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Original Article

Comparison of AI Software Based Digital Anatomy Learning and Cadaveric Prosection Among Phase I MBBS Students

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ABSTRACT

Background: Anatomy teaching has traditionally relied on cadaveric dissection and prosection,which are considered the gold standard for understanding three dimensional human structure. Advances in artificial intelligence(AI) have introduced digital anatomy applications offering interactive and learner centred experiences.
Objective: To compare the effectiveness of cadaveric prosection and digital learning AI software"Complete Anatomy" based virtual simulations.
Methodology: A comparative cross-sectional study was conducted among undergraduate medical students. 100 participants (MBBS Phase I students) were divided into two groups: Group A(cadaveric prosection) and Group B(AI digital anatomy app based learning). Knowledge was assessed using structured tests, and learner perception was evaluated using a Likert-scale questionnaire.
Results: Cadaveric prosection was superior for spatial orientation and appreciation of anatomical variation, while the AI digital anatomy app enhanced visualization, engagement, and ease of revision. Overall knowledge scores were comparable between groups.
Conclusion: Cadaveric prosection and AI digitalan atomy application are complementary modalities. A blended approach may provide optimal learning outcomes in contemporary medical education.

Keywords*: Anatomy education, Cadaveric prosection, Artificial intelligence, Digital anatomy, medical education.*

INTRODUCTION

Cadaveric dissection has been considered the gold standard however with advancements intechnology AI softwares and virtual simulations have become widely used. However advances in 3D anatomy platforms, virtual reality, augmented reality and AI driven chatbot tools have created realistic, repeatable and scalable supplements or alternatives to traditional cadaveric dissection and prosection.Digital solutions can reduce dependence on cadaver supply, increase scalability and support remote education. Anatomy is a foundational discipline in medical education, forming the structural basis for clinical reasoning and procedural competence. Cadaveric dissection and prosection have long been regarded as the cornerstone of anatomy teaching due to their ability to demonstrate real human anatomy, normal variations, and spatial relationships. [1,2] Exposure to cadavers also contributes to professional identity formation, ethical sensitivity, and respect for the human body.[3]

However,cadaver based teaching faces challenges such as high costs, limited availability of specimens, time constraints, and emotional stress among learners.[4] In response,digital anatomy tools incorporating three-dimensional visualization and artificial intelligence have gained prominence, particularly during the COVID-19 pandemic when access to dissection halls was restricted.[5]

Despite increasing adoption of digital platforms, there is ongoing debate regarding their adequacy as replacements for

cadaveric learning. This study aims to compare cadaveric prosection and an AI-based digital anatomy application to evaluate their effectiveness in undergraduate medical education.

Research Question:
Does AI software-based digital anatomy learning achieve comparable or superior learning outcomes than cadaveric prosection in spatial understanding, knowledge and practical skills after an equivalent period of instructive teaching?

Research Hypothesis:
AI software- based digital anatomy is more effective in achieving anatomy learning outcomes in terms of 3D spatial understanding, knowledge and Practical skills.

Review of Literature:
Large surveys show strong student acceptance of digital tools for flexibility and repeat practice; nonetheless, many students and educators consider cadaveric dissection important for realism and professional formation. Preferences vary by cohort and prior exposure. Evidence is mixed. Some longitudinal or follow-up studies report similar retention between groups; others show better retention when digital tools are used as adjuncts rather than replacements. High quality RCTs with extended follow-ups are limited. Multiple controlled studies and trials show no inferiority of digital modalities for factual anatomy tests and superiority for spatial tasks. Multiple studies have emphasized the educational value of cadaveric anatomy in developing deep anatomical understanding and clinical correlation.[1,6]Cadaver-based learning has also been shown to foster empathy, professionalism, and ethical awareness among medical students.[3,7]

Conversely, digital anatomy platforms provide interactive 3D models, layered visualization, and the ability to repeat learning at one's own pace. Research suggests that students using digital anatomy tools demonstrate learning outcomes comparable to those achieved through traditional methods, particularly for short-term knowledge retention.[8,9] Learner satisfaction and engagement are often reported to be higher with digital tools due to their accessibility and user-friendly interfaces.[10]

Several authors advocate a blended or hybrid approach, combining cadaveric and digital methods to leverage the strengths of both modalities.[6,11] However, evidence from the Indian medical education context remains limited, necessitating further comparative studies.

