



Simulation in Education Free Papers

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Hall 3B

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EFFECT OF VIRTUAL REALITY TRAINING ON LEARNING TOTAL HIP ARTHROPLASTY: A RANDOMISED CONTROLLED TRIAL

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Background: Virtual Reality (VR) uses headsets and motion-tracked controllers so surgeons can perform simulated open procedures in a fully-immersive operating theatre. The aim of this study was to investigate the learning effect of proficiency-based VR on trainees performing total hip replacement (THR).

Methods: Twenty-four surgical trainees with no prior experience of direct anterior approach THR were randomised to either a six-week protocol of VR simulator training or 'best available' education alone (surgical manuals, videos and observing surgery). Trainees then performed THR on donor bodies. Performance was measured on an ISCP procedure-based assessment (PBA), assessed by two blinded hip surgeons. Secondary outcome measures were completion of steps on a task-specific checklist (TSC), error in cup orientation (target: 40° inclination, 20° anteversion), and operative time.

Results: Surgeons trained using VR performed THR significantly better than controls. On average, VR-trained surgeons performed THR at PBA Level 3a (Procedure performed with minimal guidance or intervention) and controls at Level 2a (guidance required for most/all of the procedure or part performed). There was high inter-rater reliability ($k = 0.891$). VR-trained surgeons also had higher TSC scores (22 vs 12), were 12° more accurate in cup orientation (Error 4° vs 16°), and 18% faster (42 vs 51 minutes).

Discussions: Procedural knowledge and psychomotor skills learnt in VR were transferred to the real world. Conventional preparation had limited value for novice surgeons learning THR. VR training advanced them further up the learning curve, enabled highly precise cup orientation, and more efficient surgery.

Implications: Virtual reality can augment surgical training for open procedures in orthopaedics, so opportunities in real surgery can be maximised. This has implications for how surgical training is delivered for surgeons learning complex open procedures.

Disclosure: This study was partly funded by DePuy Johnson & Johnson.

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CHICKEN OR THE THUMB? COMPARING CHICKEN THIGH BONES TO HUMAN METACARPALS

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Introduction: Gold standard for simulation training in hand surgery is cadaveric hands, however ethics and cost limit their use. Chicken thigh bones have been utilised to replicate metacarpals, however there is a lack of literature to validate such a model. We aim to determine whether chicken femurs are morphologically similar to human metacarpals.



Materials and methods: Computed tomography scans of hands undertaken at our institute between 1st January and 31st December 2015 were obtained. One hundred and fourteen chicken thighs were also scanned. Bones with previous trauma or incomplete images were excluded. Bone length, distance to isthmus, radius of curvature (ROC), medullary canal diameter and cortical thickness was compared between the groups. Statistical analysis was performed using Student's t-test or Mann-Whitney U test, with statistical significance implied with P-value < 0.05.

Results: Forty-six human CT scans identified, of which 36 were included, resulting in 158 human metacarpals in 5 females and 31 males, with an average age of 39.5 years (range: 16 - 77). Of 114 chickens scanned, 101 were suitable for analysis. Mean length, distance to isthmus, ROC, medullary canal diameter and cortical thickness was 57.3 +/- 8.7mm, 32.9 +/- 8.2mm, 68.8 +/- 19.5 degrees, 9.3 +/- 1.6mm and 1.7 +/- 0.4mm respectively in human metacarpals, compared to 66.7 +/- 5.1mm, 34.1 +/- 6.4mm, 89.1 +/- 15.1 degrees, 6.4 +/- 0.6mm and 1.6 +/- 0.1mm respectively in chicken femurs. There was no significant difference in bone geometry between the groups with p value of 0.181, 0.483, 0.199, 0.541 and 0.550 respectively for the parameters described.

Conclusions: The chicken thigh model provides an anatomically suitable alternative to cadaveric metacarpals in simulation training for hand surgery.

Disclosure: Nothing to disclose.

