



Original Research Article

SIMULATION BASED LEARNING FOR TEACHING BASIC SKIN SUTURING TO PHASE II MBBS STUDENTS

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ABSTRACT

Background: Simulation-based learning has become an important approach for teaching procedural skills in undergraduate medical education because it allows repeated practice in a safe and controlled environment before performing procedures on patients. Basic skin suturing is an essential surgical skill for medical graduates, and low-cost simulation models such as banana skin may provide an accessible method for skill acquisition. The aim is to implement a simulation-based module for teaching basic skin suturing to Phase II MBBS students and to assess students' perception, procedural performance, and faculty perception regarding the feasibility of simulationbased learning.

Materials and Methods: This prospective study was conducted over one year among 90 Phase II MBBS students with the involvement of three faculty members. The structured module included orientation, video-assisted learning, faculty demonstration, supervised hands-on practice on banana skin, repeated independent practice, and post-training assessment. Each student performed 15 independent suturing practice sessions using simple interrupted sutures. Student perception was assessed using a pre-validated five-point Likert-scale questionnaire, while faculty feedback was obtained through a separate questionnaire. Procedural performance was evaluated using a Direct Observation of Procedural Skills (DOPS) checklist. Data were summarized using frequencies, percentages, mean Likert scores, standard deviations, and 95% confidence intervals.

Results: Positive student responses across the nine feedback domains ranged from 95.56% to 98.89%. Simulation suturing was considered interesting and supportive of skill development by 98.89% of students. Repeated practice, improved confidence, a safe learning environment, and contribution toward producing a better Indian Medical Graduate each received 97.78% positive responses. The overall positive response rate was 97.53%, with a mean Likert score of 4.88 ± 0.39 . All faculty members reported positive perceptions regarding repeated practice, safety, and feasibility. More than 95.00% of students correctly performed all essential suturing steps on post-training DOPS assessment.

Conclusion: Simulation-based suturing using banana skin is a feasible, lowcost, and effective method for teaching basic skin suturing to Phase II MBBS students and may complement conventional surgical skills training.

Keywords: Simulation-based learning, Skin suturing, Surgical skills, Banana skin model, MBBS students.

INTRODUCTION

Simulation-based learning has become an important component of contemporary medical education because it allows learners to acquire clinical and procedural skills in a structured environment before performing them on patients. The shift toward competency-based education has placed greater emphasis on demonstrable abilities rather than knowledge alone, particularly for procedures requiring psychomotor coordination and precision. Surgical skills are especially suitable for simulation because repeated practice can occur without exposing patients to avoidable discomfort or risk. Suturing is one of the fundamental surgical skills expected of undergraduate medical students and forms the basis of wound closure in many clinical settings. A structured approach to teaching this skill can therefore support progressive development of procedural competence during undergraduate training.^[1] Traditional surgical teaching has commonly relied on observation followed by supervised performance in the clinical environment. Although clinical exposure remains essential, opportunities for beginners to repeatedly practise procedures on actual patients may be limited by patient-safety concerns, consent, time constraints, and variability in case exposure. Simulation provides an educational bridge between theoretical instruction and clinical performance. It permits learners to become familiar with instruments, needle handling, tissue approximation, knot tying, and procedural sequence before entering patient care. When incorporated into a planned curriculum, simulation provides a reproducible setting in which errors can be identified and corrected without causing patient harm.^[2] Psychomotor skill acquisition requires repetition, focused attention, feedback, correction of errors, and gradual refinement of movements. Simulation-based surgical education is compatible with deliberate practice because learners can repeat the same task under standardized conditions until satisfactory performance is achieved. Faculty supervision can strengthen this process by identifying incorrect hand position, poor needle angles, excessive tissue handling, inappropriate knot tension, or inefficient instrument movements. Repeated practice with targeted feedback can help students develop a systematic approach to procedural learning.^[2] Simulation-based teaching may combine several educational methods rather than relying on a single mode of instruction. Video-assisted learning can introduce the sequence of a procedure and allow students to review important steps at their own pace, whereas hands-on simulation provides the motor experience needed to translate visual information into practical performance. Flipped and blended approaches can also allow learners to review instructional material before supervised practical sessions, preserving contact time for demonstration, practice, correction, and feedback. These approaches

