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Original Article

Diagnostic Approach of Dental Professionals to Word Malocclusion Types in Pakistan: A Cross-Sectional Study

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ABSTRACT

Background: Malocclusion assessment by dental practitioners is important for recognizing dental and skeletal discrepancies and facilitating appropriate orthodontic referral. Evidence regarding diagnostic practices and perceived barriers among practitioners in Pakistan remains limited. Objective: To describe dental practitioners' self-reported malocclusion-classification approaches, diagnostic practices, confidence, barriers, training needs, and referral practices. Methods: This descriptive analytical cross-sectional online survey included 200 clinically active dental practitioners recruited through convenience sampling in Pakistan from September 2025 to January 2026. Data were collected using an investigator-developed, expert-reviewed questionnaire and analyzed using frequencies, percentages, Wilson 95% confidence intervals, Pearson chi-square tests, and conditional Monte Carlo exact tests. Results: Angle's dental classification was the principal approach for 43.5% of respondents, while 38.0% combined dental and skeletal classification. Combined clinical examination and diagnostic records were reported by 47.5%, and 68.5% recorded overjet and overbite. Awareness of functional and esthetic implications was reported by 90.0%, but diagnostic confidence by 50.0%. Lack of radiographic facilities was the most frequent barrier (28.0%). Early referral was supported by 92.0%, and 75.0% favored national diagnostic guidelines. Barrier distributions and training needs differed by gender (p=0.022 and p=0.001, respectively). Conclusion: Respondents reported high awareness but variable diagnostic practices, limited confidence, and resource and training needs. These findings describe perceived practice gaps but do not establish diagnostic competence or nationally representative patterns. Keywords: Malocclusion; Dental practitioners; Orthodontic diagnosis; Diagnostic practices; Clinical confidence; Orthodontic referral; Pakistan.

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INTRODUCTION

Malocclusion refers to an abnormal alignment of the teeth or an altered relationship between the maxillary and mandibular dental arches, with or without an underlying skeletal discrepancy. Its development is multifactorial and may involve genetic influences, discrepancies between tooth and jaw dimensions, congenital conditions, environmental factors, and oral habits such as prolonged digit sucking, tongue thrusting, and mouth breathing. Depending on its type and severity, malocclusion may affect mastication, speech, facial appearance, periodontal health, psychosocial well-being, and oral health-related quality of life (1,2). Angle's classification, based primarily on the anteroposterior relationship of the first permanent molars, remains a widely used system for categorizing dental malocclusion into Class I, Class II, and Class III patterns. However, because it principally describes dental relationships, it does not independently

characterize skeletal discrepancies, vertical and transverse relationships, facial soft-tissue features, or functional abnormalities (1,2).

Malocclusion is common across different populations, although its reported distribution varies according to age, ethnicity, dentition stage, diagnostic criteria, sampling method, and study setting. A systematic review of global data found substantial variation in the distribution of Angle Class I, II, and III malocclusions and other occlusal traits across populations (3). Studies conducted in Pakistan have also reported a considerable burden of malocclusion among selected schoolchildren and patients attending dental and orthodontic facilities (4–6). However, estimates from school-based and hospital-based samples should not be interpreted as nationally representative prevalence figures. Pakistani studies have additionally documented associations between malocclusion, perceived facial appearance, psychological well-being, and orthodontic treatment need, emphasizing the clinical and psychosocial importance of timely recognition and appropriate referral (6).

Accurate assessment of malocclusion requires more than assigning an Angle classification. A comprehensive approach may include relevant history taking, extraoral and intraoral examination, assessment of occlusal relationships, measurement of overjet and overbite, evaluation of facial and skeletal patterns, functional assessment, and the selective use of photographs, study models or digital scans, panoramic imaging, and cephalometric analysis. The choice of diagnostic records should be guided by the clinical question and their expected contribution to diagnosis and treatment planning, while avoiding unnecessary radiographic exposure (1,2,7). General dental practitioners and house officers frequently serve as the first point of professional contact and therefore have an important role in recognizing developing or established malocclusion, identifying cases requiring further investigation, and referring patients for orthodontic assessment when indicated.

