Exploration on an OBE-based Pathway for Integrating Clinical and Research Training in Orthopaedic Professional Degree Postgraduate Education

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Abstract: Orthopaedic professional degree postgraduate education combines clinical practice, subspecialty training, and the translation of clinical questions into research. As trauma, joint surgery, spine surgery, sports medicine, orthopaedic oncology, and other subspecialties continue to develop, trainees must do more than master the standard diagnosis and treatment of common conditions. They also need to build subspecialty-specific abilities in clinical reasoning, imaging interpretation, surgical planning, research and innovation, communication, and collaboration. Outcome-based education (OBE) is an educational approach that defines the abilities expected at the end of training before teaching activities and assessment are arranged. Using this principle, the article proposes a pathway that links clinical questions with literature review, study design, data analysis, and the return of relevant findings to clinical practice and teaching. The competency framework, teaching activities, research training, and assessment needed to support this pathway are discussed.

Keywords: outcome-based education; orthopaedics; professional degree postgraduate education; clinical–research integration; training pathway

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Introduction

In China, postgraduate medical education includes both academic and professional degree pathways. The professional degree pathway is closely connected with standardised residency training and places particular emphasis on clinical practice, professional competence, and the management of diagnostic and therapeutic problems encountered in patient care[1]. With continuing reform in medical education, the focus of professional degree training has also evolved. Knowledge acquisition and completion of clinical rotations remain important, but increasing attention is now given to competency attainment, process management, and quality evaluation.

Orthopaedics comprises several subspecialties, including trauma, joint surgery, spine surgery, sports medicine, and orthopaedic oncology. Each has its own disease spectrum, imaging requirements, surgical techniques, perioperative considerations, and approaches to rehabilitation and follow-up[2]. Professional degree postgraduate trainees must first acquire a sound understanding of basic orthopaedic theory and the standard diagnosis and treatment of common conditions. As they move through subspecialty rotations, they are also expected to strengthen their abilities in imaging analysis, clinical reasoning, surgical planning, research and innovation, communication, and collaboration[3].

Clinical rotations, supervisor-led teaching, case presentations, and observation in the operating room remain central to orthopaedic professional degree postgraduate training. Together, they provide the clinical settings in which trainees acquire practical experience. At the same time, the growing demands of subspecialty training call for clearer objectives, more systematic organisation, closer links between clinical work and research, and greater attention to assessment throughout the training process[4, 5].

Outcome-based education (OBE) is an educational approach in which the intended learning outcomes are defined first, and teaching content, learning activities, and assessment are subsequently aligned with those outcomes[6]. Applied to orthopaedic professional degree postgraduate education, this approach may encourage trainees and supervisors to focus not only on completing training tasks but also on whether the intended competencies have been achieved[2, 7-9].

1 Rationale for Clinical–Research Integration

Orthopaedic professional degree training is grounded in clinical practice, but the demands of individual subspecialties differ. During rotations, trainees need to move from general orthopaedic knowledge towards the clinical reasoning and technical judgement required in the field they are learning. Completion of rotations, management of assigned cases, and participation in research tasks do not by themselves demonstrate competency. The expected competencies therefore need to be defined explicitly and linked to the subsequent design of training activities and assessment.

Clinical competence develops through exposure to real cases and surgical practice, yet trainees do not always encounter the same number or complexity of cases during their rotations. Their learning opportunities may therefore differ across subspecialties and training stages. Supplementary educational resources are needed to reduce these differences and to maintain continuity when direct clinical exposure is limited.

Orthopaedic practice regularly raises questions about treatment outcomes, imaging findings, complications, fixation, bone quality, and rehabilitation. Embedding research training in clinical rotations gives trainees a structured way to examine these problems rather than treating research as a separate requirement. Evidence obtained from such work can then be used to reconsider patient care and teaching.

2 Competency Framework

Within an OBE framework, training objectives are expressed as the competencies that trainees should attain. For orthopaedic professional degree postgraduate education, these competencies cover six areas: clinical diagnosis and management, imaging interpretation, surgical planning, clinical–research translation, communication and collaboration, and continuous improvement. Expected outcomes, learning activities, and assessment criteria should be defined for each area. This allows supervisors and postgraduate trainees to identify the main priorities at different stages of training[7].

Table 1 Competency Framework for Orthopaedic Professional Degree Postgraduate Education Under the OBE Approach