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A MULTICENTRE RANDOMISED CONTROLLED TRIAL EVALUATING THE EFFECTIVENESS OF COGNITIVE TRAINING FOR ANTERIOR APPROACH TOTAL HIP ARTHROPLASTY

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Background: For total hip arthroplasty (THA), cognitive training prior to performing real surgery may be an effective adjunct alongside simulation to shorten the learning curve. This study sought to create a cognitive training tool to perform anterior approach (AA) THA, validated by expert surgeons; and test its use as a training tool compared to conventional material.

Methods: We employed a modified Delphi method with four expert surgeons from three international centres of excellence. Surgeons were independently observed performing THA before undergoing semi-structured cognitive task analysis (CTA) before completing successive rounds of surveys until consensus. Thirty-six surgical residents (PGY1-4) were randomised to cognitive training or an operation manual with surgical videos, before performing a simulated AA-THA.

Results: A consensus CTA defined THA in 11 phases in which were embedded 46 basic steps, 36 decision points, and 42 critical errors and linked strategies. This CTA was mapped onto an open-access web-based learning tool. Surgeons who prepared with CTA performed a simulated THA 35% more quickly (time: 26 vs 36 minutes and procedural steps: 64 vs 78), with 69% fewer errors in instrument selection (22 vs 34 instances) and required 92% fewer prompts (six vs 19 instances). They were also more accurate in acetabular cup orientation (inclination error: 7° vs 12°, anteversion error: 11° vs 19°).

Conclusions: This is the first validated cognitive training tool for arthroplasty. It provides structure for competency-based learning of this complex procedure. It is more effective at preparing orthopaedic trainees for a new procedure than conventional materials, for learning sequence, instrumentation and motor skills.

Implications: Cognitive training combines education on decision making, knowledge and technical skill. It is an inexpensive technique to upskill surgeons to perform hip arthroplasty and more effective than current preparation methods for residents.

Disclosure: Nothing to disclose.



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REDUCING FOUNDATION DOCTORS STRESS AND ANXIETY IN MANAGING THE MULTIPLY INJURED PATIENTS: VIRTUAL REALITY FULLY IMMERSIVE INTERACTIVE VIDEOS

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Background: Foundation doctors rotate every four months across a range of primary and secondary care specialties. Each specialty requires a range of different skills which can be a source of stress. Almost 25% of doctors in training reported feeling burnt out. Within orthopaedics management of multiply injured patients and attendance at trauma calls is an area in which they have limited experience. We sought to assess foundation doctors' levels of anxiety, stress and confidence in managing trauma patients comparing tutorial teaching vs virtual reality fully immersive interactive teaching (VR FITT) videos.

Methods: Fourteen foundation doctors were divided into two groups. One group underwent a tutorial-based teaching programme. The second group underwent VR FITT. The doctors' self-reported levels of anxiety, stress, and confidence were assessed.

Results: Both groups had minimal experience of trauma calls with the 93% having never attended a trauma call. The average level of anxiety was 8/10 for attending trauma calls at the start of the job. The VR FITT group showed significantly reduced stress and anxiety self-assessed scores when compared to the traditional group. All of the VR FITT group reported the educational tool to be "beneficial to their knowledge of managing multiply injured patients".

Conclusions: Within orthopaedics the use of VR FITT has shown to significantly reduce the levels of stress and anxiety amongst foundation doctors.

Implications: VR FITT is an efficient and cost-effective educational tool to allow junior doctors to safely experience clinical scenarios in which they have limited knowledge or experience.

Disclosure: Nothing to disclose.

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IMPROVING TRAUMA AND ORTHOPAEDIC UNDERGRADUATE EXPERIENCE: ADOPTING A MODERN TEACHING APPROACH TO CURRICULUM DELIVERY

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Background: The Orthopaedic rotation was ranked one of the lowest specialties at the University of Edinburgh resulting in a negative perception of surgery to medical students. Teaching was delivered through didactic lectures combined with clinical placements that lacked focus and continuity. The introduction of a dedicated clinical teaching fellow in 2015 led to an overhaul and restructuring of the fourth-year placement. This resulted in significant and sustained improvements with the block now rated as the most popular specialty of the year.

Aims: To outline the curriculum reform and strategy of our experience.