Evidence suggests that awareness of orthodontic problems does not necessarily translate into consistent use of structured diagnostic and referral procedures. A cross-sectional study of dental healthcare professionals reported variation in knowledge and use of orthodontic triage, supporting the need for clearer assessment pathways and continuing professional education (8). Research among dental students has similarly identified differences in awareness and attitudes concerning malocclusion and orthodontic treatment, indicating that educational exposure may influence perceived preparedness for orthodontic assessment (9). Nevertheless, awareness, self-reported confidence, and actual diagnostic competence are distinct constructs. Questionnaire-based reports of knowledge or confidence cannot establish whether a practitioner can accurately differentiate dental from skeletal malocclusion or correctly diagnose individual clinical cases.

The Pakistani studies represented in the available literature have primarily examined the prevalence, distribution, treatment need, and psychosocial effects of malocclusion in patient or student populations (4–6). Comparatively less information is available regarding how clinically active dental practitioners in Pakistan report classifying malocclusion, which diagnostic methods and records they routinely use, how confident they feel in their assessments, what barriers they encounter, and how these factors relate to referral practices. Understanding these self-reported practices may help identify perceived educational and resource needs, although it cannot directly measure diagnostic accuracy. Therefore, this cross-sectional survey aimed to describe the knowledge and awareness, classification approaches, diagnostic methods and tools, self-reported confidence, perceived barriers, training needs, and orthodontic referral practices of dental practitioners recruited through professional and academic networks in Pakistan. It also explored whether selected diagnostic and assessment practices were associated with participants' age, gender, and professional qualification.

MATERIAL AND METHODS

A descriptive analytical cross-sectional online survey was conducted from September 2025 to January 2026 to examine the self-reported knowledge, diagnostic and classification practices, confidence, perceived barriers, training needs, and orthodontic referral practices of dental practitioners working in clinical settings in Pakistan. The cross-sectional design was selected to provide a contemporaneous

description of routine malocclusion-assessment practices and to explore their associations with selected demographic and professional characteristics. Because no clinical cases or reference-standard diagnoses were administered, the study evaluated reported practices and perceived confidence rather than objective diagnostic accuracy.

The target population comprised clinically active dental practitioners, including general dentists and house officers, who were involved in examining patients and identifying or classifying malocclusion as part of routine clinical practice. Practitioners were eligible if they were currently providing clinical dental care, reported involvement in the assessment of malocclusion, and voluntarily agreed to participate. Dental students below the house-officer level, individuals not actively engaged in clinical practice, and those who did not provide consent were excluded.

Participants were recruited through non-probability convenience sampling. The survey invitation, study information sheet, and electronic questionnaire link were distributed through professional contacts, academic networks, email, WhatsApp groups, professional mailing lists, and relevant social networks. Participation was voluntary, and submission of the completed questionnaire after reviewing the study information was treated as implied consent. No directly identifying information was collected through the questionnaire, and submitted responses were stored in a password-protected database accessible to the research team.

The required sample size was estimated using Cochran's formula for a single population proportion. A 95% confidence level, 5% absolute margin of error, and expected proportion of 0.50 were used, with the latter selected to produce the maximum variance. This calculation yielded a minimum required sample of 384 participants. A feasibility recruitment target of 380 was established; however, 200 completed responses were obtained during the defined data-collection period and were included in the analysis. A response rate was not calculated because the number of eligible practitioners who received or viewed the open electronic invitation could not be established.

Data were collected using an investigator-developed, self-administered questionnaire created in Google Forms. Its content was informed by a review of published literature addressing malocclusion classification, orthodontic assessment, practitioner awareness, and referral practices. Angle's classification provided the principal framework for questions concerning Class I, Class II, and Class III dental relationships (1,2). Before full distribution, orthodontic experts assessed the questionnaire for face validity, clarity, and clinical relevance. A pilot exercise was subsequently conducted to identify unclear items, refine their wording, and assess the time required for completion. Pilot feedback was used to improve the clarity and usability of the final electronic questionnaire.

