Training young adult hip surgeons for the future: the Cambridge vision

Surgery is a form of art which has transformed over the last six centuries from an individual's craftsmanship to a team-based approach to ensure patient safety.[1] Surgical training has also seen a compelling change from being a primarily apprentice-based training to a competency-based model.[2,3] Although the traditional model of apprentice-based training is still valid in modern surgical training, there has been a gradual shift over the last two decades towards achieving specific competencies in an objective manner to deliver safe surgical care.[2,3] There are several reasons for this change. A reduction in working hours in the UK and Europe, as dictated by the European Working Time Directive (EWTD), has reduced the total training time between qualification and becoming a consultant (specialist) from 30 000 hours to 6000 hours.[4] This five-fold reduction in hours has not only reduced the amount of surgical exposure gained by the resident during training, but has also resulted in significant variability in the orthopaedic caseload for the trainee.[5-8] In parallel with this, the introduction of consultant-delivered care in an effort to improve patient outcomes may have an indirect effect on surgical training by reducing the number of cases a resident performs as primary surgeon.[9] A final driving force for the shift in curriculum is the continued evolution of technically demanding surgery with steep learning curves, such as arthroscopy, which is now increasingly performed in orthopaedic practice due to several technical advances.[10-12]

ORTHOPAEDIC CURRICULUM

The current orthopaedic curriculum in the UK is based around three core themes: applied clinical knowledge, applied clinical skills and professional and management skills.[13] Competency-based training encompasses several work-based assessments, of which procedure-based assessment (PBA) is one. PBAs provide the opportunity for a detailed assessment of one's knowledge and ability to perform a procedure in 14 different domains.[14] Trainees are recommended to undertake several PBAs during their training programme, to provide objective evidence of improvement or otherwise in a specific procedure. PBAs are also a useful tool for the assessment of the trainee's progression in performing a specific procedure through their orthopaedic training, to the level needed to confidently undertake the procedure and handle complications if necessary.[14] Current literature suggests that this structured, competency-based training offers acceleration in achieving competency and a greater ability to detect and assist a struggling trainee.[15,16]

The use of simulation in training procedural skills is recognised by the surgical curriculum and can provide feedback to trainees on both technical and non-technical skills.[17] This has also been shown to translate across to improved performance in the real-life situation.

SIMULATION AND CADAVERIC TRAINING IN ORTHOPAEDIC SURGERY

As part of this evolution in orthopaedic training, the British Orthopaedic Association (BOA) Trauma and Orthopaedic (Tr & Orth) curriculum now includes the use of simulation to enable trainees to practise procedural and surgical skills in a risk-free environment, helping them

Karadi H. Sunil Kumar *MRCSEd, MCh Orth, Dip (SEM), FEBOT*
Specialty Registrar in Trauma & Orthopaedics, Addenbrooke's Hospital, Cambridge University Hospitals NHS Foundation Trust, UK
John E. Lawrence *MA (Cantab), MB BChir, MRCS*
Core Surgical Trainee in Trauma & Orthopaedics, Addenbrooke's Hospital, Cambridge University Hospitals NHS Foundation Trust, UK

Vikas Khanduja *MA (Cantab), MRCS (G), MSc, FRCS, FRCS (Orth)*
Consultant Orthopaedic Surgeon, Addenbrooke's Hospital, Cambridge University Hospitals NHS Foundation Trust, UK
Email: vk279@cam.ac.uk

Fig. 1 Simbionix Arthro Mentor hip arthroscopy simulator.

overcome the initial part of the learning curve outside of the operating room.[13] The Tr & Orth curriculum proposes three main approaches to simulation, two of which involve cadaveric surgery and virtual reality simulation:[13]

1. Learning a surgical approach in the anatomy laboratory, followed by dry lab simulation using dry bones, models and/or simulators, followed by cadaveric surgery where possible.
2. Learning a surgical approach in the anatomy laboratory, followed by wet lab simulation using animal models and/or simulators, followed by cadaveric surgery where possible.
3. Simulated practical skills using models, simulators and simulated patients, followed by simulated scenarios.

