (>5), n (%) | p-value |
|---|---|---|---|
| **Gender** | | | |
| Male | 50 (42.4%) | 68 (57.6%) | 0.033* |
| Female | 139 (53.9%) | 119 (46.1%) | |
| **Age** | | | |
| 20-25 Years | 138 (50.2%) | 137 (49.8%) | 0.910 |
| 26-30 Years | 51 (50.5%) | 50 (49.5%) | |
| **Qualification** | | | |
| Undergraduate | 98 (51.6%) | 92 (48.4%) | 0.582 |
| Graduate | 62 (47.3%) | 69 (52.7%) | |
| Postgraduate | 29 (52.7%) | 26 (47.3%) | |
| **Clinical Experience** | | | |
| ≤3 Years | 147 (50.7%) | 143 (49.3%) | 0.665 |
| >3 Years | 42 (48.8%) | 44 (51.2%) | |

*Indicated statistical significance at p≤0.05

The study shows accuracy for each photograph (Q1–Q10). Q1–Q10 correspond to the 10 anonymized frontal intraoral photographs (5 male and 5 female dentitions) presented in random order, and the accuracy reported for each item represents the proportion of participants who correctly identified the sex of that specific photograph. The proportion of correct responses, 95% confidence intervals, and two-sided binomial test p-values against a 50% chance level are reported. All p-values were <0.05, indicating that the accuracy for each photograph differed significantly from random guessing. Accuracy varied across photographs, being highest for Q3 (70.21%), Q4 (66.76%), and Q10 (65.69%), and lowest for Q8 (23.94%). The "Correct Answer" column specifies the true gender of each anonymized photograph (5 male, 5 female in random order) (Table 2).

**Table 2:** Accuracy for Gender Identification for Each Photograph (Q1 to Q10)

| Question | True Gender of Dentition in the Photograph | Correct Responses, n (%) | Incorrect Responses, n (%) | 95% CI for % Correct | p-value v/s 50% Accuracy[a] |
|---|---|---|---|---|---|
| Q1 | Female | 236 (62.77%) | 140 (37.23%) | 57.9-67.7 | <0.001* |
| Q2 | Male | 153 (40.69%) | 223 (59.31%) | 35.7-45.7 | <0.001* |
| Q3 | Male | 264 (70.21%) | 112 (29.79%) | 65.6-74.9 | <0.001* |
| Q4 | Female | 251 (66.76%) | 125 (33.24%) | 62.0-71.5 | <0.001* |
| Q5 | Male | 218 (57.98%) | 158 (42.02%) | 53.0-63.0 | 0.002* |
| Q6 | Female | 224 (59.57%) | 152 (40.43%) | 54.6-64.6 | <0.001* |
| Q7 | Female | 212 (56.38%) | 164 (43.62%) | 51.3-61.4 | 0.015* |
| Q8 | Male | 90 (23.94%) | 286 (76.06%) | 19.6-28.3 | <0.001* |
| Q9 | Female | 149 (39.63%) | 227 (60.37%) | 34.7-44.6 | <0.001* |
| Q10 | Female | 247 (65.69%) | 129 (34.31%) | 60.9-70.5 | <0.001* |

[a]Two-sided binomial test against 50% expected accuracy (chance level). *Indicates the statistical significance with p-value <0.05. Note: Each item (Q1–Q10) corresponds to one anonymous intraoral photograph depicting either a male or a female dentition, not both. The column "True gender of dentition in photograph" therefore reflects the actual gender of the dentition shown to participants. Percentages represent the proportion of participants who correctly identified that gender.

