7DD: Posters: Surgical Simulation

Location: Hall 4.1, CCB
Date: Tuesday 28th August
Time: 1015-1200 hrs

7DD1 (1762)
Integrating Skills Lab stations into a course on the principles of fracture fixation

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Background: The AO Foundation has been involved in education since the 1960s. The AO Trauma Basic Principles of Fracture Management course is now an integral component of residency programs in several countries. In 2013, a new educational simulation was introduced in the courses with the addition of 10 Skills Lab stations.

Method: The present-day Skills Lab stations started off with the idea of a 'Playground' – a time during the course when participants could experiment with drills, reduction tools, instrumentation, and bone models, to work out the principles of fracture fixation. Over the years, this activity was formalized, given a structure, and learning objectives for each station defined. Surgeons, engineers, and educationalists worked together to create a novel approach to teaching basic surgical principles and skills.

Results: The Skills Lab stations have now been used in over 300 courses worldwide. Implementation was monitored by conducting online surveys, and we received feedback from 318 participants, 146 faculty, and 91 Skills Lab directors. Faculty education programs, self-explanatory videos, and faculty guides for each station were prepared to educate faculty on the Skill Lab stations. In addition, during the early phase of the roll-out process, a surgeon expert and a member of the AO Education Institute accompanied the Skills Lab to every course.

Discussion & Conclusion: The Skills Lab has proven to be of great value to the AO Trauma Basic Principles of Fracture Management course. It is an effective way of reinforcing the concepts taught at the course, and in increasing interactivity between participants and faculty. The Skills Lab is now a core component of this course.

Take-home message: Integrating the concepts of fracture fixation within a course can be successfully performed using Skills Lab stations. The concepts addressed can be revisited, emphasized, and elaborated upon during the rest of the course in lectures, practical exercises or small group discussion. This educational simulation is highly interactive and proven to be very popular with course participants and faculty alike.

7DD2 (2484)
Novice Development of Cerebral Aneurysm Coiling Skills in Virtual Reality

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Background: Endovascular surgical procedures require visual-spatial coordination in workspaces with restricted motions and temporally limited imaging. The acquisition of the procedural skills and error reduction strategies can be facilitated by 3D simulator-based training, however, cerebral angiography (CA) has lagged behind in this training approach due to the lack of validated, realistic training models, relying strictly on clinical case exposure frequency as a means of assessing proficiency. The ANGIO Mentor visual-haptic simulator has been regarded as an effective training tool, increasing performance in diagnostic CA, however, this simulator has not been assessed thoroughly in its ability to improve interventional skills such as effective aneurysm coiling.

Method: In this study, 12 novice medical students were given simulation-based diagnostic cerebral angiography training until a procedural plateau in performance, established in our previous work (Zaika et al., 2016). Subsequently, they were trained using video tutorials and written instructions to identify, measure and intervene with cerebral aneurysms using endovascular coils. Subsequently, over the span of 6 sessions, participants were assessed on their procedural pace, coiling quantity and quality, and perforation rates. Spatial ability was assessed using a mental rotation test (MRT) and used in the performance analysis.

Results: All individuals were able to perform the procedure faster after 6 sessions, reducing their average time from 42 to 24 minutes. Coil success rate improved over from 82% to 88% and coil packing rate remained consistent at 30% throughout testing. High perforation rate seen at the start of the study showed a trend of decreasing over the latter sessions, however, over half of aneurysms were still being perforated by the novice participants. No change in aneurysm coiling quality was found, with a slight decrease in number of parent artery coil protrusions. High MRT individuals were better able to establish necessary tools prior to coiling, however, no other MRT-specific changes were seen.