Competency domain	Specific training objective	Major training activities	Expected learning outcomes
Clinical diagnosis and management	Understand the standard approaches used to diagnose and manage common orthopaedic conditions.	Outpatient shadowing, ward-based case management, case presentation, and preoperative discussion.	Able to reach a preliminary diagnosis, consider relevant differential diagnoses, and compare available treatment options for common orthopaedic conditions.
Imaging interpretation	Become familiar with the basic interpretation of commonly used orthopaedic imaging examinations.	Image-reading exercises, discussion of representative cases, and imaging parameter measurement.	Able to recognise the main imaging features of common orthopaedic conditions and relate them to the patient's history and physical examination.
Surgical planning	Understand how surgical indications, operative approaches, fixation or reconstruction strategies, and potential risks are considered during planning.	Preoperative discussion, surgical observation, and postoperative review of surgical videos.	Able to contribute to an initial surgical plan and identify the risks that require particular attention.
Clinical–research translation	Recognise questions arising in clinical care and refine suitable questions into research topics.	Literature searching, development of a study plan, data organisation and analysis, and preparation of research outputs	Able to prepare a basic study plan for a real clinical problem and present the work as a case report, conference abstract, manuscript, or teaching case, as appropriate.
Communication and collaboration	Strengthen physician–patient communication, teamwork, and humanistic competence in medical practice.	Communication training, multidisciplinary discussion, and ethics education.	Able to communicate appropriately in clinical practice, respect patient rights, and collaborate effectively with team members.
Continuous improvement	Develop reflective learning and self-directed improvement	Staged feedback, learning portfolios, mentor meetings, and case review.	Able to use feedback to revise learning plans and address areas that require further development in clinical and research training.

The use of OBE does not require established forms of supervisor-led teaching or clinical rotation to be replaced. These remain essential parts of orthopaedic training. OBE instead provides a clearer link between the objectives set at the beginning of training, the activities undertaken during each stage, and the evidence used in assessment. Supervisors and postgraduate trainees can therefore see more clearly what should be achieved and where further improvement is needed.

3 OBE-Based Training Pathway

3.1 Case-Based Training for Clinical Reasoning

Orthopaedic subspecialties involve diverse case types and complex clinical decisions, making case-based teaching particularly suitable for orthopaedic training. Training institutions may establish representative case repositories covering trauma, joint surgery, spine surgery, sports medicine, and orthopaedic oncology. Each case may include medical history, physical examination findings, imaging data, the basis for diagnosis, treatment plans, operative records, postoperative follow-up, and discussion questions[10].

A case discussion should not end with a description of the disease. Trainees should also explain how the diagnosis was reached, what alternative diagnoses were considered, why a particular treatment was selected, whether the surgical indications were appropriate, and how perioperative management and prognosis were assessed. The educator can then select one or more unresolved issues from the case as learning tasks. Trainees examine the case information, consult relevant literature, and discuss their conclusions with the group. In this way, clinical reasoning becomes the starting point for developing awareness of research questions.

3.2 Subspecialty Skills Training Through Imaging Interpretation and Surgical Video Review

During subspecialty rotations, trainees need repeated practice in reading images and planning surgery. The imaging examinations used, the questions addressed during preoperative planning, and the risks that require attention are not the same across all areas of orthopaedics. Training should therefore help trainees connect what they see on an image with the decision that follows, rather than treating image interpretation as an isolated exercise.

An imaging database can be arranged by subspecialty and by learning objective. Cases selected from the database should allow trainees to compare imaging findings with the diagnosis, treatment choice, and risk assessment. Surgical videos provide a second source of structured learning. Representative procedures can be marked to show the preoperative imaging, operative approach, key steps, points of risk, and issues identified during postoperative review. Trainees can study the case before surgery, observe the procedure, and return to the video afterwards to compare the original plan with what occurred in the operating room[11]. Repetition of this sequence helps them develop a more organised approach to surgical planning.

3.3 Clinical Question-Driven Research Training

Research training in a professional degree programme should begin with problems encountered in clinical care. Participation in a project or completion of a manuscript is only one part of that training. Trainees also need to learn how to recognise a worthwhile question, examine clinical data, and use the findings to reconsider diagnosis and treatment. In orthopaedics, such questions may involve differences between treatment methods, the relationship between imaging parameters and functional outcomes, perioperative complications, internal fixation failure, rehabilitation and functional recovery, or the use of artificial intelligence in diagnosis and treatment.

Questions often arise during outpatient consultations, ward work, surgery, or follow-up. Trainees can record them in a clinical question list and discuss them with their supervisors. Literature searching then helps determine what is already known, where uncertainty remains, and whether a question can be developed into a feasible study topic[4, 12].

Once a topic has been selected, the trainee reviews the evidence in greater depth and formulates a research hypothesis with supervisory guidance. The next steps include choosing a suitable design, organising the data, completing the statistical analysis, and interpreting the results in their clinical context[5]. The work may eventually be presented as a case report, conference abstract, teaching case, review, or clinical research article. Cases and findings with educational value can also be brought back into the case repository, preoperative discussion, or teaching round.

Research training is therefore linked directly to the clinical learning process. It helps trainees examine clinical problems more carefully, improve their diagnostic and treatment reasoning, and communicate their observations and conclusions in an academic form.

3.4 Competency Development Through Formative Assessment

OBE focuses on whether the intended learning outcomes have been achieved; assessment should therefore run throughout the training process. Evaluation of orthopaedic professional degree postgraduate trainees should not rely only on end-of-rotation examinations, dissertation evaluation, or the final defence. Process-based performance in case analysis, imaging interpretation, surgical planning, research progress, and professional conduct should also be included[8, 13].