are particularly relevant to suturing because students must understand both the principles of wound closure and the physical execution of the technique.^[3,4] The simulators used for suturing training range from commercially manufactured synthetic pads and high-fidelity systems to simple bench models made from inexpensive, locally available materials. For undergraduate teaching, a simulator need not reproduce every property of living tissue to be useful. It should allow safe handling of needles and forceps, repeated needle passage through a tissuelike surface, approximation of wound edges, knot formation, and assessment of technique. Low-cost simulators are particularly valuable when large groups require repeated practice or access to dedicated simulation laboratories is limited. Recent educational models therefore emphasize reproducibility, portability, affordability, and ease of use.^[5] Early exposure to structured surgical-skills training can help students approach later clinical postings with greater familiarity with procedural terminology, instruments, and basic operative principles. Instead of depending solely on opportunistic learning during clinical rotations, simulation permits essential skills to be introduced in a planned sequence and assessed using defined criteria. Standardized assessment tools can help faculty observe individual procedural steps and provide specific feedback. This approach is consistent with competency-oriented undergraduate education, in which learners are expected to demonstrate required skills under appropriate supervision.^[6]

MATERIALS AND METHODS

This prospective study was conducted over a period of one year among 90 Phase II MBBS students, with the involvement of three faculty members. Before initiation of the study, all participants were sensitized regarding the objectives and methodology of the simulation-based training programme. Approval was obtained from the Institutional Ethics Committee, and participation in the study was voluntary and considered as consent in accordance with the approved study protocol.

Methodology

Development of the Simulation Module: A structured module for teaching basic skin suturing through simulation-based learning was developed after discussion with the participating faculty members. The teaching-learning strategy included a short didactic session, video-assisted learning, faculty demonstration, supervised hands-on practice using banana skin, repeated independent practice, and subsequent assessment. The students and faculty members assembled in the minor operation theatre on the scheduled dates for implementation of the module.

Day 1 – Orientation and Video-Assisted Learning: On Day 1, all 90 students attended a onehour introductory lecture explaining the salient

features, objectives, methodology, and expected benefits of the simulation-based suturing programme. This was followed by a 30-minute interactive session to address students' doubts and apprehensions regarding the activity. The students were subsequently divided into five groups of approximately 18 students each. Each group was shown a 10-minute instructional video demonstrating the basic technique of skin suturing. The video link was also shared with the students through a WhatsApp group to facilitate repeated viewing and self-directed learning.

Day 2 – Demonstration and Supervised Practice:

On Day 2, each group received a 30-minute demonstration of basic skin suturing on banana skin by a faculty member. The demonstration was accompanied by an interactive discussion regarding the types of sutures, appropriate handling of instruments, and variations in suturing needles. As only three faculty members were available for five student groups, the faculty members rotated between the groups to ensure adequate supervision. For hands-on practice, a 6-cm segment of banana skin was securely fixed over a piece of cardboard placed on a table to provide a stable simulation model. Students performed simple interrupted sutures using 0 silk suture material with a curved cutting needle. The practice sessions were recorded using mobile phones and reviewed with the students to provide immediate feedback and facilitate improvement in their technique.

Day 3 – Independent Repeated Practice: On Day 3, each student independently performed 15 suturing practice sessions on the banana-skin simulation model. Faculty members continuously supervised the activity and provided guidance and corrective feedback whenever required. Repeated practice was encouraged to improve hand-eye coordination, instrument handling, knot placement, precision, and confidence in basic suturing skills.

