

KNOWLEDGE OF ORTHODONTIC DIAGNOSIS AMONG UNDERGRADUATE DENTAL STUDENTS: A LITERATURE REVIEW

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Abstract

Background: Orthodontic diagnosis is an important competency expected of undergraduate dental graduates because general dental practitioners frequently identify malocclusions and initiate orthodontic referral. However, evidence suggests that theoretical knowledge of orthodontics does not always translate into adequate clinical diagnostic competence.

Objective: To review the available literature concerning orthodontic diagnostic knowledge, clinical competence, treatment-need assessment and referral ability among undergraduate dental students, and to identify gaps in current undergraduate orthodontic education.

Methods: A focused literature search was undertaken using PubMed/MEDLINE and relevant dental education literature. Studies addressing undergraduate orthodontic education, recognition and diagnosis of malocclusion, orthodontic treatment-need assessment, clinical diagnostic competence, referral ability, confidence and educational methodologies were considered. Reference lists of relevant publications were also screened. The findings were narratively synthesized.

Results: Existing evidence demonstrates considerable variation in undergraduate orthodontic curricula, clinical exposure and assessment methods. Although theoretical knowledge generally increases with progression through dental school, improvement in clinical diagnostic ability is less consistent. Deficiencies have been reported in recognition of complex malocclusions, application of the Index of Orthodontic Treatment Need (IOTN), interpretation of diagnostic records and appropriate orthodontic referral. Case-based and clinically oriented teaching appears to improve diagnostic performance compared with conventional lecture-based approaches, although increased confidence does not necessarily correspond to improved objective diagnostic ability.

Conclusion: Undergraduate orthodontic education should place greater emphasis on clinically oriented diagnosis, treatment-need assessment and referral decision-making. Standardized case-based assessment of diagnostic competence may help identify curricular deficiencies and improve preparedness for general dental practice.

Keywords: orthodontic diagnosis; undergraduate dental students; malocclusion; dental education; orthodontic treatment need; clinical competence; referral.

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Introduction

Orthodontic diagnosis is a fundamental component of comprehensive dental care and an important competency for undergraduate dental graduates. General dental practitioners are commonly the first clinicians to identify developing malocclusions and determine whether patients require orthodontic assessment. Consequently, undergraduate dental students should be able to recognize deviations from normal occlusion, identify dental and skeletal components of malocclusion, understand relevant etiological factors, assess treatment need and make appropriate referrals. Contemporary undergraduate orthodontic education therefore emphasizes recognition and diagnosis of orthodontic problems rather than independent management of complex malocclusions [1,2].

A scoping review of undergraduate orthodontic curricula demonstrated considerable variation in curriculum content, learning outcomes, clinical requirements and assessment methods across countries and institutions. Nevertheless, a consistent recommendation was that undergraduate education should emphasize assessment and diagnosis of orthodontic treatment needs and provide sufficient understanding of treatment options to facilitate appropriate referral [1].

The distinction between theoretical knowledge and clinical diagnostic competence is particularly important. Brightman et al. evaluated both didactic knowledge and clinical diagnostic ability among dental students and found that theoretical knowledge increased during dental school, with correct responses increasing from approximately 30% among first-year students to 59% among fourth-year students. In contrast, clinical diagnostic performance showed only slight improvement, with fourth-year students correctly answering 70% of questions related to seven clinical cases compared with 65% among first-year students [3]. These findings suggest that acquisition of factual knowledge does not necessarily result in equivalent development of diagnostic reasoning.

Undergraduate orthodontic teaching has consequently been advocated to focus more strongly on diagnosis and recognition of orthodontic problems rather than limited exposure to treatment techniques [4]. The ability to identify malocclusion should include assessment of sagittal, vertical and transverse relationships, dental and skeletal components, functional factors and the patient's stage of growth and development.

Assessment of orthodontic treatment need represents another important component of diagnostic competence. The Index of Orthodontic Treatment Need (IOTN), particularly its Dental Health Component (DHC) and Aesthetic Component (AC), provides a standardized approach to treatment-need assessment. Evidence indicates that structured IOTN training can improve agreement between undergraduate students and orthodontic experts [5]. Computer-assisted learning has also demonstrated improved performance in DHC scoring compared with conventional teaching, suggesting that interactive learning may facilitate acquisition of diagnostic skills [6].

However, deficiencies in treatment-need assessment and referral remain evident. Bouskandar et al. assessed fourth- and fifth-year UK dental students using six clinical cases and found substantial limitations in IOTN scoring and referral decisions. Correct identification of treatment need varied according to the clinical condition, with particularly low accuracy for impacted teeth and hypodontia [7]. These findings highlight the need to assess not only recognition of malocclusion but also the student's ability to determine whether specialist referral is warranted.

More recent evidence has continued to demonstrate variability in undergraduate diagnostic competence. Abbass et al. assessed final-stage dental students using clinical photographs and radiographs and reported generally good diagnostic proficiency, although differences remained in students' interpretation of the factors contributing to facial disharmony and treatment requirements [8]. Thus, diagnostic ability may be influenced by institutional curriculum, clinical exposure and assessment methodology.

The educational approach used to teach orthodontic diagnosis is also relevant. A randomized controlled trial comparing case-based learning (CBL) with lecture-based learning found significantly different diagnostic performance between the two groups, with CBL also producing greater student satisfaction [9]. Conversely, a recent study of flipped-classroom orthodontic education demonstrated increased confidence in case diagnosis without a corresponding improvement in objective diagnostic ability [10]. This distinction emphasizes the importance of evaluating competence independently of self-reported confidence. The present literature review therefore aims to synthesize evidence regarding orthodontic diagnostic knowledge and clinical competence among undergraduate dental students and identify areas requiring improvement in undergraduate orthodontic education.

Methods

A focused literature search was undertaken using PubMed/MEDLINE to identify publications addressing orthodontic diagnosis and education among undergraduate dental students. Search terms included combinations of “*orthodontic diagnosis*,” “*orthodontic education*,” “*undergraduate dental students*,” “*dental students*,” “*malocclusion*,” “*clinical competence*,” “*Index of Orthodontic Treatment Need*,” “*orthodontic referral*,” and “*orthodontic curriculum*.”

Studies examining undergraduate orthodontic knowledge, diagnostic ability, treatment-need assessment, clinical reasoning, referral, educational interventions and student confidence were considered relevant. Reference lists of key publications and recent reviews were also screened to identify additional relevant studies. Priority was given to original research, educational intervention studies, curriculum reviews and recent publications addressing clinical diagnostic competence. The findings were narratively synthesized according to curriculum, diagnostic knowledge, treatment-need assessment, clinical competence, referral and educational methodology.

Results

The available literature demonstrates substantial heterogeneity in undergraduate orthodontic education. Raghavan et al. identified marked variations in learning outcomes, curriculum content, clinical requirements and assessment approaches across undergraduate orthodontic programs [1]. This variability may contribute to differences in diagnostic competence between institutions.

Evidence consistently suggests that theoretical knowledge and clinical diagnostic ability do not necessarily develop at the same rate. Brightman et al. demonstrated a clear increase in theoretical orthodontic knowledge across dental school but only a modest improvement in clinical recognition of malocclusion [3]. Similarly, earlier evaluations of undergraduate orthodontic teaching emphasized that students may acquire knowledge of orthodontic concepts without sufficient ability to apply this knowledge clinically [4].

Recognition and classification of malocclusion remain fundamental diagnostic skills. Students are expected to identify crowding, spacing, increased overjet and overbite, open bite, crossbite and abnormal sagittal relationships. However, comprehensive diagnosis requires differentiation between dental, skeletal and functional components rather than simple classification according to Angle’s system.

Treatment-need assessment is another area of concern. Structured IOTN training significantly improves student agreement with expert assessment [5], and computer-assisted learning has demonstrated

advantages over conventional teaching for DHC scoring [6]. Nevertheless, Bouskandar et al. reported deficiencies in IOTN application and orthodontic referral among senior undergraduate dental students [7].