Research Gap: Rigorous trials comparing AI based adaptive Virtual Reality(VR) teaching with cadaveric prosection for longt erm retention and clinical skill transfers are limited. Development and evaluation of high fidelity haptics and standardized outcome instruments will clarify when software can fully substitute cadaveric learning. Cost-benefit analyses comparing long term program outcomes are necessary.

AIM & OBJECTIVE
To compare the effectiveness of cadaveric prosection and digital learning AI software"Complete Anatomy" based virtual simulations.

METHODOLOGY
Study Setting was Anatomy department (Digital Lab Demonstration hall) of Palakkad institute of medical sciences.

Inclusion criteria:
Students with no prior exposure to formal anatomy courses.

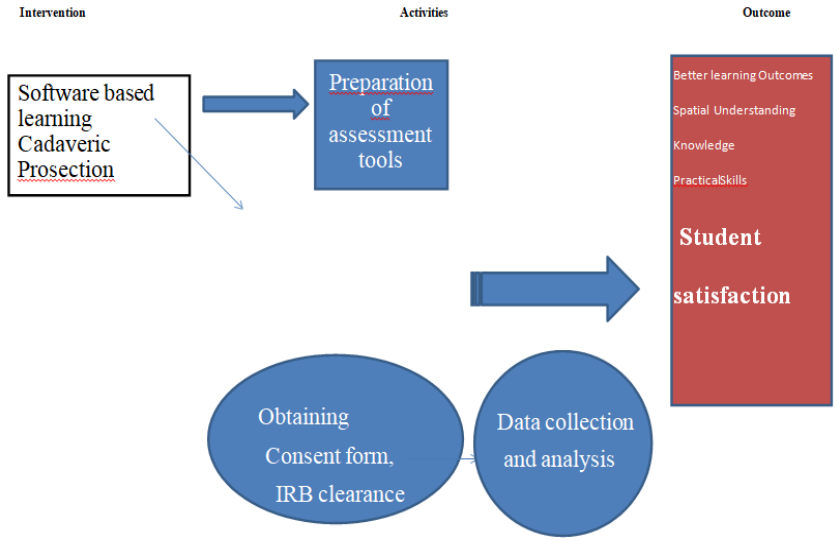
Exclusion criteria:
Students with prior advanced anatomy training or reluctance to participate in dissection.

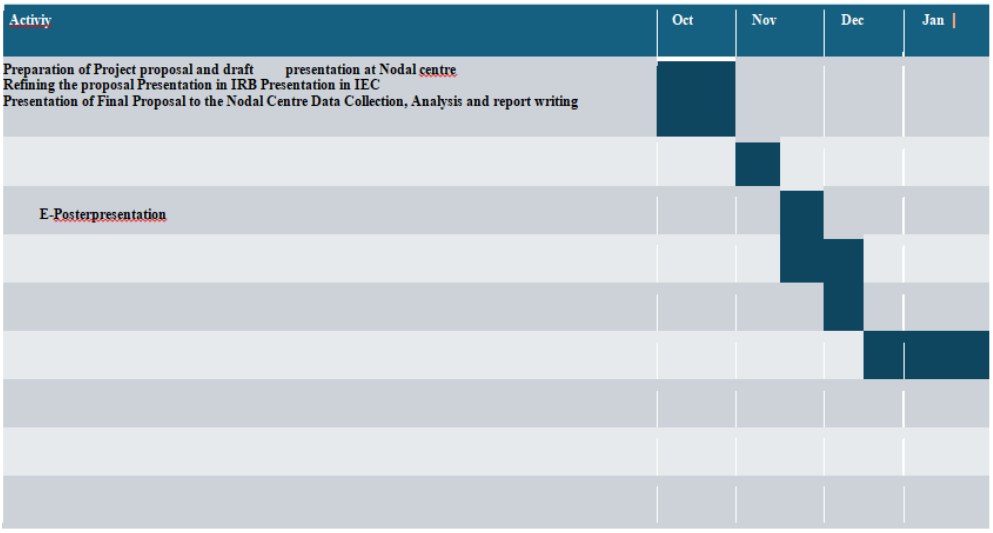
Study design was Quasi experimental cross over design (Comparative interventional study design)
Study subjects were 100 Phase I MBBS students of Palakkad Institute of Medical Sciences with 100 sample size (n=100)