Day 4 – Assessment and Feedback: On Day 4, students' perception of simulation-based suturing was assessed using a pre-structured and prevalidated feedback questionnaire. The questionnaire was validated by two surgeons who were not directly involved in the study. Students recorded their responses on a five-point Likert scale, with a score of 5 representing “strongly agree” and 1 representing “strongly disagree.” A separate prevalidated questionnaire was provided to the participating faculty members to assess their perception regarding the feasibility, usefulness, safety, and effectiveness of simulation-based suturing training. The students' practical performance was also evaluated using a Direct Observation of Procedural Skills (DOPS) checklist, which assessed the essential steps involved in basic skin suturing after completion of the training programme.

Statistical Analysis

The responses obtained from the student and faculty feedback questionnaires were tabulated and analysed using Microsoft Excel. Descriptive statistics were

used to summarize the responses, and the findings were expressed as frequencies and percentages.

RESULTS

A total of 90 Phase II MBBS students completed the simulation-based basic skin suturing programme, and three faculty members participated in the training and feedback process. Student perception was assessed across nine statements using a fivepoint Likert scale. Positive responses were defined as the combined responses of “Strongly Agree” and “Agree.” Across the nine student-feedback items, positive responses ranged from 95.56% to 98.89%. No student selected “Disagree” or “Strongly Disagree” for any of the statements. Faculty responses and post-training DOPS performance were also recorded separately. [Table 1] presents the distribution of student responses to the nine feedback statements. For the statement that simulation suturing was interesting, 84 students (93.33%) strongly agreed, 5 (5.56%) agreed and 1 (1.11%) remained neutral. Regarding the helpfulness of simulation suturing, 80 students (88.89%) strongly agreed, 6 (6.67%) agreed and 4 (4.44%) were neutral. For development of suturing skills, 83 students (92.22%) strongly agreed, 6 (6.67%) agreed and 1 (1.11%) was neutral. In relation to repeated practice improving performance, 82 students (91.11%) strongly agreed, 6 (6.67%) agreed and 2 (2.22%) were neutral. For improvement in patient safety, 80 students (88.89%) strongly agreed, 6 (6.67%) agreed and 4 (4.44%) were neutral. When asked whether simulation suturing was better than video teaching alone, 82 students (91.11%) strongly agreed, 6 (6.67%) agreed and 2 (2.22%) were neutral. Regarding confidence while dealing with real patients, 80 students (88.89%) strongly agreed, 8 (8.89%) agreed and 2 (2.22%) were neutral. For creation of a safe learning environment, 82 students (91.11%) strongly agreed, 6 (6.67%) agreed and 2 (2.22%) were neutral. Similarly, for the statement that simulation suturing contributes to producing a better Indian Medical Graduate, 80 students (88.89%) strongly agreed, 8 (8.89%) agreed and 2 (2.22%) were neutral. No disagree or strongly disagree responses were reported in any of the nine items.

[Table 2] summarizes the combined positive responses, 95% confidence intervals and mean Likert scores for each student-feedback item. The highest positive response was recorded for simulation suturing being interesting and for supporting development of skill, with 89 of 90 students (98.89%) responding positively to each statement. The corresponding 95% confidence interval was 93.97–99.80%. Repeated practice improving performance, simulation being better than video teaching, increasing confidence while dealing with real patients, creating a safe learning environment and contributing to producing a better Indian Medical Graduate each received positive responses from 88

students (97.78%), with a 95% confidence interval of 92.26–99.39%. Simulation suturing being helpful and improving patient safety each received positive responses from 86 students (95.56%), with a 95% confidence interval of 89.12– 98.26%. Mean Likert scores ranged from 4.84 ± 0.47 to 4.92 ± 0.31 . The highest mean score was observed for simulation suturing being interesting (4.92 ± 0.31), followed by support for skill development (4.91 ± 0.32). Mean scores of 4.89 ± 0.38 were observed for repeated practice improving performance, simulation being better than video teaching and creation of a safe learning environment. Confidence while dealing with real patients and contribution to producing a better Indian Medical Graduate both had a mean score of 4.87 ± 0.40 , while helpfulness and improvement in patient safety each had a mean score of 4.84 ± 0.47 . [Table 3] presents the responses of the three participating faculty members. All three faculty members (100.00%) strongly agreed that repeated practice of simulation skin suturing would improve performance. All three faculty members (100.00%) also strongly agreed that simulation skin suturing creates a safe learning environment. Regarding feasibility, 2 faculty members (66.67%) strongly agreed and 1 faculty member (33.33%) agreed that