Conclusion: This work identifies the utility of simulation-based cerebral angiography training in identifying the particular difficulties trainees experience in learning procedural skills, including prevention of perforations, proper positioning and success of coils within the aneurysm.
7DD3 (2771)
First experiences in hospital-based simulation training in spinal decompression and fusion

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Background: Time away from clinical practice is a challenge for surgeons. Hospital-based education in the local setting using a simulator and supported by a blended learning approach should be explored as an alternative or complementary to external courses. A group of AOSpine surgeon faculty decided to design and evaluate a new, standardized program on simulation training in spinal decompression and fusion for international implementation.

Method: The surgeon faculty designed a program consisting of 2 hours of online learning materials, a 1-hour online tutorial for participants with the chairperson, and a 3-hour face-to-face event focused on simulated minimally invasive procedures. Microsurgical decompression and interbody fusion were selected and scheduled for groups of 2 participants to perform on a simulator with a lumbar pathology model and a microscope under the guidance of faculty.

Results: The program was delivered to 81 orthopedic and neurosurgical trainees and fellows during 2017 in 6 events in England (n=18 participants), Wales (n=6), US (n=18), Japan (n=8), Brazil (n=19), and Kuwait (n=12) with a local chairperson and faculty. Evaluation by 62 participants (76%) showed 82% (range 64%-100%) learned something new and intend to use it in practice. All responders would recommend the event to colleagues. Positive feedback was noted regarding minimal interruption to regular work, enhancement with online pre-course activities, the authenticity of the simulator, the OR setting, and the high faculty to participant ratio. Feedback from participants and faculty compare favorably to our other educational events. The evaluation instruments could be enhanced by the addition of procedure metrics for participants and faculty to receive and provide even more focused feedback. Projected advantages of condensed on-site time, no travel, and low costs were all found in these events. Future plans are to deliver such events on a larger scale. A detailed analysis and comparison with other events is currently being made.

Conclusion: Hospital-based education using simulation will be an effective alternative and complements existing education. Further study of its effectiveness and efficiency is warranted.

7DD4 (2898)
Exploration of learning curves for simulation-based training in hip-fracture surgery

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Background: Several studies describe virtual reality (VR) simulators conveying training in osteosynthesis of hip fractures and their metrics’ ability to differentiate between novices and experts. However, there is no evidence in simulated hip fracture surgery supporting a pass/fail standard based on proficiency. The aims of the study were to determine when novices and experts reached their learning plateau and to establish a pass/fail performance standard for trainees based on experts’ performance.

Method: Thirty-eight orthopedic interns and eight consultants were included for simulation with cannulated screws, Hansson Pins and sliding hip screw on Swemac’s TraumaVision, which has metrics with established validity evidence. The training ceased when a participant failed to improve the combined score for three consecutive times and a plateau score was defined as an average of combined scores of the last four tries.

Results: The novices trained for 168.5 minutes (range 82.1-295.5, SD: 52.1) compared to 143.3 minutes (range 83.1-198.9, SD: 40.9) for the experts. The highest achieved combined scores for novices was 92.0% (range 82-98%, SD: 4.2) and the experts 95.6% (range 92-98%, SD: 1.9), p=0.022. The plateau scores were 84.9% for the novices (range 60-98%, SD: 7.7) and the experts 92.4% (range 84-97%, SD: 4.0), p=0.011. A pass/fail standard for the plateau score using contrasting groups’ methods was 88%. Time needed to train to plateau was highly variable for both groups. The participants trained to a plateau without the motivation to attain a predefined standard and hence it cannot be concluded that the novices trained to their best of their ability, why we are reluctant to use contrasting groups’ method to establish a criterion for proficiency, but prefer a mastery performance criterion.

Conclusion: The variability of time spent to reach plateau emphasizes that simulation-based training should continue to a predetermined criterion with supporting validity evidence. We suggest a mastery learning criterion of 92 % based on the experts’ average plateau score.
Take-home message: A plateau score of 92% on Swemac Traumavision VR trainer for hip fracture osteosynthesis is recommended as a mastery learning pass/fail standard.