Separate binary logistic regression models were performed with clinical experience (>3 years vs. < 3 years) as the dependent variable and correct/incorrect response for each photograph as the predictor. Only Q7 and Q9 emerged as significant. Participants who correctly identified the female dentition in Q7 had 43.6% lower odds of having >3 years of clinical experience (OR = 0.564, 95% CI 0.333–0.954, p=0.033)). In contrast, those who correctly identified the female dentition in Q9 had 2.58 times higher odds of having >3 years of experience (OR = 2.583, 95% CI 1.522–4.384, p<0.001). These odds ratios are based on 2×2 tables of correctness (correct vs. incorrect) by experience group. The 10 morphological feature items corresponded directly to the questionnaire statements "I use -feature- to help differentiate between male and female dentitions" (rated agree/neutral/disagree). Their endorsement frequencies and the chi-square tests for differences by clinical experience are summarized. Overall, tooth size was the most frequently endorsed feature, followed by maxillary central/lateral crown morphology and mucosal pigmentation. Chi-square analysis indicated that features such as size, triangular canines, incisal alignment, incisal crowding, diastema, anterior restorations, and poor oral hygiene were used differently by clinicians, indicating that clinical experience shapes which specific cues clinicians rely on for gender judgements. In contrast, broader characteristics such as tooth color, mucosal pigmentation, and maxillary crown morphology were endorsed by all participants, suggesting that these cues are viewed as relevant by all clinicians (Table 3).

**Table 3:** Prominent Features Used to Distinguish Between Male and Female Dentition

| Morphological Feature | Agree, n (%) | Disagree, n (%) | Neutral, n (%) | Chi-Square (Clinical Experience) |
|---|---|---|---|---|
| Tooth Color | 127 (33.8%) | 118 (31.4%) | 131 (34.8%) | $\chi^2$ = 3.274, p=0.195 |
| Size | 274 (72.9%) | 26 (6.9%) | 76 (20.2%) | $\chi^2$ = 10.573, p=0.005* |
| Pigmentation of Mucosa | 213 (56.6%) | 42 (11.2%) | 121 (32.2%) | $\chi^2$ = 0.429, p=0.807 |
| Triangular Canines | 195 (51.9%) | 57 (15.2%) | 124 (33.0%) | $\chi^2$ = 8.169, p=0.017* |
| Incisal Alignment | 153 (40.7%) | 82 (21.8%) | 141 (37.5%) | $\chi^2$ = 6.245, p=0.044* |
| Incisal Crowding | 89 (23.7%) | 142 (37.8%) | 145 (38.6%) | $\chi^2$ = 22.374, p<0.001* |
| Incisal Diastema | 101 (26.9%) | 136 (36.2%) | 139 (37.0%) | $\chi^2$ = 6.473, p=0.039* |
| Anterior Restoration | 107 (28.5%) | 158 (42.0%) | 111 (29.5%) | $\chi^2$ = 17.213, p<0.001* |

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| | | | | |
|---|---|---|---|---|
| Poor Oral Hygiene | 139 (37.0%) | 128 (34.0%) | 109 (29.0%) | $\chi^2$ = 10.586, p=0.005* |
| Maxillary Central/ Lateral Crown | 215 (57.2%) | 46 (12.2%) | 115 (30.6%) | $\chi^2$ = 2.152, p=0.341 |