simulation suturing was feasible. None of the faculty members selected neutral, disagree or strongly disagree for any of the three statements. Thus, the combined positive response among faculty members was 100.00% for all assessed items. [Table 4] shows the post-training performance of students assessed using the DOPS checklist. More than 95.00% of the students correctly performed all essential steps of simulation suturing after completion of the training module, while fewer than 5.00% did not correctly complete all of the assessed steps. The original study data reported this outcome as “more than 95%”; therefore, exact frequencies were not assigned to these two performance categories.

[Table 5] summarizes all student-feedback responses across the nine questionnaire items. A total of 810 individual item responses were generated from 90 students responding to nine statements. Of these, 733 responses (90.49%) were in the “Strongly Agree” category, 57 (7.04%) were in the “Agree” category and 20 (2.47%) were neutral. No response was recorded under “Disagree” or “Strongly Disagree.” The combined number of positive responses was 790 of 810 (97.53%). The overall mean Likert score calculated across all questionnaire responses was 4.88 ± 0.39 .

Table 1: Students’ responses to the simulation-based suturing feedback questionnaire (N=90)

Statement	Strongly Agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly Disagree n (%)
Simulation suturing was interesting	84 (93.33%)	5 (5.56%)	1 (1.11%)	0 (0.00%)	0 (0.00%)
Simulation suturing was helpful	80 (88.89%)	6 (6.67%)	4 (4.44%)	0 (0.00%)	0 (0.00%)
Simulation suturing supports development of skill	83 (92.22%)	6 (6.67%)	1 (1.11%)	0 (0.00%)	0 (0.00%)
Repeated simulation suturing improves performance	82 (91.11%)	6 (6.67%)	2 (2.22%)	0 (0.00%)	0 (0.00%)
Simulation suturing improves patient safety	80 (88.89%)	6 (6.67%)	4 (4.44%)	0 (0.00%)	0 (0.00%)
Simulation suturing is better than video teaching	82 (91.11%)	6 (6.67%)	2 (2.22%)	0 (0.00%)	0 (0.00%)
Simulation-based learning increases confidence while dealing with real patients	80 (88.89%)	8 (8.89%)	2 (2.22%)	0 (0.00%)	0 (0.00%)
Simulation learning creates a safe learning environment	82 (91.11%)	6 (6.67%)	2 (2.22%)	0 (0.00%)	0 (0.00%)
Simulation suturing contributes to producing a better Indian Medical Graduate	80 (88.89%)	8 (8.89%)	2 (2.22%)	0 (0.00%)	0 (0.00%)

Table 2: Positive response, mean Likert score and 95% confidence interval for student perceptions

Parameter	Positive Response* n (%)	95% CI for Positive Response	Mean Likert Score $\pm$ SD
Simulation suturing was interesting	89 (98.89%)	93.97–99.80%	4.92 ± 0.31
Simulation suturing was helpful	86 (95.56%)	89.12–98.26%	4.84 ± 0.47
Supports development of skill	89 (98.89%)	93.97–99.80%	4.91 ± 0.32
Repeated practice improves performance	88 (97.78%)	92.26–99.39%	4.89 ± 0.38
Improves patient safety	86 (95.56%)	89.12–98.26%	4.84 ± 0.47
Better than video teaching	88 (97.78%)	92.26–99.39%	4.89 ± 0.38
Increases confidence while dealing with real patients	88 (97.78%)	92.26–99.39%	4.87 ± 0.40
Creates a safe learning environment	88 (97.78%)	92.26–99.39%	4.89 ± 0.38
Contributes to producing a better Indian Medical Graduate	88 (97.78%)	92.26–99.39%	4.87 ± 0.40

*Positive response = Strongly Agree + Agree. Likert 2 = Disagree and 1 = Strongly Disagree. The 95% scoring: 5 = Strongly Agree, 4 = Agree, 3 = Neutral, confidence intervals were calculated for the positive-response proportions using the Wilson method.