The questionnaire collected demographic and professional information, including age, gender, highest professional qualification, years of clinical experience, professional category, and practice setting. Its clinical domains addressed the classification systems used to assess malocclusion; the reported purpose of Angle's classification; routine assessment of occlusion; measurement of overjet and overbite; use of clinical examination, clinical photographs, radiographs, study models, and digital scans; awareness of the functional and esthetic consequences of malocclusion; recognition of oral habits as contributory factors; self-reported confidence in identifying malocclusion; perceived diagnostic barriers; areas in which further training was required; preferred timing of orthodontic evaluation; perceived value of early referral; and principal reasons for referring patients for orthodontic assessment. These domains were consistent with previously reported investigations of orthodontic awareness and triage practices among dental students and healthcare professionals (8,9).

The diagnostic classification approach was treated as a categorical variable and represented the principal system that respondents reported using in practice, including Angle's dental classification, skeletal classification, a combination of dental and skeletal classifications, or soft-tissue assessment. "Diagnostic approach" referred to the reported combination of clinical methods and diagnostic records routinely used to recognize and classify malocclusion. Use of specific diagnostic aids and recording of overjet and overbite were analyzed as categorical responses. Self-reported confidence was measured as an ordinal

response, while perceived barriers, training needs, referral timing, and referral considerations were summarized according to the response categories included in the questionnaire. These measures reflected participants' reported practices and perceptions and were not interpreted as objective assessments of clinical competence.

Completed questionnaires were exported from Google Forms into Microsoft Excel for data checking and organization and were subsequently analyzed using IBM SPSS Statistics version 27.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized using frequencies and percentages, and cross-tabulations were used to describe distributions across demographic and professional groups. Continuous variables were to be summarized using means and standard deviations where applicable. Pearson chi-square tests were used to explore associations between selected diagnostic, assessment, barrier, training, and referral variables and participants' age group, gender, and professional qualification. All comparisons were two-sided, and a p-value below 0.05 was considered statistically significant. Because the analyses were exploratory and unadjusted, the findings were interpreted as associations rather than causal relationships. Cases with missing information required for an inferential comparison were excluded from that analysis using listwise deletion.

Selection bias was addressed to the extent possible by distributing the survey through several professional, academic, and social channels rather than a single institution. Eligibility was restricted to practitioners engaged in clinical dental care to reduce responses based solely on theoretical exposure. Questionnaire piloting and expert review were used to improve item clarity and content relevance, while anonymous participation was intended to reduce response pressure. Nevertheless, the use of convenience sampling and self-reported measures limited control of selection, nonresponse, recall, and social-desirability biases.

Ethical approval was obtained from the Ethical Review Board of the PRIDE Centre for Research & Learning Institute, Pakistan, under reference number PRIDE/ERB/2026/074. Participation was voluntary, electronic submission of the completed questionnaire constituted implied informed consent, and no personally identifying information was collected. The study procedures were reported as being conducted in accordance with the ethical principles of the Declaration of Helsinki.

RESULTS

A total of 200 dental practitioners were included. Most participants were female (128, 64.0%), and 169 (84.5%) were 30 years of age or younger. The largest age group was 26–30 years (96, 48.0%). Most respondents held a BDS qualification (156, 78.0%), while 44 (22.0%) reported an MDS, MSc, or FCPS qualification (Table 1).

Angle's dental classification was the most frequently reported principal classification approach (87, 43.5%), followed by combined dental and skeletal classification (76, 38.0%). Routine occlusal assessment was reported as occurring always by 78 participants (39.0%) and often by 86 (43.0%). A combined approach incorporating clinical examination, photographs, radiographs, and study models or digital scans was reported by 95 participants (47.5%), whereas 67 (33.5%) relied principally on clinical examination alone (Table 2).

