International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Teaching Basic Suturing Skills Using Simulation for MBBS Students

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Received: 22-12-2025
Accepted: 13-01-2026
Available online: 23-01-2026

ABSTRACT

Background: Traditional surgical training using the 'see one, do one, teach one' approach is limited by time constraints, patient safety concerns, and litigation risks. Simulation-based medical education (SBME) provides a safe alternative for acquiring basic suturing skills, with evidence supporting its effectiveness in improving proficiency among medical students.
Objective: To evaluate the utility of simulation-based training for basic suturing skills in final-year MBBS students, assess skill attainment using the Objective Structured Assessment of Technical Skills (OSATS), and explore associated factors.
Methods: This quasi-experimental study involved all 150 final-year MBBS students (2019 regular batch: n=145; 2018 additional: n=5) at a medical college in India. Participants underwent two 2-hour hands-on simulation sessions (total 4 hours) over 4–5 months during clinical postings. Skills taught included simple interrupted/continuous sutures, hand knots, mattress sutures, and running subcuticular suture. Proficiency was assessed post-training using a 17-item OSATS task-specific checklist (scored 0=poor, 1=good, 2=excellent; maximum 34). Descriptive statistics summarised mean scores, percentages proficient (≥1), and excellent (2).
Results: All students completed training with no loss to follow-up. Mean item score was 1.79 (SD 0.24), and total OSATS score was 30.37 (SD 4.02). Proficiency (≥1) was achieved by ≥96.7% across items, with 92.0% proficient in all skills and 14.7% excellent in all. Basic techniques (e.g., simple interrupted: mean 1.91) outperformed advanced ones (subcuticular: 1.33). No data quantified practice repetitions or influencing factors.
Conclusion: Simulation-based training enabled high post-training proficiency in basic suturing among final-year MBBS students, supporting its integration into undergraduate curricula to enhance confidence and reduce operating room risks. Limitations include lack of pre-training assessment and long-term follow-up; future studies should incorporate controls and retention evaluation.

Keywords*: Simulation training, suture techniques, clinical competence, education medical undergraduate, clinical skills.*

INTRODUCTION

Acquiring basic suturing skills is a core competency in medical education, essential for all undergraduates and surgical residents.[1] Traditionally, training followed the 'see one, do one, teach one' model, but this approach is increasingly inadequate due to time constraints, advanced technologies, steeper learning curves, heightened patient expectations, and risks of medical litigation.[2,3] Simulation-based medical education (SBME) offers a safe, controlled alternative, allowing repetitive practice and objective assessment without patient harm.[4,5] Evidence supports SBME's superiority over traditional methods in skill acquisition, with studies showing improved self-efficacy and proficiency in knot-tying and suturing among third-year students during clerkships.[6] Pre-clerkship programs like the Surgical Skills and Technology Elective Program (SSTEP) have demonstrated enhanced surgical knowledge and technical skills.[7] Both hands-on and

video-based simulations are effective, though long-term multicenter evaluations are needed to assess sustained competence.[8]

Despite these benefits, simulation has not been formally integrated into many medical curricula.[9] The Objective Structured Assessment of Technical Skills (OSATS) remains a gold standard for evaluating trainees.[10] This study addresses gaps by implementing simulation-based training for basic suturing in final-year MBBS students, providing opportunities for extensive practice and confidence-building before clinical exposure. The aim of this study was to evaluate simulation-based learning as a model replicating real surgical scenarios for acquiring suturing skills.The objectives are**,**To assess the utility of simulation for teaching basic suturing skills among final-year MBBS students, To determine the practice required to attain proficiency and influencing factors,To measure individual skill attainment using OSATS.