Table 3: Faculty perception regarding simulation-based skin suturing (N=3)

Statement	Strongly Agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly Disagree n (%)
Repeated practice of simulation skin suturing will improve performance	3 (100.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Simulation skin suturing creates a safe learning environment	3 (100.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
Simulation suturing is feasible	2 (66.67%)	1 (33.33%)	0 (0.00%)	0 (0.00%)	0 (0.00%)

Table 4: Post-training performance of students on DOPS assessment

Performance Outcome	Percentage of Students
Correctly performed all essential steps of simulation suturing	>95.00%
Did not correctly perform all essential steps	<5.00%

Table 5: Overall distribution of responses across the nine student feedback items

Response Category	Total Responses (n=810)*	Percentage
Strongly Agree	733	90.49%
Agree	57	7.04%
Neutral	20	2.47%
Disagree	0	0.00%
Strongly Disagree	0	0.00%
Overall Positive Responses	790	97.53%

*A total of 810 questionnaire responses were obtained from 90 students across nine feedback items (90 × 9 =

810).

DISCUSSION

The present study demonstrated a very high level of acceptance of simulation-based basic skin suturing among the 90 Phase II MBBS students. Positive responses across the nine assessed domains ranged from 95.56% to 98.89%, while the overall positive response rate was 97.53% and the overall mean Likert score was 4.88 ± 0.39 . These findings are comparable with those of da Silva et al. (2019), who evaluated a silicone-based suturing model among 48 undergraduate medical students and reported 89.58% positive concordant responses regarding its incorporation into surgical-technique teaching. The proportion of favourable responses in the present study was therefore somewhat higher than that reported with the silicone model, although both studies showed strong acceptance of low-cost simulation models for suturing training.^[7] Students also showed a particularly favourable response regarding the learning environment and educational value of the programme. In the present study, 98.89% considered simulation suturing interesting, 95.56% considered it helpful, and 97.78% reported that it created a safe learning environment. The corresponding mean score for interest was 4.92 ± 0.31 , the highest among all assessed parameters. Similar findings were reported by Preece et al. (2015) in a peer-assisted suturing workshop involving 35 medical students. All participating students reported that the teaching environment was relaxed and that the workshop improved their suturing technique and confidence; additionally, 87% stated that it increased

their interest in pursuing a surgical career. Their objective assessment also demonstrated a significant increase in the number of sutures completed after teaching ($p < 0.001$), with variability in inter-suture distance decreasing from approximately ± 4.7 mm to ± 2.6 mm.^[8] Confidence for subsequent clinical application was another prominent finding of the present study. A total of 88 of 90 students (97.78%) responded positively to the statement that simulation-based learning increased their confidence while dealing with real patients, including 88.89% who strongly agreed, and the corresponding mean Likert score was 4.87 ± 0.40 . Comparable improvement was demonstrated by Quaranto et al. (2021) among 31 third-year medical students who completed structured sessions on surgical instruments, knot tying and suturing with real-time instructor feedback. Their mean confidence score for suturing increased from 8.0 ± 1.3 before training to 13.8 ± 0.9 after training ($p < 0.001$), and all participating students successfully demonstrated simple suturing and two-handed knotting techniques after the course.^[9] Repeated practice was strongly supported by students in the present study, with 88 of 90 students (97.78%) agreeing or strongly agreeing that repeated simulation suturing would improve performance; 91.11% strongly agreed with this statement and the mean Likert score was 4.89 ± 0.38 . Each student in the present programme independently completed 15 suturing practice sessions before final assessment. This observation is consistent with Vanyolos et al. (2017), who evaluated simple interrupted suturing among 152 students in a compulsory basic course and