Two groups A and B were identified with 50 each for comparative interventional cross over study.
Cadaveric Prosection for Group A and AI software for Group B with 6 exposures (interventions with cross over) Study Tools included were OSPE, Pre/Post test MCQs,Lab Mannequin

Data collection was done with Students satisfaction Questionnaires: Likert scale score Data Analysis was done using Statistical tools: unpaired t test and chi square test

Concept map





- **Preparation of Project proposal and draft presentation at Nodal centre**
- **Refining the proposal Presentation in IRB Presentation in IEC**
- **Presentation of Final Proposal to the Nodal Centre Data Collection, Analysis and report writing**

E-Posterpresentation

Outcome matrix

	Outcome	Indicators	Datasource	Data collection Method
Shortterm	Student satisfaction	Satisfaction score	Students	Questionnaire-Likert scale
Intermediate	Improved knowledge	Percentage of Students having optimal scores	Students	MCQs OSPE LabMannequin
Longterm	•Improved academic performance in FA	• Scoresin Phase I university examinations	• University results	University results

Evaluation Matrix

Kirkpatrick model	Evaluation Question	Indicators	Data source	Data collection method
Level-1 Reactions	Satisfaction acquired by medical students	Student satisfaction score	Students	Questionnaires
Level-2 Learning	Spatial relations,Knowledge acquisition & retention	Improved post test score	Students	MCQs
Level-3 Behaviour	Application of concepts in real life situations	Percentage of Students securing >75%score	Students	OSPE with Mannequins
Level-4Results	Overall impact on student performance and behaviour	•Passpercentage–University exam	University results	Feedbacks

RESULTS

TOPIC	HIGHER MEAN SCORE	P-VALUE	SIGNIFICANCE	INTERPRETATION
Upper Limb	**CADAVERIC PROSECTION (6.4>6.28)**	**0.772**	**Not significant**	**No significant difference**
Lower Limb	**CADAVERIC PROSECTION (7.3>7.12)**	**0.651**	**Not significant**	**Both methods equally effective**
Abdominal Viscera	**CADAVERIC PROSECTION (7.47>6.1)**	**0.001**	**Statisfically significant**	**Prosection more effective**
Lungs	**Equal (6.25=6.25)**	**1**	**No tsignificant**	**Both methods equally effective**
Heart	**CADAVERIC PROSECTION (7.07>6.45)**	**0.04**	**Statisfically significant**	**Prosection more effective**
Neuroanatomy	**AI Digital App (6.07>5.85)**	**0.603**	**Not significant**	**No significant difference**

Students exposed to cadaveric prosection performed better in questions assessing spatial relationships and anatomical variability. The AI digital anatomy app group showed improved performance in image-based identification questions.

Perception scores indicated higher engagement, flexibility , and reduced anxiety in the digital learning group, while cadaveric prosection was rated superior for realism and depth of understanding. No statistically significant difference was observed in overall knowledge scores between groups.

The mean knowledge score of students taught using cadaveric prosection was marginally higher than that of students taugh tusing the AI digital anatomy application (Figure1). Cadaveric prosection learners demonstrated better performance in questions related to spatial orientation, anatomical relations, and recognition of normal anatomical variations .In contrast ,students exposed to the AI digital anatomy app performed well inidentification-based and visually oriented questions.

Overall, the difference in total mean scores between the two groups was small and did not indicate a clear superiority of one modality over the other,suggesting that both teaching methods were effective in achieving core cognitive learning objectives.