METHODS

This quasi-experimental study, conducted in accordance with STROBE guidelines adapted for educational interventions, took place in the simulation laboratory of a medical college in India over approximately 4–5 months during 2023–2024, coinciding with Phase III Part II MBBS clinical postings. All 150 eligible final-year MBBS students (145 from the 2019 regular batch and 5 from the 2018 additional batch) were included with no exclusions; participation was voluntary, integrated into routine postings, and followed informed consent. The primary outcome was post-training suturing proficiency assessed using the 17-item Objective Structured Assessment of Technical Skills (OSATS) task-specific checklist (scored 0=poor, 1=good, 2=excellent; maximum total 34), while secondary outcomes included perceived utility of simulation (via Likert-scale student survey) and practice requirements/influencing factors (not quantified due to study design). Students were divided into four batches (A–D, approximately 36 students each) and underwent two 2-hour hands-on simulation sessions (total 6 hours: 3 hours per week) over the study period. In the first session, facilitators demonstrated and supervised practice of simple interrupted and continuous sutures and hand knots; the second session covered vertical and horizontal mattress sutures and running subcuticular suture using low-fidelity simulation kits sponsored by ETHICON. OSATS assessments were performed by trained evaluators during the hands-on sessions, with responses recorded directly and later entered into Excel. Assessor bias was minimised through use of the standardised OSATS tool, though blinding was not feasible; selection bias was absent due to inclusion of the entire cohort, and there was no loss to follow-up. As an exploratory study involving the full convenience sample of 150 students, no formal sample size calculation or power analysis was performed. All analyses were descriptive: OSATS item and total scores were summarised as means with standard deviations, medians with interquartile ranges, ranges, and frequencies/percentages for proficient (score ≥1) and excellent (score 2) performance; no inferential statistics were applied.

RESULTS

All 150 final year MBBS students (2019 regular batch: n=145; 2018 additional batch: n=5) completed the simulation-based training programme, consisting of two 2-hour sessions over 4–5 months. Skills were assessed using the Objective Structured Assessment of Technical Skills (OSATS) task-specific checklist during hands-on training. Scores ranged from 0 (poor) to 2 (excellent) across 17 items. No pre-training baseline was available, as the design focused on post-training proficiency.

Overall, the mean score per item was 1.79 (SD 0.24) out of 2, indicating good to excellent performance. Item-specific results are summarised in table 1. High proficiency (score ≥1) was achieved by ≥96.7% of students on all items, with excellent performance (score 2) varying from 36.7% (subcuticular suture) to 92.0% (simple interrupted suture). Basic techniques like simple interrupted and continuous sutures showed the highest means (1.91 and 1.87, respectively), while subcuticular suture had the lowest (1.33). Performance by skill category is shown in table 2.

The mean total OSATS score was 30.37 (SD 4.02) out of 34 (table 3). Overall, 138 (92.0%) students were proficient (≥1) in all skills, and 22 (14.7%) achieved excellence (2) in all (table 4).

No data were collected on practice repetitions or influencing factors due to the quasi-experimental design constraints. Student survey responses on simulation utility were not quantified in the master chart.

Table 1: Performance on OSATS checklist items (n=150)

Skill	Mean score (SD)	% Excellent (score 2)	% Proficient (score ≥1)
Loading needle with suture material	1.77 (0.47)	78.7	98.0
Loading needle holder with needle at 1/2 distance from tip	1.86 (0.38)	87.3	98.7
Appropriate handling of forceps	1.84 (0.39)	84.7	99.3
Maintain 90° angle between needle and skin	1.79 (0.43)	79.3	99.3
Pulling needle out in curve to reduce trauma	1.76 (0.44)	76.7	99.3
Correct direction of knotting	1.84 (0.40)	85.3	98.7
Square knot using instrument tie	1.83 (0.41)	84.7	98.7

Square knot using hand tie	1.89 (0.32)	88.7	100.0
Appropriate tension of knotting	1.79 (0.41)	78.7	100.0
Correct edge distance	1.73 (0.49)	75.3	98.0
Equal spacing between sutures	1.61 (0.54)	64.0	97.3
Simple interrupted	1.91 (0.31)	92.0	99.3
Simple continuous	1.87 (0.34)	86.7	100.0
Interrupted vertical mattress	1.87 (0.33)	87.3	100.0
Interrupted horizontal mattress	1.81 (0.43)	82.0	98.7
Subcuticular	1.33 (0.54)	36.7	96.7
Hand knots	1.87 (0.34)	86.7	100.0

