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Exploring Core Anatomy Competency for Clinical Skill Development in Dental Undergraduate Curriculum: A Scoping Review Protocol

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ABSTRACT

Competency refers to the combination of knowledge, skills, attitudes, and abilities that an individual must possess to perform tasks effectively and meet specific objectives or standards. Anatomy competency specifically refers to the ability to translate anatomical understanding into safe and accurate clinical practice. In dental education, anatomy is a cornerstone of this competency, supporting essential procedures such as local anaesthesia, surgical planning, and radiographic interpretation. However, inconsistencies in anatomy instruction and a lack of standardised competency frameworks have contributed to variability in students' clinical readiness. This scoping review protocol outlines the methodology for systematically mapping the literature on anatomy-related competencies that support clinical skill development in undergraduate dental education. This review systematically investigates the essential anatomy core competencies underpinning clinical skill development in dentistry and evaluates their contribution to clinical preparedness. The methodology adheres to the Joanna Briggs Institute (JBI) framework and is reported in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. This review will examine the anatomy core competency required for the development of clinical skills in dentistry and their impact on clinical preparedness, guided by the JBI methodology and will be reported using the PRISMA-ScR checklist. Primary studies, reviews, and grey literature published between June 2020 and May 2025 will be retrieved from Scopus, PubMed, and Wiley Online Library databases and included. Only studies involving undergraduate dental students will be considered. Data extraction will capture study characteristics, anatomy content, competency elements, and clinical relevance. Results will be presented in tabular, narrative, and concept map formats to illustrate the relationships between anatomy education and clinical skill development. This will inform curriculum reform and strengthen competency-based anatomy instruction in dental programmes.

Keywords: *Competency, Anatomy, Clinical skills, Dental undergraduate, Scoping review protocol*

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INTRODUCTION

Anatomical knowledge serves as a critical scaffold for safe and effective clinical decision-making in dentistry. From radiographic interpretation to surgical precision, the spatial understanding of craniofacial structures directly impacts procedural outcomes. Nonetheless, accumulating evidence suggests a growing disconnect between preclinical anatomical education and the complex realities of clinical dentistry (1, 2). While the anatomical foundations are theoretically emphasised, students often struggle to translate this knowledge into clinical practice, highlighting the need for a clearer link between anatomy instruction and clinical skill development (3, 4).

In general, competency is a multidimensional construct that integrates and applies knowledge, cognitive and psychomotor skills, attitudes, and professional values, enabling individuals to perform tasks and fulfil roles effectively within a specific context (5–7). While defined within the broader scope of medical education, anatomy competency has been described as the ability to apply anatomical knowledge accurately and effectively in clinical settings, encompassing spatial understanding, structural interpretation, and informed decision-making (8). Furthermore, competency-based frameworks aim to standardise expectations and ensure graduate readiness across core disciplines. Despite these efforts, anatomy instruction frequently lacks defined competency outcomes, with many curricula still rooted in passive, memorisation-heavy approaches (9, 10). A recent systematic review emphasised the need for structured strategies to embed competency frameworks in dental education, particularly in disciplines such as anatomy that traditionally lack clinical alignment (11).

Modern anatomy education has seen the introduction of advanced modalities, including three-dimensional (3D) visualisation techniques, virtual reality, and interactive platforms, to foster deeper engagement (12, 13). While these innovations have enhanced knowledge retention and student satisfaction, their integration into competency assessment remains underdeveloped (12–14). More critically, there is still no clear consensus on the core anatomical content necessary for safe clinical practice, nor on the depth and breadth of knowledge that should be included in the undergraduate dental syllabus (15, 16). Dental students continue to voice concerns about inconsistent teaching quality, limited clinical context, and uncertainty about the relevance of the content taught, particularly in digital or hybrid learning environments (14, 17). These challenges underscore the need not only for innovation in delivery but also for curricular clarity and alignment with clinical competencies.

Despite broad agreement on the relevance of anatomy to clinical success, there is still no standardised set of anatomy competencies tailored to the clinical demands of dentistry (15, 16). Stakeholders, including educators, students, and curriculum planners, have varied perceptions of what constitutes essential anatomical knowledge for clinical competence (10). This variability contributes to fragmented learning experiences and uneven clinical preparedness. A systematic synthesis of the literature is therefore needed to clarify which anatomy competencies are emphasised in current curricula and how these relate to clinical expectations in undergraduate dental training.