Methods: Several areas for redesign were addressed:

- Consolidation of learning objectives
- Active tutorials with a “flipped classroom” approach to replace didactic lectures
- Paired consultant tutor system for continuity in clinical placement
- Self-directed sign-up clinical sessions
- A work book to guide learning objectives on clinical placement.

End of year student feedback from the University of Edinburgh was used to measure the impact of the redesign over the subsequent four years following restructuring.

Results: Baseline student feedback from the end of the academic year in 2015 (n = 109) was referenced against 2018 (n = 113). Learning objectives were perceived to be clear by 61.9% (strongly agree/agree) in 2015 and 93.7% in 2018. The relevance of the clinical placement for learning increased from 48% to 91.3%. Teaching being rated as high quality increased from 74.3% to 97.8%.

Overall 57.8% found the block excellent or good in 2015 versus 91% in 2018. Free text and qualitative feedback reflected positive engagement in the interactive tutorials, student-led autonomy in the block and improved continuity with tutors.

Conclusions: A modern approach to curriculum delivery has led to a sustained ongoing improvement in the Orthopaedic block. Our approach may be of value for other University surgical departments to identify key areas for improvement.

Disclosure: Nothing to disclose.

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SAS DOCTORS AND FRCS TRAUMA & ORTH - HOW MUCH DOES IT COST?

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Background: There are 72,958 SAS doctors practicing in UK of the total doctors registered with GMC. These doctors form a vital part of the NHS. They sometimes struggle to pass the exit examination in any speciality and thereby get their name on the specialist register via the Certificate of Eligibility for Specialist Registration route in order to become a consultant. The aim of the study was to estimate the financial impact of passing the FRCS (Tr & Orth).

Methods: We did a randomised selection of 50 SAS and 50 trainees from different online groups that doctors were using to guide and chat with each other while preparing for FRCS Tr & Orth exam. The questionnaire included the age, sex, number of years in orthopaedics, time spent for preparation, number of courses done before the exam, course fee, travel and accommodation expenses, number of attempts and gap between taking Part 1 and Part 2. All the data were analysed on Microsoft Excel 2010. The data was collected from GMC data explorer as well as from the Joint Committee on Intercollegiate Examinations.

Results: Ninety-four percent of SAS doctors and 78% of trainees responded. For the SAS doctors, all were male with an average age of 39 years. They are in this speciality for an average of 12 years, and did nine clinical courses before the exam. The average number of attempts to pass Part 1 was 2.7 and to pass Part 2 was 3. The average cost of passing the exam was around £18,750 per person. Two females and 37 males with an average age of 34 years, at ST8 level participated. The average cost of passing the exam was £2,508.



Conclusions: SAS doctors spent more time and money to pass FRCS Tr & Orth exam compared to trainees and the overall pass rate for SAS is only 30% while the pass rate for trainees is 85%.

Disclosure: Nothing to disclose.

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THE USE OF A SURGICAL SIMULATOR TO DEVELOP KNEE ARTHROSCOPY SKILLS

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Background: The use of simulators in surgical training is increasing. New simulators have recently been developed to improve knee arthroscopic skills. We wanted to demonstrate the effectiveness of surgical simulators in improving knee arthroscopy skills in junior surgical trainees.

Methods: We organised a knee arthroscopy educational day for junior surgical trainees using knee arthroscopy simulators. Trainees had to complete a range of different assessments, which included diagnostic arthroscopy, triangulation skills, foreign body retrieval and meniscal resection. Performances were graded by the simulator, from 0 to 10, based on time taken to complete the assessment, safety in preventing iatrogenic damage and efficiency of movements. Trainees repeated the same assessments, later in the day, to assess whether their performance had improved.

Results: Overall simulator performance scores significantly improved from a mean 5.8 to 8.0 ($p = 0.002$). The time to completion of the assessment, also improved significantly from mean 4.6 to 7.9 ($p = 0.005$). There were also non-significant improvements in both safety and efficiency of arthroscopy. Feedback obtained from the surgical trainees after the course, indicated that they particularly enjoyed the use of simulators to train arthroscopic skills and that, as a result, they would feel more confident with performing knee arthroscopy in the operating room in future.