Clinical exposure appears to be important for developing confidence and competence. Qualitative research involving students and graduates found that participants perceived undergraduate orthodontic education as relatively theory-focused and reported limited confidence in extrapolating diagnoses and treatment plans after graduation [11]. These findings support greater integration of clinical cases and diagnostic exercises into undergraduate education.

Educational methodology may influence diagnostic performance. Case-based learning has demonstrated advantages over lecture-based learning in undergraduate orthodontic case diagnosis [9]. However, student confidence should not be considered an independent measure of competence because student-centered and flipped learning approaches may increase confidence without producing equivalent improvement in objective diagnostic performance [10].

Discussion

The literature indicates that orthodontic diagnosis represents a potentially underdeveloped component of undergraduate dental education. The most consistent finding is the discrepancy between knowledge acquisition and clinical application. Students may demonstrate satisfactory recall of orthodontic terminology and classification systems while experiencing difficulty integrating clinical findings into a coherent diagnosis.

This distinction is important because the primary orthodontic responsibility of a general dental practitioner is not necessarily to provide comprehensive orthodontic treatment but to recognize orthodontic abnormalities, assess their significance and facilitate appropriate referral [1,4]. Therefore, undergraduate education should prioritize diagnostic recognition and clinical decision-making.

The application of IOTN illustrates this knowledge–competence gap. Although students can be taught the principles of the index, accurate application to clinical cases requires calibration and repeated exposure [5,7]. This suggests that assessment of orthodontic knowledge should incorporate clinical photographs, study models and radiographs rather than rely exclusively on conventional recall-based questionnaires.

Referral competence is particularly important. Failure to recognize an impacted canine, significant skeletal discrepancy, hypodontia or developing crossbite may result in delayed specialist assessment and potentially compromise treatment timing. Thus, an undergraduate diagnostic assessment should include questions

addressing whether referral is indicated and when it should occur, rather than simply asking students to identify the malocclusion.

The available educational evidence also favors greater use of clinically oriented learning. Case-based learning has demonstrated improved diagnostic performance compared with lecture-based learning [9]. Such approaches allow students to integrate patient age, clinical findings, photographs and radiographic information and consequently resemble the reasoning required in clinical practice.

However, the evidence also demonstrates that educational innovation alone does not guarantee improvement in diagnostic competence. The finding that flipped learning may increase confidence without improving objective diagnostic performance [10,11] reinforces the importance of validated competency-based assessments. Recognition of orthodontic anomalies such as spacing and midline diastema forms part of the broader diagnostic assessment of malocclusion [12].

A major limitation of the existing literature is methodological heterogeneity. Studies differ in sample size, academic year, questionnaire design, clinical cases and outcome measures. Furthermore, contemporary evidence specifically addressing Indian undergraduate dental students remains limited. This represents an important research opportunity because differences in curriculum structure, clinical exposure and institutional resources may influence diagnostic competence.

Future studies should therefore evaluate multiple dimensions of orthodontic diagnosis, including recognition and classification of malocclusion, identification of dental and skeletal components, etiological understanding, interpretation of diagnostic records, treatment-need assessment and referral decision-making. A case-based instrument combining clinical photographs, radiographs and structured questions may provide a more clinically meaningful assessment than a conventional knowledge questionnaire.

Conclusion

Current evidence indicates that undergraduate dental students acquire theoretical orthodontic knowledge during dental education, but this does not consistently translate into equivalent clinical diagnostic competence. Deficiencies have been reported in malocclusion recognition, IOTN application, interpretation of clinical cases and appropriate orthodontic referral. Educational strategies incorporating case-based and clinically oriented learning may improve diagnostic performance, although confidence should not be considered a surrogate for competence.

Undergraduate orthodontic curricula should consequently emphasize the progression from knowledge acquisition to clinical recognition, diagnostic interpretation, treatment-need assessment and referral decision-making. Further research using standardized, case-based assessment tools is warranted, particularly among undergraduate dental students in India, to identify specific deficiencies and guide curriculum development.

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