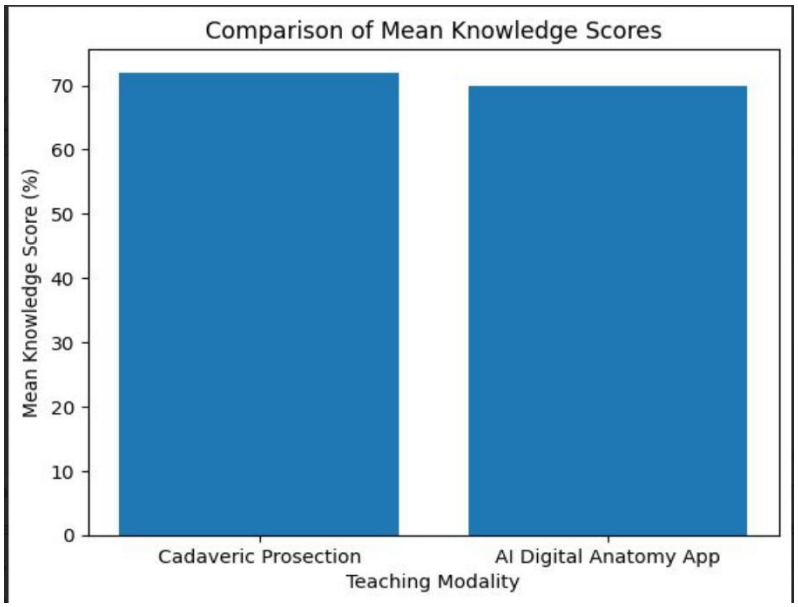


Figure 1: Comparison of mean knowledge scores (%) between cadaveric prosection and AI digital anatomy app–based teaching.

Learner perception analysis revealed a favourable attitude towards the AI digital anatomy application (Figure 2). A large proportion of students reported being highly satisfied or satisfied with the digital learning experience. Students highlighted advantages such as enhanced visualization, ease of revision, self-paced learning, and reduced anxiety during learning sessions.

A smaller proportion of students expressed neutral perceptions, while very few reported dissatisfaction, mainly citing the lack of tactile experience and reduced exposure to real anatomical variability.

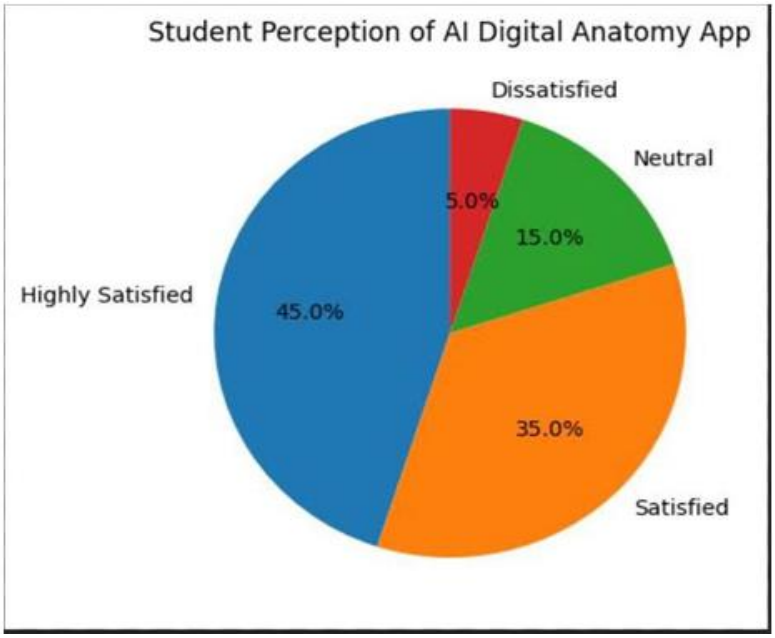


Figure 2: Pie diagram showing student perception of the AI digital anatomy application.

UG MBBS Students
↓
Lecture (Baseline)
↓
Cadaveric Prosection
↓
MCQ Assessment
↓

AI Digital Anatomy App for Demonstration of corresponding portion

↓

Same MCQ Assessment

↓

Student Perception Likert score Questionnaire

↓

Data Analysis

DISCUSSION

The findings demonstrate that cadaveric prosection and AI-based digital anatomy applications contribute differently to anatomy learning.Cadaveric teaching supports contextual understanding and professional development, consistent with previous studies.[3,7] Digital anatomy tools enhance visualization and self-directed learning, aligning with reports of increased learner satisfaction and accessibility.[8-10]

Comparable overall knowledge outcomes suggest that AI-base ddigital tools can effectively supplement traditional methods but should not entirely replace cadaveric exposure. Blended learning models align well with competency- based medical education principles and are increasingly recommended in the literature.[6,11]

CONCLUSION

Cadaveric prosection and AI digital anatomy applications are both effective for undergraduate anatomy education. While cadaveric prosection remains essential for realism and professional formation, AI-based digital tools enhance engagement and learner autonomy. Integrating both modalities may provide the most comprehensive educational experience. Cadaveric prosection provides essential tactile and realistic experience. AI enables flexible revision of the curriculum.

Limitations

The study was limited by short duration, single-institution setting,and assessment focused primarily on cognitive outcomes. Long-term retention and affective-domain learning were not extensively evaluated. Topic specific outcomes and subjectivity in

perception of data are limitations.

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