Table 1. Demographic characteristics of participants (N=200)

Characteristic	n (%)
Gender	
Female	128 (64.0)
Male	72 (36.0)
Age group, years	
20–25	73 (36.5)
26–30	96 (48.0)
31–35	26 (13.0)
>35	5 (2.5)
Professional qualification	
BDS	156 (78.0)

Characteristic	n (%)
MDS	18 (9.0)
MSc	14 (7.0)
FCPS	12 (6.0)

Abbreviations: BDS, Bachelor of Dental Surgery; FCPS, Fellow of the College of Physicians and Surgeons; MDS, Master of Dental Surgery; MSc, Master of Science.

Table 2. Reported malocclusion-classification and diagnostic practices (N=200)

Practice variable	n (%)
Principal classification approach	
Angle's dental classification	87 (43.5)
Combined dental and skeletal classification	76 (38.0)
Skeletal classification	25 (12.5)
Soft-tissue assessment	12 (6.0)
Routine occlusal assessment	
Always	78 (39.0)
Often	86 (43.0)
Occasionally	30 (15.0)
Rarely	6 (3.0)
Principal diagnostic-tool approach	
Combined clinical examination, photographs, radiographs, and models or digital scans	95 (47.5)
Clinical examination alone	67 (33.5)
Study models or digital scans	21 (10.5)
Radiographs	15 (7.5)
Clinical photographs	2 (1.0)

Table 3. Selected awareness, assessment, confidence, and referral indicators (N=200)

Indicator	n (%)	95% CI (%)
Aware of functional and esthetic implications of malocclusion	180 (90.0)	85.1–93.4
Recognized oral habits as contributory factors requiring interception	195 (97.5)	94.3–98.9
Recorded overjet and overbite measurements	137 (68.5)	61.8–74.5
Reported confidence in diagnosing malocclusion	100 (50.0)	43.1–56.9
Agreed or strongly agreed that early orthodontic referral improves outcomes	184 (92.0)	87.4–95.0
Favored standardized national diagnostic guidelines	150 (75.0)	68.6–80.5

Confidence intervals were derived using the Wilson score method.

Table 4. Routine occlusal assessment by professional qualification (N=200)

Qualification	Always, n (%)	Often, n (%)	Occasionally, n (%)	Rarely, n (%)	Total, n	p-value	Cramér's V
BDS	56 (35.9)	76 (48.7)	18 (11.5)	6 (3.8)	156	0.033	0.178
MDS	6 (33.3)	6 (33.3)	6 (33.3)	0 (0.0)	18		
MSc	8 (57.1)	2 (14.3)	4 (28.6)	0 (0.0)	14		
FCPS	8 (66.7)	2 (16.7)	2 (16.7)	0 (0.0)	12		
Total	78 (39.0)	86 (43.0)	30 (15.0)	6 (3.0)	200		

Percentages are calculated within qualification groups. The p-value applies to the overall table and was obtained using a conditional Monte Carlo exact test with 500,000 replicates because eight expected cell counts were below five. The corresponding Pearson statistic was $\chi^2(9) = 18.980$.

Table 5. Principal reported barrier to malocclusion diagnosis by gender (N=200)

Diagnostic barrier	Female, n (%)	Male, n (%)	Total, n (%)	p-value	Cramér's V
Lack of radiographic facilities	30 (23.4)	26 (36.1)	56 (28.0)	0.022	0.250
Time constraints	26 (20.3)	22 (30.6)	48 (24.0)		
Limited clinical experience	24 (18.8)	12 (16.7)	36 (18.0)		
Variability in diagnostic criteria	20 (15.6)	3 (4.2)	23 (11.5)		
Difficulty differentiating skeletal and dental components	27 (21.1)	9 (12.5)	36 (18.0)		
Other	1 (0.8)	0 (0.0)	1 (0.5)		
Total	128 (100.0)	72 (100.0)	200 (100.0)		

Percentages in the gender columns are calculated within gender groups. The total column uses all 200 participants as the denominator. The p-value applies to the overall table and was obtained using a conditional Monte Carlo exact test with 500,000 replicates because two expected cell counts were below five. The corresponding Pearson statistic was $\chi^2(5) = 12.483$.

Table 6. Principal area in which further training was required, by gender (N=200)

Training area	Female, n (%)	Male, n (%)	Total, n (%)	p-value	Cramér's V
Growth prediction and treatment planning	34 (26.6)	18 (25.0)	52 (26.0)	0.001	0.302
Advanced imaging and CBCT	42 (32.8)	9 (12.5)	51 (25.5)		
Cephalometric analysis and interpretation	15 (11.7)	21 (29.2)	36 (18.0)		
Differentiating skeletal and dental malocclusion	26 (20.3)	12 (16.7)	38 (19.0)		
Clinical examination techniques	11 (8.6)	12 (16.7)	23 (11.5)		
Total	128 (100.0)	72 (100.0)	200 (100.0)		

Percentages in the gender columns are calculated within gender groups. The total column uses all 200 participants as the denominator. The p-value applies to the overall Pearson chi-square test: $\chi^2(4) = 18.226$.

Table 7. Principal reason for orthodontic referral among participants with a recorded response (n=199)

Referral reason	n (%)
Esthetic concerns	92 (46.2)
Functional problems	65 (32.7)
Skeletal discrepancies	27 (13.6)
Combined esthetic, functional, and skeletal factors	15 (7.5)
Total	199 (100.0)

Percentages were recalculated using the 199 reported responses as the denominator.

Awareness of the functional and esthetic implications of malocclusion was reported by 180 participants (90.0%; 95% CI 85.1%–93.4%), while 195 (97.5%; 95% CI 94.3%–98.9%) recognized oral habits as contributory factors requiring interception. Overjet and overbite measurements were recorded by 137 participants (68.5%; 95% CI 61.8%–74.5%). One hundred participants reported confidence in diagnosing malocclusion (50.0%; 95% CI 43.1%–56.9%). Agreement that early orthodontic referral improves outcomes was reported by 184 participants (92.0%; 95% CI 87.4%–95.0%), and 150 (75.0%; 95% CI 68.6%–80.5%) favored standardized national diagnostic guidelines (Table 3).

The frequency of routine occlusal assessment differed across professional qualifications (conditional Monte Carlo exact $p = 0.033$; Cramér's $V = 0.178$). Always assessing occlusion was reported by 35.9% of BDS respondents, 33.3% of MDS respondents, 57.1% of MSc respondents, and 66.7% of FCPS respondents. Because several qualification groups were small, the association was characterized by limited precision despite the observed overall difference (Table 4).

The distribution of the principal diagnostic barrier also differed by gender (conditional Monte Carlo exact $p = 0.022$; Cramér's $V = 0.250$). Lack of radiographic facilities was reported by 36.1% of male and 23.4% of female participants, while variability in diagnostic criteria was reported by 4.2% and 15.6%, respectively. Difficulty differentiating skeletal and dental components was selected by 21.1% of female participants and 12.5% of male participants (Table 5).

Training needs varied across gender groups, $\chi^2(4) = 18.226$, $p = 0.001$, with a Cramér's $V$of 0.302. Advanced imaging and CBCT constituted the principal training need for 32.8% of female participants compared with 12.5% of male participants. Conversely, cephalometric analysis and interpretation were selected by 29.2% of male participants and 11.7% of female participants. Growth prediction and treatment planning were reported at similar frequencies by female and male participants (26.6% and 25.0%, respectively) (Table 6).

A referral-reason response was recorded for 199 participants. Esthetic concerns were the most frequently reported principal reason for referral (92, 46.2%), followed by functional problems (65, 32.7%), skeletal discrepancies (27, 13.6%), and combined esthetic, functional, and skeletal considerations (15, 7.5%) (Table 7).