7DD5 (1030)
Development and validation of a canine castration model and rubric

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Background: Veterinary educators use models to allow repetitive practice of surgical skills leading to clinical competence. Canine castration is a commonly performed procedure that is considered a day one competency for a veterinarian.

Method: This study sought to create and evaluate a canine pre-scrotal closed castration model and grading rubric using a validation framework of content evidence, internal structure evidence, and relationship with other variables. Veterinarians (n=8) and students (n=32) were recorded while performing a castration on the model and provided survey feedback. A subset of the students (n=7) then performed a live canine castration with scores compared to their model scores.

Results: 100% of the veterinarians and 91% of the students reported that the model was helpful in training canine castration. They highlighted several areas for continued improvement. Veterinarians’ model performance scores were significantly higher than students’, indicating that the model had adequate features to differentiate expert from novice performance. Students’ performance on the model strongly correlated with their performance of live castration (r=0.82). Surgical time was also strongly correlated (r=0.70). The internal consistency of model and live rubric scores were good at 0.85 and 0.94, respectively.

Conclusion: Validation of the model and rubric was supported by the framework. The canine castration model facilitated cost-efficient practice in a safe environment where students received instructor feedback and learned through experience without the risk of negatively impacting a patient’s well-being. Strong correlation between model and live animal performance scores suggest that the model could be useful for mastery learning, where students are promoted to live surgery only after demonstrating a set level of competence in this procedure.

7DD6 (1490)
Improving basic surgical skill with suture practice assignment at home for medical students

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Background: The limited time to practice during practicum becomes a problem for students to have good basic surgical skills. Home assignment of making some types of sutures such as simple interrupted sutures, continuous sutures, horizontal mattress sutures and vertical mattress sutures is expected to be a solution.

Method: A cross sectional descriptive analytic study was carried out on total sample of 20 students that divided into two groups. Group A, group of 10 students were given four kinds of sutures (simple interrupted sutures, continuous sutures, horizontal mattress sutures and vertical mattress sutures) tutorial and they were given assignment to do the four kinds of sutures at home every day and collected in the next day for seven days. Group B, group of 10 other students that were only given four kinds of sutures tutorial and opportunities to try independently during the practicum and allowed if they want to practice any of the time in the practicum room. After one week, an assessment was done based on the time it takes for each student to do four types of sutures.

Results: Data analyzed with independent T-test. There were significant differences between two groups (sig.(2tailed) 0,00 < 0,05). The average time from group A to make the four types of sutures is 283 seconds while group B obtained the average time making the four types of sutures is 374 seconds.

Conclusion: From the evaluation result it was found that there was significant time difference between group A that were given assignment with group B that were not given assignment to practice at home. The method of assignment is still effective in the world of education, a significant result indicates that individual awareness only is not optimal enough if it is not accompanied by other factors.

Take-home message: Home assignment is effective to improve learning outcome especially for limited time practicum conditions.
Cricothyroidectomy 3D Simulation Model

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Background: Cricothyroidectomy is an emergency life-saving surgical procedure performed on the airway. Cricothyroidectomy training is crucial to ensure the competency of our doctors. This entails thorough knowledge of the procedure, steps, airway anatomy, and ability to detect subtle surface anatomy to perform the procedure with confidence.

Current available model in cricothyroidectomy simulation teaching is not anatomically accurate, and is unable to replicate real life tactile sensation. We hope to improve this with our model.

Method: We utilized an amalgamation of 3D printing resources and produced a prototype model of the laryngeal framework to replicate the surgical field over the neck. The skin substitute made from an admixture of silicon materials bears close resemblance to skin thickness and feel, allowing for accurate tactile simulation. Performing the cricothyroidectomy procedure on the prototype model closely replicates the actual surgical procedure. With the prototype, we conducted training sessions for our junior medical officers. We evaluated their confidence in performing the procedure with a survey with both qualitative and quantitative elements before and after the training session.

