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WRIST

Education in wrist arthroscopy: past, present and future

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Abstract
Purpose Arthroscopy has assumed an important place in wrist surgery. It requires specific operative skills that are now mainly acquired in the operating room. In other fields of endoscopic surgery, e-learning and virtual reality (VR) have introduced new perspectives in teaching skills. This leads to the following research question: Could the current way of teaching wrist arthroscopy skills be supported using new educational media, such as e-learning and simulator training?
Method The literature was searched for available methods of teaching endoscopic skills. Articles were assessed on the evidence of validity. In addition, a survey was sent to all members of the European Wrist Arthroscopy Society (EWAS) to find out whether hand surgeons express a need to embrace modern educational tools such as e-learning or simulators for training of wrist arthroscopy skills.
Results This study shows that the current way of teaching wrist arthroscopy skills can be supported using new educational media, such as e-learning and simulator training. Literature indicates that e-learning can be a valuable tool for teaching basic knowledge of arthroscopy and supports the hypothesis that the use of virtual reality and simulators in training enhances operative skills in surgical trainees. This survey indicates that 55 out of 65 respondents feel that an e-learning program would be a valuable asset and 62 out of the 65 respondents are positive on the additional value of wrist arthroscopy simulator in training.
Conclusion Study results support the need and relevance to strengthen current training of wrist arthroscopy using e-learning and simulator training.
Level of evidence V.

Keywords Education · Wrist · Arthroscopy · E-learning · Virtual reality · Simulation

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Introduction

Since the 1960s, arthroscopy has assumed an important place in the surgery of joints. Compared to open surgery, arthroscopy requires specific operative skills [31, 32, 38]. Many surgeons have acquired their operative skills by operating patients under supervision with gradually more independence (the so-called apprentice system or Halsted model) [16, 22]. Whereas some open surgery skills may be innate, developing naturally because of lifelong experience with basic tools and utensils, skills needed to perform arthroscopy are not naturally derived. For example, arthroscopy requires surgeons to perceive a three-dimensional environment from a two-dimensional camera image [33]. Furthermore, specific hand–eye coordination is required, and the sense of touch is minimal [19]. Finally, every endoscopic procedure poses the challenge of the fulcrum effect. The fulcrum effect is the fact that when the surgeon moves his hand to the right, the working end of the instrument moves to the left on the monitor and vice versa. The surgeon has to compensate for this effect in his brain [14].

In wrist arthroscopy, the placement of the entry portals also poses a particular challenge to the surgeon, as this is a percutaneous procedure in an area with many structures at risk. Profound knowledge of the anatomy of the wrist is important to avoid possible complications.

Medicine has learned from the military and the aviation industry that the basic skills should be acquired in a safe and controlled environment before using it in practice [23, 31, 32, 52].

Another important aspect is that today's residents spend less time in the operating theatre due to the European Working Time Directive (EWTD) mandate. As a consequence, residents have a lower exposure to surgical skills during residency than their trainers had. Furthermore, patient safety issues, reflected in modern legislation, forces the physician to deliver maximum quality. This makes it unacceptable for any surgeon to perform a procedure on a patient as long as he or she has not shown to be proficient before embarking surgery. Therefore, skills laboratories have become important in training and assessing surgical proficiency [16, 22, 38]. Finally, hospitals are on tight budgets and in need of increasing efficiency and cost-effectiveness while preserving accountability.

For all of the above-mentioned reasons, training in surgical skills laboratories before embarking on patients is now common practice in laparoscopy [22, 26, 37]. With its restricted field of vision and limited physical interaction between physician and patient, arthroscopic surgery lends itself to simulation solutions more so than most other orthopaedic procedures [31, 32]. Yet, the only training of wrist arthroscopy in skills laboratories is cadaver courses. The disadvantages of cadaver training are the costs, ethical issues in some countries, risk of contamination and the limited availability of the cadavers.

Before developing new educational tools, it is important to assess what is already available and whether there is a perceived need for new tools.

The research question was, "Could the current way of teaching wrist arthroscopy skills validly be supported using new educational media, such as e-learning and simulator training?"

Materials and methods

An informal review of the PubMed database was conducted using relevant search terms and then narrowing down the subject by adding specific terms. The basic terms were Education and Surgery. In the next steps, we added simulation and e-learning combined with arthroscopy (Fig. 1). Only papers written in English or with an English summary were included. All the abstracts of the retrieved articles were reviewed, and those that were most relevant to our subject were selected. Duplicate abstracts were removed. These papers were reviewed and analysed for cross-references not covered in the computerized searches. Furthermore, we searched the Internet for examples of simulators and e-learning solutions.

Selected articles were scrutinized on the following issues:

- Which tools have been developed for the education of endoscopic skills in general and arthroscopic skills in particular?
- Why have these tools been developed?
- What are the strengths and weaknesses of each method?
- