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Research on Teaching Reform and Practice of Systemic Anatomy Based on Clinical Thinking-Oriented Approach

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Abstract: Systemic anatomy is the cornerstone of modern medical education. Guided by the cultivation of clinical thinking, this paper expounds the practical dilemmas faced by current systemic anatomy teaching from the dimensions of teaching content, methods, resources and evaluation. It further proposes strategies including constructing a "dual-drive & four-dimensional" teaching model, implementing a "dual-teacher linkage" integration mechanism, innovating teaching methods with cutting-edge technologies, and establishing a formative evaluation system. This study aims to build a clinical thinking-oriented teaching reform paradigm for systemic anatomy and provide a referential solution for cultivating interdisciplinary medical talents with solid theoretical foundations and early clinical competence.

Keywords: Systemic anatomy; Clinical thinking; Teaching reform; Integration of basic and clinical medicine; Medical education

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1. Introduction

Under the traditional teaching mode, systemic anatomy teaching focuses on mechanical memorization and one-way instillation of morphological structures, resulting in problems such as "compressed class hours, complex content, tedious memorization, and disconnection between learning and application". Although students can memorize relevant knowledge firmly, they fail to establish an organic connection among "structure–function–disease," leading to the lagging development of clinical thinking. Against the background of new medical science construction, universities should adhere to the clinical thinking-oriented principle and organically integrate clinical thinking into the whole teaching process, so as to lay a solid foundation for students' sustainable development.

2. Practical dilemmas in systemic anatomy teaching

2.1. Single traditional teaching mode, difficulty in stimulating learning motivation and clinical thinking

Traditional systemic anatomy teaching is teacher-centered, leaving students in passive listening and memorization with unsatisfactory effects. The "lecture–memorize–examination" closed loop ignores the cultivation of critical thinking and decision-making ability in complex scenarios, dampening learning interest and causing a gap between knowledge and application.

On the one hand, systemic anatomy involves complex human morphological structures, which are difficult to understand and easily cause learning anxiety [1]. On the other hand, teachers follow a linear "structure-first" logic without reverse deduction of anatomical mechanisms from clinical symptoms, slowing the development of clinical thinking. For example, in teaching the spinal cord, instructors usually focus only on external morphology and internal nuclei without analyzing clinical manifestations such as paraplegia and sensory disturbance caused by acute myelitis, leaving knowledge isolated from application [2].

2.2. Barriers between basic teaching and clinical practice, fragmented knowledge

Systemic anatomy is usually taught by basic medical teachers, while subsequent clinical courses are delivered by clinicians, creating separation in faculty and content.

First, teaching content is disconnected from clinical practice. Basic teachers lack familiarity with cutting-edge clinical techniques such as Deep Brain Stimulation (DBS) in neurosurgery and cannot fully explain the clinical value of anatomical knowledge. Second, the knowledge system is fragmented. Courses are divided into modules (locomotor system, splanchnology, nervous system, etc.) that are isolated from each other, failing to foster a holistic view [3]. For instance, when teaching the hepatic portal structure, teachers rarely link it to clinical symptoms of liver cirrhosis, such as portal hypertension and esophagogastric variceal bleeding, preventing students from forming a systematic clinical thinking chain.

2.3. Limited teaching resources and methods, unable to meet personalized and in-depth inquiry needs

Current teaching faces resource and methodological bottlenecks:

(1) Scarcity of physical specimens. Expanded enrollment has worsened shortages of human anatomical specimens, reducing hands-on practice time and quality.

(2) Disconnection between virtual and real teaching. Virtual dissection tables and 3D modeling provide simulation opportunities but lack alignment with clinical practice, failing to form a "specimen–virtual–specimen" enhancement loop.

(3) Superficial teaching methods. Case-based learning and group discussions are often formulaic, with outdated cases, weak integration with theory, and an inability to support in-depth exploration or personalized tutoring [4].