Results: Our simulation model is anatomically accurate and silicon replica as skin substitute accords reasonable real-life simulation. Confidence scores of seven participants improved after the training session over all domains (Understanding of airway anatomy, Ability to surface mark, Procedural Steps, Performing the procedure). After the training session, all participants were assessed to be competent by a senior ENT surgeon. A significant residual concerns participants have is the challenge of performing the procedure under time constraints, with anatomical or positional variation in real life scenarios.

Conclusion: An anatomically accurate 3D simulation model for cricothyroidectomy is an advancement in the training of this critical procedure. Trainees were competent after the training session. They are also more confident in performing the procedure.

Interprofessional team-based in situ simulation in the intensive care unit

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Background: Most teaching hospital provide off-site simulation, but within the hospital in-house training center in Taiwan. Interprofessional teamwork training can reduces clinical errors. We design interprofessional, team-based in situ simulation courses for patient safety. The course focused on critical thinking, problem solving, effective communication and collaboration.

Method: The in situ, announced simulation course was held monthly in the intensive care unit. The participants were chosen from nurse, nurse practitioners, respiratory therapy or residents based on clinical scenario. To evaluate the teamwork and management critical patients after course, the database of reporting system of patient safety was applied.

Results: Participants were satisfied to join the simulation course and had feedback with benefit to their clinical work, especially in communication. The quarterly database of reporting system showed no improvement of patient safety. The published studies indicated in situ simulation may be more effective than other types of simulation model in medical education. In situ simulation provides participants realistic condition and environment for achieving the learning objectives. Our finding showed the interprofessional team-based in situ, announced simulation course can help participants to have effective communication. To improve patient safety in the intensive care unit maybe need continuous and more authentic learning course.

Conclusion: Designing interprofessional, team-based simulation course was challenging, and we think the in situ, announced simulation course can provide learner to get more real experience for patient safety in the teaching hospital.
Using a 360° video based Virtual Reality environment of a kidney transplantation and donation procedure in different phases of the medical curriculum

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Background: 360° degree Virtual Reality (VR) is a digital technology where learners using VR equipment are able to "look around" in an artificial world. The VR experience gives medical students the opportunity to be involved in activating experiences and to be engaged in actual clinical situations before entering these in real life. To our knowledge this technology has not yet been applied in teaching medical students on the topic of renal transplantation procedures.

Method: Two 360° videos of an actual kidney donation and transplantation procedure were recorded at the Leiden University Medical Center. Both the 360° view of the operating room and the direct surgical view were incorporated in the VR environment. The 360° video was shown to fourth year medical students and surgical residents equipped with 3D glasses. During and after watching the video, the students took additional assignments focusing on observed behavioral skills in the operation room and the student’s knowledge regarding different tasks of the operating team and procedure.

Results: The medical students experienced the 360° video realistic and stated unanimously that they had a better idea of what actual participation in operative procedures would be like, and which role every professional has. This preparation was found to be superior to immediate exposure during internships. Students indicated VR is an inspiring addition to traditional course materials, and helps them to feel better prepared for complex and dynamic environments such as the operating room. Surgical residents indicated that the environment would be helpful in preparing for assisting in the operation room. Introducing VR in the medical curriculum provides students and residents with more adequate preparation for live situations in the operating room. When clear learning goals and focussed learning assignments are provided, the same VR environment can be used for teaching different target audiences, ranging from medical students to experienced doctors.

Conclusion: Virtual Reality can be used in different phases of the medical curriculum to teach both behavioral skills and content knowledge.
7DD1 (2825)
Early simulated surgical practice improves learning effectiveness and attitude in clerkship

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Background: Clerks under the new academic system are facing the challenge of shortened training time from 7 years to 6 years by Taiwan’s medical education system. The Tzuchi “Basic skill learning programs on cadavers” for the 7th-year internship are changed to the 5th-year clerkship who has no clinical experience before and there are two-years of overlapping periods for this two different systems. This study will clarify if the goal of building the self-confidence and adaptation in the clinical environment have the same effectiveness in the new system.

