

ENHANCING SURFACE MARKING COMPETENCE USING HORIZONTALLY ALIGNED PRACTICAL TEACHING IN PHASE 1 MBBS STUDENTS: A CROSSOVER STUDY

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ABSTRACT

Background: Surface marking is an essential clinical skill for accurate palpation and interpretation of medical images. However, undergraduate medical students often demonstrate poor competence in surface anatomy. Many innovative teaching strategies require additional instructional time, limiting their routine implementation in an already crowded curriculum. Horizontally aligned teaching that integrates disciplines within existing practical sessions may provide a feasible alternative. The objective is to evaluate the effectiveness of horizontally aligned Anatomy–Physiology practical teaching in improving surface marking competence among Phase 1 MBBS students and to explore student perceptions. **Materials and Methods:** This crossover study was conducted during routine Anatomy and Physiology practical sessions. The intervention included surface anatomy of the head and neck and lower limb. Anatomy surface marking was integrated with relevant Physiology components—palpation of peripheral arterial pulses for the lower limb, and palpation of the common carotid artery, superficial temporal artery, and assessment of jugular venous pulse for head and neck. Group A received aligned teaching for head and neck topics and conventional teaching for the lower limb, while Group B received aligned teaching for the lower limb and conventional teaching for head and neck topics. Baseline competence was assessed before the intervention using a structured checklist evaluating anatomy surface marking and related physiology practical skills. The same checklist was used for post-intervention and crossover assessments. **Result:** One hundred and fifty students participated. Pre–post data were available for 107 students, while crossover and paired analyses included up to 130 students. Baseline competence was low (median score 3.0; IQR 1.0–5.0). Post-intervention scores improved significantly (median 8.0; IQR 6.5–9.5; $p < 0.001$). Aligned teaching produced significantly higher scores than conventional methods during both crossover phases ($p < 0.001$). **Conclusion:** Horizontally aligned Anatomy–Physiology practical teaching significantly improves surface marking competence and supports integrated learning without increasing curricular burden. **Conclusion:** Surface Marking should not be viewed merely as an optional or supplementary component of the curriculum. Instead, it is a fundamental clinical skill and

essential tool that significantly enhances the diagnostic and procedural accuracy of a medical professional. Surface marking should be considered a fundamental clinical skill rather than a supplementary component. Horizontally aligned Anatomy–Physiology practical teaching significantly improves surface marking competence and supports integrated learning without increasing curricular burden.

INTRODUCTION

Surface anatomy helps medical students connect basic anatomical knowledge with its clinical application. Surface marking is the process of identifying underlying anatomical structures using external body landmarks. It is an important skill for physical examination, interpretation of radiological images, and performing clinical procedures safely. Learning surface marking helps students apply their theoretical knowledge of anatomy in clinical settings and develop clinical reasoning skills early in their training.^[1-4]

Accurate knowledge of surface landmarks is essential for many routine clinical tasks, such as palpating arterial pulses, assessing jugular venous pressure, locating organs, and planning diagnostic or therapeutic procedures. With the increasing use of imaging techniques such as ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI), a good understanding of surface anatomy has become even more important. Early training in these skills promotes better integration of anatomical knowledge with clinical practice.^[1,3,6-8]

The Competency-Based Medical Education (CBME) curriculum introduced by the National Medical Commission (NMC) emphasizes integrated learning, early clinical exposure, and the development of clinically relevant competencies. Horizontal integration, which links related subjects taught during the same phase of training, is one effective method of achieving these goals. Integrating Anatomy and Physiology helps students understand not only the location of structures but also their functions, leading to better understanding and retention of knowledge.^[9-11]

Several teaching methods, such as team-based learning, simulation, peer-assisted learning, and technology-enhanced teaching, have been shown to improve anatomy learning. However, these methods often require additional time, resources, and infrastructure, making them difficult to implement regularly within the existing curriculum.^[7,8,11,12]

A practical alternative is to integrate Anatomy and Physiology teaching within regular practical sessions without adding extra teaching hours. In this approach, surface marking is taught alongside relevant physiology examination skills. For example, surface marking of the head and neck can be combined with palpation of the carotid and superficial temporal arteries and assessment of the jugular venous pulse, while lower limb surface anatomy can be linked with palpation of peripheral pulses. This integrated approach may improve understanding, retention, and clinical application of knowledge.^[2,4,7,8,10]

However, evidence on the effectiveness of this simple and curriculum-neutral model of horizontal integration is limited, particularly among Phase I MBBS students in India. Therefore, the present study was undertaken to evaluate the effectiveness of integrated Anatomy–Physiology practical teaching in improving surface marking skills among Phase I MBBS students and to assess students' perceptions of this teaching approach.

Objectives: To evaluate the effectiveness of horizontally aligned Anatomy–Physiology practical teaching in improving surface marking competence among Phase 1 MBBS students and to explore student perceptions.