By mapping the anatomical knowledge and skills explicitly connected to clinical performance, this review aims to support the development of standardised, competency-based anatomy education. The findings will offer insights into curriculum strengths, expose existing gaps, and inform evidence-based strategies to improve clinical preparedness among dental graduates.

OBJECTIVES AND REVIEW QUESTIONS

This scoping review aims to identify the anatomy competencies embedded in undergraduate dental education and their relevance for clinical skill development. The review will attempt to answer the research question: What is the essential anatomy competency required for clinical skill development in the dental undergraduate curriculum?

METHODS AND ANALYSIS

This protocol follows the guidelines provided by the Joanna Briggs Institute (JBI) Scoping Review Methodology Group (18). The review will be reported according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) framework. The review will be conducted between the 17th of April 2025 and the 17th of December 2025, covering literature published from June 2020 to May 2025. Any modifications to the methodology will be documented and justified in the final review.

REVIEW TEAM

The review team includes anatomists and medical education experts with at least three years of experience teaching anatomy to undergraduate medical and dental students. One reviewer holds a doctoral degree in medical education with expertise in competency-based curriculum design.

INCLUSION CRITERIA

Types of Participants

The included literature will focus on undergraduate dental students, with particular emphasis on those in their clinical years. This group is selected due to the increased academic and practical demands they face during clinical training, which often highlight challenges related to performance, feedback reception, and professional development (5). By concentrating on clinical year students, the review aims to capture insights into the factors influencing their anatomy learning experiences within the clinical education context (17). Studies involving postgraduate students, non-dental health professions, or participants outside undergraduate dental education will be excluded.

Concept

This review explores the essential anatomical competencies relevant to clinical skill development. The core anatomy knowledge refers to foundational areas of anatomy, including head and neck anatomy, tooth morphology, and anatomical variation. Core anatomy competencies include not only clinical skills but also the ability to integrate anatomical understanding with evidence-based knowledge and professional attitudes, thereby supporting holistic dental care (5). This review will also evaluate the applicability of anatomy knowledge in dental diagnosis, treatment planning, and procedures (1, 2).

Context

The context includes educational settings in which anatomy is taught as part of undergraduate dental curricula, with clinical application emphasised. Literature related to postgraduate dental education or elective programmes will be excluded. Studies conducted in postgraduate programmes, elective courses, or other contexts unrelated to undergraduate dental training will be excluded.

Sources

The review will include primary studies employing quantitative, qualitative, and mixed methods designs, utilising data collection approaches such as interventional studies, surveys, interviews, and direct observations. Relevant secondary research, including systematic reviews, scoping reviews, and narrative reviews, will also be considered if they provide meaningful insights into anatomy competency and its relevance to clinical skill development. Grey literature, such as dissertations or institutional reports, will be included if they are peer-reviewed or publicly archived. Only English-language resources published between June 2020 and May 2025 will be considered. In contrast, studies will be excluded if they involve postgraduate education or non-dental health professions, fail to address anatomy competency or clinical skill development, consist only of editorials, opinion pieces, or commentary papers, are conference abstracts without accessible full texts, are published in languages other than English, or are review articles that do not provide relevant insights into anatomy competency or meaningfully address the research question. The eligibility criteria used to screen the title, abstract and full text are listed in Table 1.

Table 1: Eligibility criteria for title, abstract and full text screening

Selection	Criteria
Title	a. Title in English
	b. Year of publication from June 2020 to May 2025
	c. Title reflects relevance to anatomy education or clinical skills in dental undergraduate curricula.
Abstract examination	a. Abstract confirms the article is a research study (primary or secondary).
	b. Study design and methodology are clearly described.
	c. Abstract indicates focus on anatomy competencies and clinical application.

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Table 1: (*Continued*)

Selection	Criteria
Full-text examination	a. Article discusses specific anatomy competencies, teaching strategies, assessment methods, or clinical skill outcomes. b. Provides clear qualitative or quantitative data or review-based insights. c. Includes a defined research methodology and addresses its relevance to dental undergraduate education.
Procedure for solving disagreements between the reviewers (Research team)	Disagreements during article selection will be resolved through team discussions. If consensus cannot be reached, a third independent reviewer will be involved to ensure objectivity.
Pilot testing of source selectors	A random sample of 20–30 titles and abstracts will be screened by all team members using the eligibility criteria. Discrepancies will be discussed, and criteria may be refined for clarity and consistency.