Research Method and Structure: Quantitative

Method: Due to medical education system reform, there were two group clerks six-year (no clinic experience) and seven-year (two years of clinic experience) were tested. After standardizing the teaching of simulated surgeries, the survey was conducted using the questionnaire on “Effectiveness of Clerks in Learning Clinical Skills. Questionnaire”. Descriptive statistics are presented in times, percentage, average, and standard deviation. The results of questionnaire analysis are compared by independent sample T test, with p <0.05 being a significant difference.

Results: A total of 58 questionnaires, 36 from 5th-year clerks (male 22, female 14) and 22 from 7th-year clerks (male 11, female 10), were collected from September 2017 to January 2018. The results show the benefits for clerkship on familiarizing with the clinical settings and procedures and elevating self-confidence. In surgical skills, lack of previous clinical experience is the weak point on strengthening their spatial sense, confidence of clinical practice, and understanding the surgical impacts on patients. The clerks with no clinical experience focus more on basic skills, procedures, and are more dependent on teacher’s teaching. By operating on the cadavers, the clerks can establish a physician’s identity sooner and a more positive learning attitude.

Conclusion: As far as experiential learning, the clerks’ early participation in simulated surgery courses may promote their confidence and positive attitudes in the workplace, and the clinical experience has vital impact in the training course. Based on this study, learner-centered training programs will be the principle in the future.

7DD12 (3495)
Laparoscopic Surgery: Based in Illumination Training System (Bits) Face, Content and Construct Validity

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Background: The purpose of this work is to present and validate BITS (Based in Illumination Training System), an inanimate, low-cost and low-technology model, as a tool for laparoscopic surgery training. To determine the usefulness of this system was used face, content and construct validities

Method: We evaluated 16 participants divided into two working groups, experts and novice surgeons. Both groups made three BITS exercises and results were compared based on time, number of errors, and object drop while performing tasks. Participants completed a post-study questionnaire to evaluate face and content validity.

Results: The expert surgeons group made the three exercises faster, making fewer errors, and with less object drops than the novice surgeon group, showing significant statistical differences between the two groups. Expert participants found the model acceptable and rated the model favorably in terms of content and face validity.

Conclusion: The model described proved to be able to differentiate between novices and experts surgeons, and the experts surgeons rated the model favorably in terms of content and face validity, which validates this as an useful tool for laparoscopic surgery training.

Take-home message: BITS is a validated model for laparoscopic surgery training.
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Background: Our initial course design was to apply over-learning theory using high fidelity simulation as a tool to facilitate team skills learning for final year medical students in emergency medicine clerkship.

Method: We have designed four short emergency scenarios in a 3-hour session in which small group of students were put into a fully immersed critical situation with instructors played as nurses. Video-assisted debriefing was carried out immediately after each scenario with team-skills as main learning objective. Students were asked to complete an evaluation form including their learning points and feelings. Instructors’ observation and recommendations were also collected after the course. These data were then process through thematic analysis.

Results: Besides our main learning objective of team-skills were well-received by the students, they have highlighted a few more important learning points which include:

- increased self-awareness of knowledge deficit.
- increased awareness of the gap between knowledge and its application.

From the feedback of instructors, we also identified some important issues that should be incorporated into our future teaching. One of them is the observation of unsafe behavior among students when encountering critical patients especially in time pressure. Timely debriefing and correction of unsafe behavior could avoid serious mistake and promote patient safety.

Conclusion: Simulation training allow medical students to learn skills not easily achieved by other training strategy in medical school (such as team skills) and debriefing can increase their self-awareness. High fidelity simulation can surface unsafe behavior among students before they enter clinical practice and it could enhance patient safety in the future.

Take-home message: Medical students should undertake more high fidelity simulation training before graduation.