DISCUSSION

This cross-sectional survey found that dental practitioners generally reported frequent occlusal assessment and high awareness of selected functional, esthetic, and etiological aspects of malocclusion. Nevertheless, self-reported diagnostic confidence was limited, and respondents identified important

differences in classification approaches, diagnostic-resource availability, and perceived training requirements. Angle's dental classification remained the most frequently reported principal approach, although more than one-third of respondents combined dental and skeletal classification. Approximately half reported using multiple diagnostic records, while one-third relied primarily on clinical examination. These findings suggest a gap between general awareness of malocclusion and perceived preparedness to undertake comprehensive diagnostic assessment.

The continued reliance on Angle's classification is clinically understandable because it provides a simple and familiar description of anteroposterior dental relationships. However, Angle's classification alone does not characterize the complete skeletal, transverse, vertical, soft-tissue, or functional components of malocclusion (1,2). The finding that 38.0% of respondents combined dental and skeletal classification indicates recognition that assessment should extend beyond molar relationships. This distinction is important because apparently similar dental relationships may occur with different underlying skeletal patterns and may consequently require different referral or management pathways. Nevertheless, the present survey measured respondents' reported approaches rather than their ability to apply these classifications correctly in clinical cases.

Most participants reported that they always or often assessed occlusion during routine dental examinations. The frequency of this practice differed across professional qualifications, although the magnitude of association was limited and the postgraduate groups were comparatively small. These findings should therefore not be interpreted as evidence that a particular qualification independently determines diagnostic practice. Ikram et al. found that many dental healthcare professionals were unfamiliar with the practical application of structured orthodontic triage and that 79% did not report using orthodontic triage in practice (8). The apparently higher frequency of routine occlusal assessment in the present study does not necessarily conflict with that finding because examining occlusion is a broader and less structured activity than applying a formal orthodontic-triage protocol. Together, the studies indicate that general screening may occur more frequently than systematic risk classification and referral decision-making.

The high proportions reporting awareness of the functional and esthetic implications of malocclusion and recognizing oral habits as contributory factors indicate familiarity with fundamental orthodontic concepts. Similar positive attitudes toward the importance of malocclusion and orthodontic treatment have been reported among dental students (9). However, only half of the respondents in the present study reported confidence in diagnosing malocclusion. This difference reinforces the distinction between awareness, confidence, and competence: familiarity with the consequences or causes of a condition does not necessarily provide the clinical skills required to distinguish dental from skeletal discrepancies, interpret diagnostic records, or determine the need and timing of referral. Previous work on orthodontic triage has similarly identified a gap between awareness of orthodontic problems and consistent application of structured assessment procedures (8).

The use of diagnostic records also varied substantially. Although 47.5% of participants reported combining clinical examination, photographs, radiographs, and study models or digital scans, 33.5% relied principally on clinical examination. Comprehensive orthodontic assessment may require integration of clinical findings with appropriate diagnostic records, particularly where skeletal relationships, growth, asymmetry, or complex occlusal discrepancies must be evaluated (1,2). Nevertheless, additional imaging should be selected according to clinical need rather than used routinely for every patient. Evidence concerning lateral cephalometric radiography indicates that its contribution to diagnosis and treatment planning varies across clinical circumstances, supporting selective rather than indiscriminate use (7). Consequently, the reported lack of radiographic facilities may restrict assessment in some settings, but availability alone should not determine whether imaging is undertaken.

Lack of radiographic facilities and time constraints were the most frequently identified diagnostic barriers. The overall distribution of barriers differed by gender, with an association magnitude of Cramér's $V = 0.250$. Training needs also varied by gender, particularly for advanced imaging and cephalometric

interpretation, with Cramér's $V = 0.302$. These patterns should be interpreted as exploratory associations rather than inherent gender differences in diagnostic capability. They may reflect unmeasured variation in professional qualification, clinical experience, workplace responsibilities, access to equipment, or practice setting. Because no multivariable analysis was available, the independent contribution of gender could not be distinguished from these related professional and institutional factors.