SEARCH STRATEGY

A three-phase search strategy will be implemented for this review. First, a preliminary search will be conducted in Scopus and PubMed to identify relevant keywords and index terms. Next, a comprehensive search will be carried out using refined search strings in Scopus, PubMed, and Wiley Online Library, combining terms such as ("dental anatomy" OR "head and neck anatomy" OR "anatomy teaching" OR "anatomy core competency" OR "anatomy learning outcomes") AND ("clinical skills" OR "clinical competency" OR "clinical relevance" OR "clinical training") AND ("undergraduate dental education" OR "dental curriculum" OR "dental students"). Finally, an additional search will be conducted by manually screening the reference lists of included articles and relevant reviews to identify additional sources, including grey literature. Grey literature will be searched through platforms such as ProQuest Dissertations & Theses, OpenGrey, and selected institutional repositories. To ensure comprehensive coverage, this review will use a combination of discipline-specific databases, such as PubMed and ERIC, and general academic databases, including Scopus and Web of Science. The three-step search strategy is summarised in Table 2.

Table 2: The three-step strategy

Steps	Description
Step 1 Initial limited search	a. An initial limited search of Scopus and Web of Science will be conducted to identify relevant articles on anatomy education and competency in dental undergraduate training. b. Titles, abstracts, and index terms of retrieved articles will be examined to extract commonly used keywords.
Step 2 Comprehensive search	a. A comprehensive search will be conducted using refined Boolean search strings in PubMed and ERIC. b. The search string will combine keywords and index terms related to anatomy and clinical skills in dentistry. c. The proposed search string is: ("dental anatomy" OR "head and neck anatomy" OR "anatomy teaching" OR "anatomy core competency" OR "anatomy learning outcomes") AND ("clinical skills" OR "clinical competency" OR "clinical relevance" OR "clinical training") AND ("undergraduate dental education" OR "dental curriculum" OR "dental students")

(*Continued on next page*)

Table 2: (*Continued*)

Steps	Description
Step 3 Reference list screening	a. The reference lists of all included studies and relevant reviews will be manually screened to identify additional relevant literature. b. Grey literature will be searched using platforms such as ProQuest Dissertations & Theses, OpenGrey, and selected institutional repositories.

SELECTION OF SOURCES

All results will be exported into Microsoft Excel and screened for duplicates. Titles and abstracts will be independently reviewed by two reviewers (EJE and SNH) using predefined criteria. A pilot test (20 to 30 articles) will ensure consistency. A third reviewer (ZIM/NLA) will resolve any discrepancies. Selection results will be reported using a PRISMA-ScR flow diagram.

DATA EXTRACTION

Data extraction will be conducted on the full-text sources of the included studies. The extracted information will include the article title, authors, year of publication, study location, type of resource, study design and methods, anatomy content focus, competency elements described, clinical relevance or application and stated justification or impact. Four reviewers (EJE, SNH, NLA and ZIM) will independently extract data using a standardised extraction form. Any disagreements between the researchers will be resolved through discussion among team members to reach a consensus. A pilot test will be conducted beforehand to ensure the consistency and clarity of the data extraction form (Figure 1).

Title (Author/s)	Year of publication	Geographical location	Types of sources	Study design	Dental anatomy content emphasised for clinical competency	Justification or impact on clinical application

Figure 1: Example of data extraction form.

PRESENTATION OF RESULTS

Findings will be presented in tabular, narrative, and conceptual formats, summarising key data such as article title, author(s), year of publication, study location, type of resource, study design and methods, anatomy content focus, competency elements described, clinical relevance or application and stated justification or impact. In addition, the data will be analysed using thematic categorisation, in which extracted information will be systematically organised into emerging themes and subthemes. This inductive process will involve identifying patterns, recurring concepts, and key insights across the included studies. The thematic synthesis will provide a structured overview of how anatomical competency is conceptualised and applied in clinical dental education, without imposing a priori frameworks, in keeping with the exploratory nature of a scoping review.

CONCLUSION

This review will offer a comprehensive synthesis of how anatomy competencies in dental education contribute to clinical skill development. The findings will inform curriculum developers and educators by bridging theoretical instruction with practical application.

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ETHICAL APPROVAL

This study involves a scoping review of existing literature and does not include human participants, data collection, or intervention. However, as part of institutional research governance, this protocol has been submitted to the institutional Research and Ethics Committee for review and approval prior to commencement. The findings of this review will be disseminated through peer-reviewed publications and academic conferences related to anatomy and dental education.

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