Conclusions: The use of a surgical simulator to develop knee arthroscopic skills is an effective way of delivering surgical training. The simulator helps surgical trainees to build up their arthroscopic skills in a controlled environment and provides them with an objective analysis of their performance.

Implications: Surgical simulators can be used to develop knee arthroscopy skills and in future could be routinely employed as part of orthopaedic training to improve registrar arthroscopic skills.

Disclosure: Nothing to disclose.

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USING THE IMMERSIVE AND ENGAGING PROPERTIES OF 360° VIRTUAL REALITY TO DELIVER COST-EFFECTIVE, ACCESSIBLE SURGICAL TRAINING

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Background: Virtual reality (VR) experiences are now widely available, from museum tours to hyper-realistic movie experiences. Their immersive and engaging properties are now being widely explored in medical education. Recent studies have demonstrated effective knowledge retention and attentiveness in surgical training compared to standard video, however, due to high operational costs, exposure of this technology to trainees is still limited. Our study sought to establish whether low cost, accessible smartphone VR experiences could be used for effective knowledge acquisition in surgical trainees.



Summary of Work: A commercially available 360-degree camera was used to record a dynamic hip screw operation. The surgeon described the surgical technique throughout and anatomical diagrams and radiographs were overlaid at relevant intervals. 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 remained on the intended focus of the scenario. Feedback was obtained via a short survey upon completion.

Summary of Results: Twenty surgical trainees at various stages of training (FY2 to SpR) partook in the study. One hundred percent of participants stated they thought it was a useful training tool. Specific benefits highlighted over 2D video or other methods of surgical training were immersion, entertainment, engagement and the potential to experience the scenarios at their discretion while avoiding the need to attend a simulation lab. Head movement observation demonstrated high levels of engagement.

Take home message: Our setup is cost-effective and easy to distribute. It allows candidates to experience immersive VR training whenever they wish just by using their phone. Creation of these scenarios is straightforward and requires little expertise. There is therefore potential to create a large library of VR scenarios that can be distributed to trainees via the internet or smartphone app.

Disclosure: Nothing to disclose.

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MASTERY LEARNING FOR KNEE ASPIRATION. IMPROVING SERVICE DELIVERY IN THE EMERGENCY DEPARTMENT (ED)

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Background: Aspiration is the decisive investigation in the management of the acutely hot swollen knee. With limited available expertise to carry out the procedure, previous work revealed that patients regularly suffered a prolonged delay to treatment in our Emergency Department (ED). Following this a regional mastery programme was developed to train health professionals in knee aspiration with the principal aim of improving patient care in the ED.

Aims: To evaluate the introduction of a mastery knee aspiration programme to patient care in the ED.

Methods: A simulator model was acquired (£1,800 Limbs & Things, UK) and education online pack with demonstration video was produced to review before the training session for a "flipped classroom" approach. Health professionals self-enrolled on the course following a discussion with the ED outlining the potential for service improvement. A prospective quality improvement project was established from October 2018 to audit the impact and safety of the intervention.

Results: A total of 20 health professionals underwent mastery knee training (ED registrar n = 11, ANP = 9). 80% had no training or experience in aspiration prior to intervention. All candidates would recommend the programme to a colleague and felt confident to perform aspiration following the training.

A prospective audit following the intervention identified aspiration was undertaken in the first 20 patients. Aspiration was performed by Orthopaedics only 10% (2/20) of the time versus baseline at 58% (49/85) ($p < 0.001$). The time to aspiration reduced from 227.1 minutes (SD 68.7) to 155.6 minutes (SD 56.6) ($p = 0.02$ paired t test). Overall 45% of patients breached versus 66% (56/85) prior to intervention ($p = 0.08$).

Conclusions: A mastery knee aspiration programme to enable ED staff to perform knee aspiration has improved time-to-treatment and reduced ED breaches. Our experience may be of use to other hospitals wishing to implement a change in service delivery.

Disclosure: Nothing to disclose.