Growth prediction and treatment planning, advanced imaging, differentiation of skeletal and dental malocclusion, cephalometric interpretation, and clinical examination were all identified as areas requiring further training. These responses are consistent with the observed uncertainty in diagnostic confidence and with previous evidence supporting structured orthodontic-triage education among dental healthcare professionals (8). The results support consideration of educational activities that integrate clinical examination with case-based interpretation of dental, skeletal, facial, and functional findings. However, the survey did not test an educational intervention, and it cannot establish that additional training would improve diagnostic accuracy or patient outcomes.

Most respondents agreed that early orthodontic referral could improve outcomes, and three-quarters favored standardized national diagnostic guidelines. These findings represent practitioners' opinions rather than evidence of the effectiveness of a particular referral age or national guideline. Referral decisions should remain responsive to the type, severity, functional consequences, growth status, and complexity of the presenting malocclusion rather than being determined by a single age threshold (1,2). Nevertheless, a clearly defined triage pathway may help general dental practitioners identify conditions that require monitoring, interceptive assessment, or specialist referral, particularly where confidence and access to diagnostic resources vary (8).

Esthetic concerns were the most frequently recorded principal reason for referral, followed by functional problems and skeletal discrepancies. This pattern is consistent with Pakistani patient-based research demonstrating the psychological and appearance-related importance of malocclusion (6). It is also broadly comparable with findings from a cross-sectional survey in Xi'an, where knowledge, attitudes, expectations, and esthetic considerations influenced orthodontic treatment-related behavior and satisfaction (10). Because the present study assessed practitioners rather than patients, it cannot determine whether referral reasons reflected patient demand, practitioner judgment, or both. Referral assessment should therefore consider esthetic concerns alongside functional impairment, skeletal discrepancy, oral health, patient expectations, and the potential benefits and burdens of further orthodontic evaluation.

This study addressed several related components of malocclusion assessment within a clinically active practitioner sample, including classification methods, diagnostic records, confidence, perceived barriers, training requirements, and referral practices. Reporting counts with confidence intervals and using exact testing for sparse contingency tables improved the interpretability of the available data. However, several limitations materially affect the conclusions. Convenience recruitment through electronic professional and social networks created a risk of selection and nonresponse bias, and the absence of a defined invitation denominator prevented calculation of a valid response rate. The final sample of 200 was below the calculated minimum of 384, while postgraduate qualification groups were small. The geographical distribution of respondents was not available, limiting the extent to which the findings can represent dental practitioners throughout Pakistan.

The findings were also based entirely on self-reported practices and may have been affected by recall and social-desirability biases. The questionnaire underwent expert face review and pilot refinement, but comprehensive psychometric validation was not reported. No clinical vignettes, patient examinations, or reference-standard diagnoses were used; consequently, awareness and confidence could not be linked to diagnostic accuracy. Numerous exploratory subgroup comparisons were undertaken without multivariable adjustment or correction for multiple testing, and residual confounding by experience, specialty, region, and practice setting could not be assessed. Some questionnaire outcomes had incomplete or internally inconsistent category reporting and were therefore excluded from the revised analysis. Accordingly, the findings should be interpreted as an exploratory description of the practices and perceptions reported by

this convenience sample rather than an evaluation of the competence of Pakistani dental practitioners as a whole.

CONCLUSION

Dental practitioners in this cross-sectional convenience sample reported frequent occlusal assessment and high awareness of selected aspects of malocclusion, but only half expressed confidence in diagnosis, and substantial variation was observed in classification approaches, use of diagnostic records, perceived barriers, and training needs. The findings identify areas in which structured diagnostic support and access to appropriate resources may be valued by practitioners, while the self-reported design and non-probability sample limit conclusions regarding diagnostic competence or national practice patterns.

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