2.4. Overemphasis on summative assessment, neglect of formative competency development

The existing evaluation system has obvious defects. Most teachers rely on final written exams to test memorization, which cannot measure clinical thinking, practical skills, or problem-solving ability [5]. Although some use formative assessment (in-class questions, lab reports, group projects), feedback is often delayed and

inaccurate, weakening the "assessment for learning" function. This orientation encourages cramming and hinders the cultivation of lifelong learning awareness and clinical competence.

3. Reform and practice strategies for clinical thinking-oriented systemic anatomy teaching

3.1. Reshape teaching objectives and content, build a "theory–practice–clinical" closed-loop model

The core of reform is to restructure the system and embed clinical thinking into the main line:

(1) Upgrade teaching objectives. Shift from "mastering morphology" to "solving clinical problems with anatomical knowledge" and establish four-dimensional goals: knowledge, ability, thinking, and humanistic values.

(2) Reconstruct teaching content. Organize content by human organ systems, break traditional module boundaries, and adopt a "clinical problem-driven anatomical knowledge" design to link anatomy with diagnosis and treatment. For example, in the central nervous system, use "localization diagnosis in stroke patients" as the core question to help students understand cortical function, internal capsule structure, cerebrovascular distribution, and clinical manifestations [6].

(3) Innovate the teaching model. Teachers should establish a "dual-drive four-dimensional" teaching model. The "dual-drive" refers to the utilization of both internal and external dual driving forces. The internal driving force includes students' interests, self-planning, learning traits, etc., which are the endogenous motivations; the external driving force includes teacher guidance, school-enterprise cooperation, skill competitions, and industry demands. The "four dimensions" refer to the four types of teaching activities: course teaching, project training, competition practice, and practical activities. On this basis, teachers also need to construct a three-stage teaching loop of "anatomical lecture - case analysis - practical verification", dividing the course design into four steps: "theoretical introduction, knowledge exploration, practical verification, and clinical connection" [7].

3.2. Deepen basic-clinical integration, forge a "dual-teacher linkage" interdisciplinary community

To strengthen clinical relevance, universities must break faculty barriers:

(1) Establish a regular "dual-teacher co-teaching" mechanism. Basic teachers explain anatomical theories; clinicians present real cases, demonstrate procedures (e.g., lumbar puncture), and interpret imaging findings [8].

(2) Launch interdisciplinary collective lesson preparation. Promote collaboration between anatomy departments and clinical divisions to co-develop case and imaging databases linked to frontline practice. For example, design teaching cases for the brainstem using Parkinson's disease DBS therapy [9].

(3) Open clinical resources for teaching. Integrate surgical videos and typical cases into teaching materials to expose students early to real medical scenarios [10].

3.3. Innovate teaching methods and resources, promote virtual-real integration and personalized learning

(1) Deepen virtual-real integrated teaching. Create a path: "physical specimens → virtual simulation →

hands-on operation". Use 3D virtual systems for risk-free repeated observation, then return to specimens for spatial verification and surgical approach simulation [11].

(2) Popularize student-centered methods. Widely apply project-based learning, case-based learning, paired classrooms, and flipped classrooms to support independent expression and cooperative inquiry, helping students internalize clinical cases [12].

(3) Build an intelligent personalized resource system. Use AI and online platforms to develop high-quality resource libraries and big-data student profiles for pre-class tests, targeted resource push, micro-lectures, and personalized practice, realizing precision teaching [13].

3.4. Reconstruct a diversified evaluation system, focus on developmental assessment of clinical thinking

(1) Strengthen formative assessment. Include case analysis, practical operation, SP interview performance, group reports, and online learning data in regular grades [14].

(2) Reform summative exams. Reduce memorization questions and increase comprehensive case analysis, imaging reading, and simulated diagnosis tasks [15].

(3) Establish learning portfolios to record progress, achievements, and clinical thinking development.

4. Conclusion

Guided by clinical thinking, systemic anatomy teaching should transform from "knowledge-based" to "thinking-based" education. By analyzing current dilemmas and carrying out top-level design, mechanism innovation, technological upgrading, and evaluation reform, universities can solve problems in faculty collaboration, resource allocation, and evaluation inertia, laying a solid thinking foundation for students' clinical learning and lifelong professional development.

Disclosure statement

The authors declare no conflict of interest.

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