Conclusion

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Presenters: Dean Malik, Imperial College NHS Healthcare Trust, London, UK

Background: Immersive 360 degree headset virtual reality (VR) experiences are now widely available, from museum tours to hyper-reality movie experiences. Their immersive and engaging properties are being explored in medical education. Recent studies have demonstrated effective knowledge retention and attentiveness in surgical training compared to standard 2D videos but, due to high cost, exposure of trainees to this technology is still limited. We sought to establish whether relatively low fidelity, easily accessible smartphone VR experiences could be used for effective knowledge acquisition in surgical trainees.

Method: A commercially available 360 degree camera (Ricoh Theta S, Ricoh Company LTD) was used to record a Dynamic Hip Screw Operation. The surgeon talked through the surgical steps throughout with anatomical diagrams and radiographs overlaid in post production at relevant intervals. Postgraduate surgical trainees were shown the video using a free smartphone application and a generic smartphone headset cradle. Candidates’ head movements were recorded throughout the experience to observe if their attention deviated from the intended focus of the scenario. Feedback was obtained via a short survey upon completion.

Results: 20 surgical trainees at various stages of training (FY2 to SpR) partook in the study. All candidates viewed the video to completion with no interruptions. 100% stated they thought it was a useful training tool. Specific benefits highlighted over 2D video were immersion, entertainment, engagement and the potential to experience the scenarios at their discretion and avoid the need to attend a simulation lab. Head movement observation demonstrated high levels of engagement. Surgical trainees of varied experience and seniority all found this technology engaging and useful. All candidates stated they would actively engage in an online library of similar scenarios for training purposes.

Conclusion: Our setup is cost-effective and easy to distribute allowing trainees to experience immersive VR training whenever they wish just by using their phone. Creation of these scenarios is straight forward and requires little expertise. There is therefore significant potential to create a large library of VR scenarios than can be distributed to trainees via the internet or smartphone app.
A randomised pilot study comparing structured vs unstructured delivery of teaching and its impact on surgical skill knowledge acquisition

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Presenter: Prasanna Raj Supramaniam, Oxford University Hospitals NHS Foundation Trust, Oxford, UK

Background: Surgical training lags behind the advancements in endoscopic techniques. The European Working Time Directive has impaired the ‘apprentice’ model, with increasing required levels of competency and evolution in medical ethics making performing clinical procedures on patients for the first time no longer acceptable. The Royal College of Obstetricians and Gynaecologists actively advocate the use of simulation training, to provide a safe environment for surgical skill acquisition. Unfortunately, access is limited secondary to resources, expense and time constraints. This study compares whether the order of lectures, structured simulation and time for simulation practice has an impact on their knowledge retention and ability to complete the 10-steps required to perform a diagnostic laparoscopy.

Method: A randomised study including 20 first and second year O&G trainees. Each participant completed 15 true/false questions and listed the 10-steps required to perform a diagnostic laparoscopy. All participants received the same didactic lectures and were then randomised into two groups. Group A had solo practice with a laparoscopic box trainer, followed by a structured facilitator-led dry lab simulation session. Group B was given the structured session prior to the solo practice time. The same 15 questions and 10-step list task were repeated by all participants. Statistical analysis was performed using the paired t-test.

Results: Both groups had similar prior experience. Both groups demonstrated an improvement in their score, significantly greater for Group B (11% vs 28%, p=0.017, 95%CI 0.38-3.49). The greatest improvement was from the 10-step list task, (A vs B: 13% vs 26%, p=0.006, 95%CI 0.64-3.36).

Conclusion: Simulation training is demonstrated to significantly improve knowledge retention, particularly when structured. This supports ‘Kolb's learning cycle', suggesting that structured teaching can help maximise learning potential. However, learning is still demonstrated when the delivery is unstructured, emphasising that different learning methodologies do increase knowledge, albeit to a different degree.

Take-home message: Structured simulation training is superior for knowledge acquisition of surgical procedures.