Assessment may incorporate feedback from individual supervisors, supervisory teams, peers, members of the clinical team, and trainees' self-assessments. Methods may include case-presentation scoring, imaging interpretation assessments, surgical video analysis, research progress presentations, and annual reviews of competency attainment. Individual learning portfolios may also be established to record case-based learning, imaging training, research progress, and feedback received at different stages[14]. The assessment record can then be used to revise the trainee's priorities and learning activities during the next stage of training[9].

4. Supporting Mechanisms for Implementation

4.1 Development of Standardised Educational Resources and Case-Based Learning Systems

The proposed pathway requires shared educational resources because trainees may encounter different cases and procedures during clinical rotations. Institutions can develop case repositories, imaging databases, surgical video libraries, and research case collections that reflect their subspecialty strengths.

To support consistent use, these materials should be organised by subspecialty, disease category, imaging modality, and learning objective. Case records may link clinical history, examination findings, imaging, treatment planning, operative information, and follow-up, while videos can highlight key operative steps and risk points. Research cases can illustrate how a question from practice is developed into a study. The resources should be reviewed regularly and updated when clinical practice or teaching needs change. Patient privacy, data de-identification, and institutional requirements for ethical data use must be addressed whenever clinical materials are used for teaching[15].

Table 2 Pathway for Integrating Clinical and Research Training in Orthopaedic Professional Degree Postgraduate Education Under the OBE Approach

Training component	Main content	Implementation approach	Competency focus
Goal setting	Define the core competencies expected at graduation	Develop competency lists, staged objectives, and assessment criteria	Professional competence
Clinical training	Develop competence in history taking, physical examination, case interpretation, and treatment decision-making.	Participation in outpatient care, ward management, preoperative planning, and discussion of complex cases	Clinical diagnosis and management
Imaging training	Relate imaging findings to diagnosis, treatment selection, and risk assessment.	Joint review of radiographs, CT, and MRI, together with practice in measuring relevant imaging parameters	Imaging interpretation
Surgical training	Learn how preoperative plans are developed and how key operative steps and risks are assessed.	Observation in the operating room, review of surgical videos, and discussion of complication cases	Surgical planning
Research training	Develop selected clinical questions into feasible research topics	Clinical question lists, literature searching, study planning, data analysis, and preparation of research outputs	Clinical–research translation
Application of research findings	Bring relevant research findings back into clinical discussion and teaching.	Updating case repositories, preparing teaching cases, revisiting questions during preoperative discussions, and producing manuscripts or conference abstracts	Clinical reasoning and continuous improvement
Assessment and feedback	Establish a longitudinal, multi-source assessment system	Supervisor evaluation, trainee self-assessment, case presentation scoring, and research progress assessment	Continuous improvement

4.2 Establishment of a Collaborative Supervisory Mechanism

Orthopaedic professional degree training involves both clinical and research-related tasks, ranging from diagnostic reasoning and surgical planning to imaging interpretation, statistics, ethics, rehabilitation, and academic writing. These areas do not always require the same type of guidance. We therefore propose that the primary supervisor work with teachers who can provide additional support in specific areas when needed[4, 16].

The group can include an orthopaedic clinical supervisor, a research supervisor, imaging and statistics teachers, and rehabilitation specialists. Clinical supervisors lead diagnostic reasoning and surgical planning, while research supervisors guide study design, project implementation, and manuscript preparation. Imaging and statistics teachers assist with image interpretation, parameter measurement, research methods, and data analysis. Senior postgraduate trainees may also help junior trainees organise cases, search the literature, and begin research work.

The primary supervisor remains central to the process. The wider group provides additional guidance when needed and helps maintain continuity between clinical training and research activity.

4.3 Assessment, Feedback, and Continuous Improvement Mechanisms

While formative assessment tracks the progress of individual trainees, programme evaluation should examine whether the training pathway itself is functioning as intended. Institutions can review competency attainment across trainees together with supervisor feedback, trainee comments, and the use of teaching resources. Publications and end-of-rotation examinations remain relevant, but they represent only part of the available evidence. Case presentations, imaging interpretation, surgical planning, research progress, physician–patient communication, and professional conduct should also be considered[7, 13].

When a particular competency remains weak across a group of trainees, the cause may lie in limited resources, uneven case exposure, insufficient guidance, or unclear assessment criteria. The relevant part of the training plan can then be revised. In this way, assessment is used not only to judge trainees but also to improve the programme itself.

5. Conclusion

OBE provides a way to make the expected outcomes of orthopaedic professional degree training explicit and to connect them with everyday teaching and assessment. The pathway described in this article brings together case-based learning, imaging and surgical review, clinical question-driven research, and formative assessment. Its central aim is to allow clinical work to generate research questions and to bring relevant findings back into patient care and teaching.

This pathway is designed to strengthen rather than replace experience-based clinical teaching. Future development may include artificial intelligence-assisted imaging education, virtual surgical simulation, and digital systems for managing teaching cases.

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