Several studies have validated virtual reality arthroscopy simulators and other 'dry bone' simulations by demonstrating a correlation between a surgeon's experience and their performance on the simulator. Procedures investigated include basic surgical skills such as drilling, hip fracture fixation, complex articular fracture fixation and also arthroscopy of the knee and the shoulder.[18-25] Studies showing that these skills are transferable to the operating room are fewer in number, but provide encouraging results nonetheless.[25-27]

A theoretical benefit of simulation training is that patient safety is not compromised during training, and indeed a recent survey of 159 patients showed that not one of them would feel happy if the operating surgeon had not trained previously on a simulator, with 94% considering simulation compulsory in surgical training.[28]

Cadaveric simulation provides a 'real feel' of surgery so that a skill or procedure can be learned as realistically as possible. Furthermore, a recent study by Chambers et al showed a substantial increase in surgeon confidence following the completion of a cadaveric simulation course for arthroplasty.[29] Cadaveric training can also be used along with simulator training, to enhance trainees' education and improve their performance in a specific and complex surgical procedure or task.

The learning curve for each procedure varies and there is some evidence to support minimum numbers to improve learning curves for specific procedures. Price et al reported that one needs to perform around 170 knee arthroscopies to achieve the proficiency levels of a consultant.[30] Hoppe et al showed that one needs to perform at least 30 hip arthroscopies before one sees a reduction in operative time and complications.[11] Furthermore, Konan, Rhee and Haddad reviewed a single-surgeon series of 100 hip arthroscopies and also found that a minimum of 30 cases were necessary to improve surgical performance and decrease complications.[12]

The duration of orthopaedic higher specialist training in the UK is six years, and a trainee usually spends between six and 18 months on the rotation learning hip arthroplasty surgery.[13] On the other hand, arthroscopic surgery of the hip is an extremely specialist field with very few centres performing this procedure in large numbers. This leads to inadequate exposure to this procedure during general orthopaedic training. To overcome the learning curve, a trainee aiming to take on hip arthroscopy later on in his or her career will need to attend cadaveric courses, simulation training and spend time undertaking a recognised fellowship.

THE HISTORY OF HIP ARTHROSCOPY AND THE CAMBRIDGE HIP COURSE

The credit for performing the first hip arthroscopy in the UK goes to Richard N. Villar, a former SAS military surgeon. In the mid-1980s, Richard Villar corresponded with both James Glick and Richard Hawkins, and began to pioneer hip arthroscopy on this side of the Atlantic, following on from his first successful hip arthroscopy in Cambridge. He then went on to become the founding member and first president of the International Society for Hip Arthroscopy. His textbook of 1992[31] was the first available specifically on the subject and, together with his enthusiastic advocacy and teaching skills, helped to inspire more widespread use of conservative hip surgery in the UK. He continues to practise, teach, and publish on the technique.

The senior author was appointed to Addenbrooke's Hospital in 2007 to continue the development of hip arthroscopy, and the service for young adult hips has grown gradually over the last nine years. The service now accepts referrals from the whole of the East of

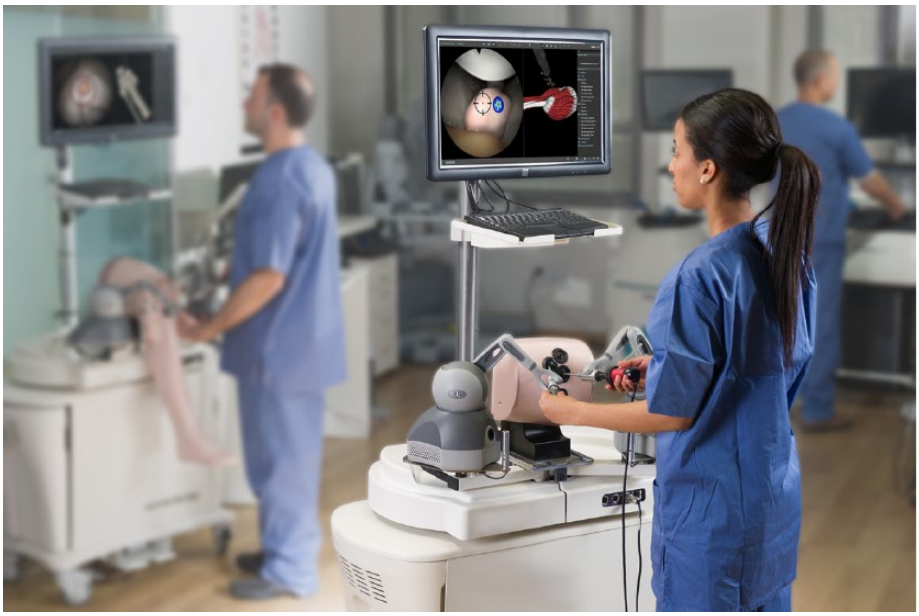

Fig. 2a Participants using the Simbionix Arthro Mentor hip arthroscopy simulator.