MATERIALS AND METHODS

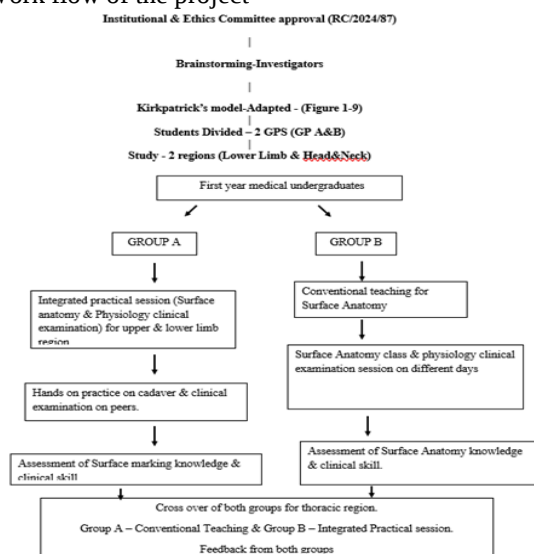
Study Design and Setting: This educational interventional study employed a crossover design and was conducted among Phase I MBBS students during regularly scheduled Anatomy and Physiology practical sessions. The intervention focused on two anatomical regions commonly taught during the first phase of the MBBS curriculum: 1. Head and Neck 2. Lower Limb. For each region, Anatomy surface marking was integrated with clinically relevant Physiology practical skills to provide functional and clinical context to the anatomical structures being studied. The integrated teaching approach combined Anatomy surface marking exercises with relevant Physiology examination skills. For the head and neck region, students were taught surface marking of important anatomical structures along with palpation of the common carotid artery, superficial temporal artery, and assessment of the jugular venous pulse (JVP). For the lower limb region, surface marking was integrated with palpation of clinically important peripheral arterial pulses. The sessions were conducted jointly in a coordinated manner so that students could immediately relate anatomical landmarks to their physiological and clinical significance. Participants were divided into two groups:

- Group A received integrated (aligned) Anatomy–Physiology teaching for the head and neck region and conventional Anatomy teaching for the lower limb region.
- Group B received integrated (aligned) Anatomy–Physiology teaching for the lower limb region and conventional Anatomy teaching for the head and neck region.

Following completion of the first phase of teaching and assessment, the groups crossed over, allowing all students to experience both integrated and conventional teaching approaches for different

anatomical regions. Students' baseline competence was assessed before the intervention using a structured assessment checklist. The checklist evaluated both Anatomy surface marking skills and the corresponding Physiology practical skills relevant to each anatomical region. The same checklist was administered immediately after the intervention to assess learning outcomes. During the crossover phase, identical assessment methods were used to evaluate student performance and allow comparison between integrated and conventional teaching approaches. The primary outcome measure was improvement in students' competence scores in surface anatomy and associated physiology examination skills following the integrated teaching intervention. Secondary outcomes included comparison of performance between integrated and conventional teaching methods and evaluation of learning gains following crossover exposure. At the end of the study, students' perceptions regarding the integrated teaching approach were collected using a structured feedback questionnaire. The questionnaire assessed students' views on understanding of concepts, clinical relevance, engagement, knowledge retention, and overall satisfaction with the integrated learning experience.

Work flow of the project



RESULTS

One hundred and fifty students participated. Pre-post data were available for 107 students, while crossover and paired analyses included up to 130 students. Baseline competence was low (median score 3.0; IQR 1.0–5.0). Post-intervention scores improved significantly (median 8.0; IQR 6.5–9.5; $p < 0.001$). Aligned teaching produced significantly higher scores than conventional methods during both crossover phases ($p < 0.001$).

Thematic Analysis: Students' Feedback Horizontally Aligned Surface Marking Teaching (Phase I MBBS) (Qualitative):

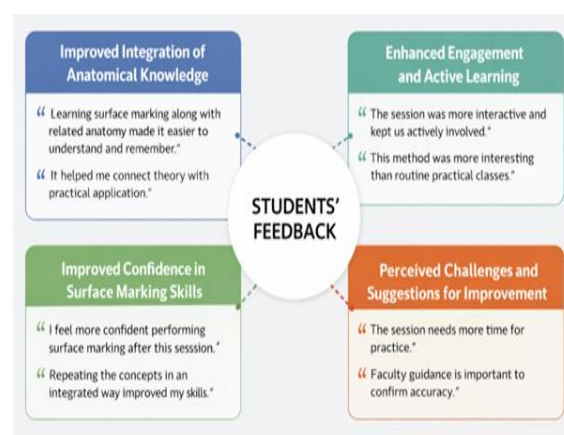


Table 1: Descriptive statistics of Pre & Post -test score (Quantitative)

Number of participants analyzed	Pre-test score	Post-test score	Wilcoxon Signed Ranks Test
107	Median = 3.0 (IQR: 1.0–5.0)	Median = 8.0 (IQR: 6.5–9.5)	Z = -8.46, $p < 0.001$

DISCUSSION

Table 2

Supporting Literature	Key Findings
Arraez-Aybar LA et al., 2010	Experiential learning - Enhances long-term memory retention
Susan Standring., 2012	Fosters clinical relevance and integration
Abu Bakar et al., 2021	Promotes student confidence in SM
Abu Bakar et al., 2022	Evidence-based, work-based learning is needed
Dim E et al.,2022	Surface marking is key to diagnosis
Asad MR et al., said in 2015 &2023	Helps - Links basic to clinical training

Present Study	Promotes, Confidence, Interepretation, Long term memory, Stimulates cognitive, psychomotor & affective domains
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Our study highlights the importance of integration in medical education. By aligning Anatomy and Physiology, students are able to correlate structure with function more effectively. This not only improves conceptual clarity but also strengthens clinical reasoning skills. Our findings are consistent with previous studies that emphasize the benefits of integrated and active learning strategies in medical education.

CONCLUSION

Surface Marking should not be viewed merely as an optional or supplementary component of the curriculum. Instead, it is a fundamental clinical skill and essential tool that significantly enhances the diagnostic and procedural accuracy of a medical professional. Surface marking should be considered a fundamental clinical skill rather than a supplementary component. Horizontally aligned Anatomy–Physiology practical teaching significantly improves surface marking competence and supports integrated learning without increasing curricular burden.

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