subsequently among 27 students in an elective course. They observed progressive improvement in both the time required to complete the suturing task and the quality of performance during individual classes, throughout the course and when performance in the basic and subsequent elective courses was compared.^[10] Objective assessment following training further supported the procedural outcomes of the programme. In the present study, more than 95.00% of students correctly performed all essential steps of simulated skin suturing on the post-training DOPS assessment. This finding can be compared with the study by Shen et al. (2018) involving 42 medical students who performed suturing tasks using synthetic pads and biological tissue and were assessed using the Objective Structured Assessment of Technical Skill (OSATS). In that study, 93% of students considered clinical simulated basic surgical-skills training necessary and believed that it could increase confidence for future clinical work, while 98% considered OSATS based evaluation more objective.^[11] The consistently high Likert scores in the present study also indicate that favourable responses were not restricted to a single component of the programme. Mean scores ranged narrowly from 4.84 ± 0.47 to 4.92 ± 0.31 , while 90.49% of all 810 responses were in the “Strongly Agree” category. These findings are comparable with Pintér et al. (2021), who studied 60 medical students undergoing a basic surgical-skills course and reported an improvement in overall performance scores from 119.86 to 153.55 points ($p < 0.01$). Students receiving additional near-peer tutoring demonstrated a greater improvement than those without it (37.20 vs 30.18 points; $p = 0.036$), while satisfaction was already very high in the control group at 4.82 on a five-point scale. The mean satisfaction level reported in that study was therefore close to the overall Likert mean of 4.88 observed in the present study.^[12] The present study also recorded high positive responses for outcomes related to future clinical practice: 95.56% of students believed simulation suturing improves patient safety, 97.78% reported increased confidence while dealing with real patients, and 97.78% felt that such training contributes to producing a better Indian Medical Graduate. These findings are consistent with Shewmake et al. (2023), who introduced a 7.5-hour longitudinal suturing curriculum and evaluated 167 students before training, 148 after the course and 82 after completion of clinical clerkships. Comfort with proper instrument positioning, simple interrupted sutures and instrument ties improved significantly after training (all $p < 0.001$) and remained improved at two-year follow-up. Furthermore, 66% of students reported being very or completely prepared to suture wounds during clerkships, while 83% reported successfully suturing patient wounds without requiring substantial direction or guidance.^[13] Faculty perception in the present study was uniformly favourable: all three faculty members (100.00%) strongly agreed that repeated simulation practice improves performance and creates a safe learning

environment, while 66.67% strongly agreed and 33.33% agreed that the approach was feasible. Students also considered hands-on simulation preferable to video teaching alone, with 97.78% positive responses for this item. A related finding was reported by Alameddine et al. (2018) in a study of 16 fourth-year medical students using faculty directed video review and coaching for suturing. All students who underwent coaching stated that they would definitely recommend the session, 94% strongly agreed that it was beneficial, and 75% strongly agreed that it improved their technical skills. Faculty grading additionally demonstrated improvement in specific technical domains. These results complement the present findings by showing that supervised practice, faculty feedback and video review can be successfully incorporated into structured suturing training.^[14]

CONCLUSION

Simulation-based learning using banana skin was found to be a feasible, inexpensive, and effective method for teaching basic skin suturing to Phase II MBBS students. The programme was associated with high student satisfaction, improved confidence, and successful acquisition of essential suturing skills. More than 95% of students correctly performed the required steps on post-training assessment, while faculty members reported uniformly favourable perceptions regarding feasibility and safety. Simulation-based suturing can therefore be incorporated as a useful complementary method for undergraduate surgical skills training.

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