Fig. 2b Surgical practice with the Simbionix Arthro Mentor hip arthroscopy simulator.

England and Northern Ireland, and has established pathways for the management of young adults with hip problems. The main reason for the growth has been the ability to deliver a high-quality service and the paucity of well-trained surgeons performing this operation in the region in large numbers. The Cambridge Hip Course was established to overcome this gap, and currently plays an important role in surgical skills training.

The first Cambridge Hip Course was held in December 2015 at the Evelyn Cambridge Surgical Training Centre (ECSTC), in the UK,[32] and was chaired by the senior author with expert faculty in the field from the UK and Europe. The course utilises a dual approach of both simulation and cadaveric training for arthroscopic surgery and joint arthroplasty alike. The ECSTC is a state-of-the-art training laboratory with cadaveric facilities for surgical training in both minimally invasive and open surgical procedures.[32] The centre is designed to simulate theatre conditions, with ten operating stations with fully integrated audio-visual equipment, lights and operating microscope so that training can be provided in an environment which closely reflects the operating theatre.

The course was split over two days, with the first focused on hip arthroscopy and the second on hip arthroplasty. Delegates benefited from close supervision with one faculty member for every two delegates and a series of short lectures were integrated with wet lab and simulator training.

Every participant was also given the opportunity to practise his or her arthroscopic skills on the new Simbionix Arthro Mentor (Simbionix Ltd, Cleveland, Ohio) hip arthroscopy simulator before and after the wet lab session to assess his or her progress (see Figs 1-3). This new virtual reality haptic feedback simulator allowed trainees to initially familiarise themselves with basic visualisation of the hip joint, then progress to a basic probe examination (Figs 4, 5).

The structure of the course was designed specifically to build on the principles outlined in the UK orthopaedic surgical curriculum. Day 1 focused on hip arthroscopy, beginning with lectures on assessment and investigation of young adult hip pain, femoroacetabular impingement (FAI), indications for hip arthroscopy, assessment of outcomes following arthroscopic surgery, rehabilitation protocols and regenerative strategies in the hip. This was followed by a wet lab session focusing on patient set up for hip arthroscopy, portal placement, and assessment of central and peripheral compartment. This gave the participants not only an opportunity to gain hands-on experience of performing hip arthroscopy under expert supervision but also to try out some of the common procedures such as labral debridement, chondroplasty and excision of a cam lesion. The day concluded with the course dinner, allowing informal discussion and to build on the day's learning.

Day 2 concentrated on hip arthroplasty with short, focused lectures on hip biomechanics, cementation techniques, preparation of femur and acetabulum, and different surgical approaches to the hip. The participants again had the opportunity to choose the surgical approach they wished to practise on the cadaver under the supervision of the faculty. This allowed the trainee to tailor the learning experience to suit their needs, with ample opportunity to seek technical advice and obtain feedback and tips on the chosen surgical exposure. The participants were also given the opportunity to implant genuine prostheses, ensuring a high-fidelity training experience. The course concluded following talks on outcomes of hip arthroplasty from the various joint registries and highlighting future advances in hip arthroplasty surgery.

Each of the faculty members was selected not only for their expertise in their field but also to create an approachable and focused environment which catered to the learning needs of the participants, addressing questions raised throughout the course. Simulator training at the beginning and end of the course helped participants to assess the progress achieved with cadaveric surgical training in hip arthroscopy.

The course was an effective example of simulated surgery following the principles outlined by the BOA curriculum. The delegates first were introduced to the anatomy and technique of the

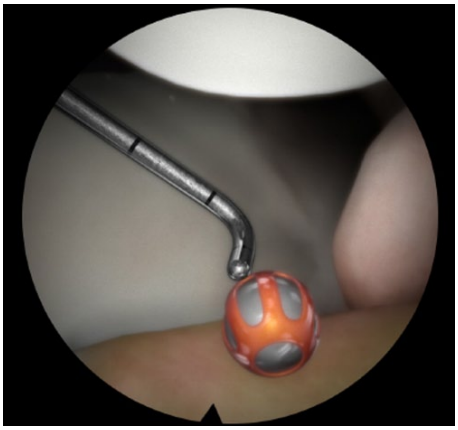

Fig. 3 Basic probe examination.