* Indicates statistical significance at p≤0.05

## DISCUSSION

The results of this study offer significant insights into the capacity of dental professionals and students to identify gender using dental micro-aesthetic traits, highlighting both the potential and limitations of these features in clinical and forensic dentistry. With a mean accuracy score of 5.38 ± 1.72 for gender identification from 10 intraoral photographs, the findings determined moderate success, with notable inconsistencies in accuracy across photographs. This variability indicates that some dental images presented clearer gender-specific cues, while others were ambiguous, underscoring the challenges of relying on micro-aesthetic traits for gender determination. A significant association between participant gender and accuracy (p=0.033) indicated that male were more likely to score above the median (5 marks), which is in contrast to Alam *et al.* who stated that females were more likely to notice aesthetic impacts [3]. Social media significantly influences female patients' perceptions of dental aesthetics, with increased exposure to dental content on platforms like Snapchat and Instagram driving a preference for aesthetic treatments such as bleaching and veneers [12]. Cheng *et al.* found gender-based differences in aesthetic perception, with female laypeople showing a stronger preference for parallel smile arcs and reduced gingival and incisor display, suggesting differing aesthetic sensitivities compared to male participants and professionals [13]. This pattern suggests that gender identification accuracy is shaped not only by dental morphology but also by participants' preconceived concepts of gendered aesthetics, potentially reinforced through dental training or cultural influences on facial profile preferences [14, 15]. Clinical experience variably affected performance. Logistic regression showed that correct identification of Q7 (female) was associated with lower odds of having >3 years of experience (OR = 0.564, p=0.033), suggesting subtler cues in Q7 challenged experienced clinicians reliant on features like canine size [5, 6]. In contrast, Q9 likely included clearer cues, such as gingival exposure or tooth alignment, which more experienced clinicians were trained to recognize with greater precision [8, 16]. The results demonstrated that experienced clinicians prioritized tooth size and canine morphology for gender identification, consistent with forensic evidence showing significant sexual dimorphism in canine dimensions and ridge prominence [5, 17]. Less experienced participants may rely on general esthetic features such as tooth color and alignment, findings consistent with El Mourad *et al.* who reported that dental students often focus on these aspects in self-assessments of their own smiles.[6] However, such features may be less useful for gender identification tasks that require attention to more sexually dimorphic traits [6, 16]. These findings have important implications for dental education. The moderate accuracy (58.8% scoring 4–6) and reliance on gendered stereotypes suggest that current curricula may overemphasize simplistic morphological associations, such as rounded teeth for female and angular teeth for male [2, 4]. Dental training should incorporate modules on sex and gender differences in oral health, recognizing that both biological and sociocultural factors influence oral health outcomes and care-seeking behaviors [18]. Addressing cognitive biases is also critical, as participants' perceptions may be shaped by assumptions rather than objective evidence [19]. Nakhapaksirat *et al.* stated that targeted interventions like workshops and reflective case discussions help dental students transition to independent practice by equipping them with skills to recognize and manage cognitive biases, thereby promoting evidence-based clinical decision-making [19]. Furthermore, incorporating advanced visual aids like intraoral scans, as demonstrated by Schulz-Weidner et al. and Menon and Kumar, forensic techniques such as 3D scanning, can enhance training by improving students' ability to interpret subtle aesthetic and morphological cues [20, 21]. In forensic dentistry, the study highlights the limitations of using dental micro-aesthetics for gender identification. Ajmal *et al.* confirmed sexual dimorphism in canine morphology but noted trait overlap, reducing reliability, as seen in the low accuracy for Q8 [5]. This aligns with findings from Viciano *et al.* and Heng *et al.* which highlight that while odontometric analysis and dental morphology display measurable dimorphism, significant trait variability necessitates the use of multimodal methods, including advanced imaging, to improve the accuracy of sex estimation [22, 23]. Stojilković *et al.* highlight that dental aesthetics significantly impact psychosocial well-being and self-esteem, with varying perceptions of traits like tooth alignment or color influencing personal and social confidence.[24] This psychosocial dimension, as noted by Campos *et al.* underscores the need for dentists to consider how patients' aesthetic perceptions may influence the interpretation of dental traits in gender identification [25]. Advanced imaging like CBCT and OPG has been evaluated for forensic sex estimation, with CBCT offering higher accuracy due to its 3D visualization of dental and craniofacial structures, though limited by cost and accessibility [26]. Integrating dental traits with other forensic markers, such as cranial features, could enhance gender determination.

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# CONCLUSIONS

This study showed that dental professionals and students moderately succeeded in identifying gender using tooth shape and size. They correctly identified gender in about half the intraoral photographs, with accuracy varying widely from low to high. Male participants generally performed better than female participants, suggesting that personal biases may influence how dental features are interpreted. Experienced professionals focused on tooth size and canine shape, but accuracy depended on trait clarity, while less experienced dentists relied on less reliable features like tooth color. These findings show that dental features can help identify sex, but are not always dependable due to overlapping traits and individual biases.

## Authors Contribution

Conceptualization: MIR, NF
Methodology: AFB
Formal analysis: MUDA, UWJ, SRK
Writing review and editing: AFB, AAB

All authors have read and agreed to the published version of the manuscript

## Conflicts of Interest

All the authors declare no conflict of interest.

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