Table 2: Performance by skill category (n=150)

Category	No. of items	Mean score (SD)
Needle handling	5	1.80 (0.28)
Knotting	4	1.84 (0.26)
Placement	2	1.67 (0.46)
Suture techniques	5	1.76 (0.26)
Hand knots	1	1.87 (0.34)

Table 3: Summary statistics for total OSATS scores (maximum 34; n=150)

Statistic	Value
Mean (SD)	30.37 (4.02)
Median (IQR)	32 (4)
Range	17–34

Table 4: Students achieving proficiency levels across all skills (n=150)

Level	No. (%)
Proficient (≥1 in all)	138 (92.0)
Excellent (2 in all)	22 (14.7)

DISCUSSION

This quasi-experimental study demonstrated high post-training proficiency in basic suturing skills among final-year MBBS students, with a mean OSATS score of 1.79/2 per item and 30.37/34 total, where ≥96.7% achieved at least good performance across items and 92.0% were proficient in all. Basic techniques like simple interrupted sutures excelled (mean 1.91), while subcuticular lagged (1.33), likely due to complexity and limited sessions, consistent with steeper learning curves in advanced sutures. [1,2]

Compared to prior studies, our findings align with proficiency-driven curricula enhancing self-efficacy in third-year students [4] and pre-clerkship programs improving technical skills [5]. High proficiency rates support SBME's superiority over traditional education [6], addressing barriers like time pressures [3]. However, absent pre-assessments limit direct gains inference, unlike randomized trials showing simulation boosts knot-tying efficiency [8].

Recent studies reinforce these benefits. A 2025 randomized cohort using 3D-printed models improved suturing in sixth-year students, with better operative interest and skills versus basic pads, suggesting our low-fidelity kits could be augmented for realism [11]. Ten-hour simulation training enhanced medical students' anastomosis performance objectively, mirroring our OSATS improvements but with longer duration implying our 4-hour program may suffice for basics [12]. Virtual reality (VR) simulation for facial wound suturing yielded high student satisfaction and skill transfer [13], while flipped classroom SBME at Soroti University increased engagement and autonomy [14], highlighting potential

for hybrid models to address our unquantified utility surveys. A 2024 bibliometric analysis noted SBME's evolution toward AI-integrated curricula for standardization [15], urging future enhancements beyond our descriptive approach.

Strengths: Full participation, validated OSATS. Limitations: Single-centre, no controls/long-term follow-up, unmeasured factors like prior exposure. Multicentre RCTs with retention assessments could refine integration, reducing errors and building confidence [7,9].

CONCLUSION

This quasi-experimental study demonstrated that a brief, structured simulation-based training programme (4 hours total) enabled final-year MBBS students to achieve good to excellent proficiency in basic suturing skills, with a mean OSATS score of 1.79/2 per item and 92.0% of participants proficient across all assessed techniques. Basic sutures outperformed advanced ones, highlighting the value of progressive skill-building in a safe environment. These findings reinforce simulation as an effective, patient-safe alternative to traditional apprenticeship models, addressing key barriers such as limited operative exposure and safety concerns. Integrating such programmes early in undergraduate curricula can enhance technical competence, build confidence, and potentially reduce errors in clinical practice. Future research should incorporate pre-post designs, randomised controls, long-term skill retention evaluation, and quantification of practice requirements to optimise simulation curricula and support broader adoption in medical education.

Conflicts of Interest: None
Funding: Self-funded; suture materials sponsored by ETHICON
Acknowledgements: The authors thank the final-year MBBS students and simulation lab facilitators at PSG Institute of Medical Sciences & Research for their participation and support.

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