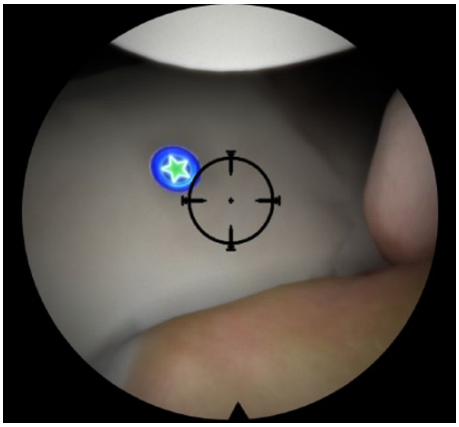

Fig. 4 Visual examination.

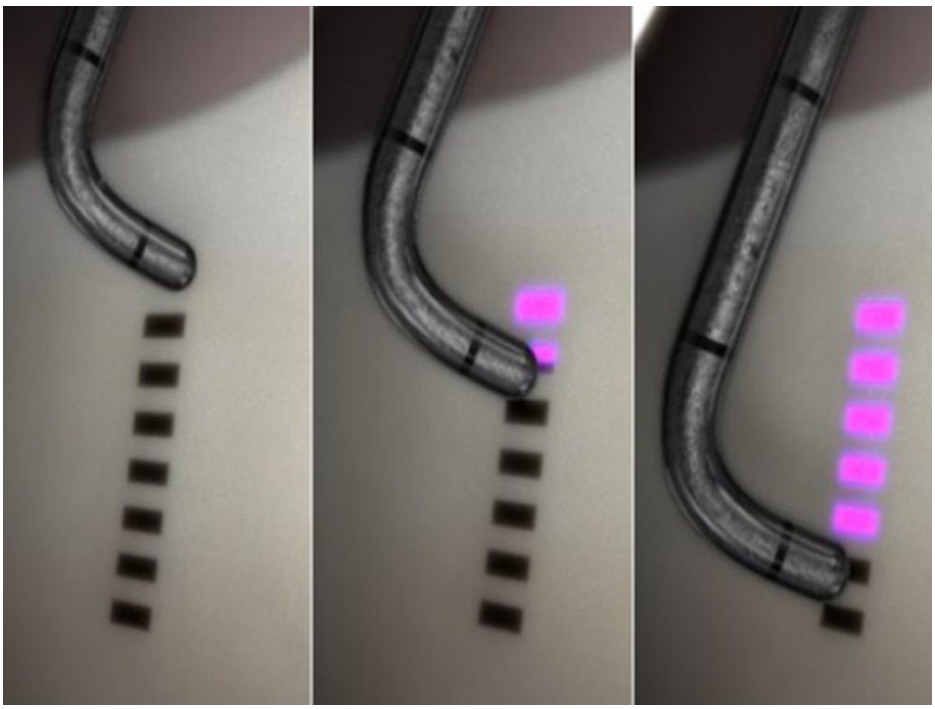

Fig. 5 Probe examination.

various surgical procedures through lectures and a wet lab telecast, before performing simulated surgery using both virtual reality simulation and cadaveric surgery. This structured approach, together with ample faculty, ensured that trainees could achieve their educational goals and was reflected in the overwhelmingly positive feedback at the conclusion of the course.

While encouraged by the curriculum, courses such as this still face some challenges. Although the general feeling among trainers and trainees is that these courses are invaluable, there remains little research into their effect on trainees' performances in the clinical setting.[33] In combination with the high cost of cadaveric programmes, such evidence is likely to be required by education authorities before they can justify the additional expenditure required for the widespread implementation of such courses. The existence of a defined, regional centre such as the ECSTC for cadaveric courses across all specialties can help to reduce these costs and ensure adequate access for trainees in all centres within a region. In the future, the development of a high-quality surgical simulator with the capability to input an individual patient's data may enable the trainee to perform a virtual procedure prior to the actual surgery, leading to a better outcome.[17]

CONCLUSION

Surgical training has evolved significantly, with a marked reduction in the time spent on surgical training. The introduction of competency-based learning paves the way for specific, focused courses providing training on procedures such as hip arthroscopic surgery, an extremely specialist area of orthopaedics. The use of cadaveric and simulator training such as this enhances the learning with better progression through the learning curve, leading to improved patient safety. Courses such as this one are likely to become increasingly important in the provision of specialist training to address gaps in clinical experience.

CONFLICT OF INTEREST

None declared

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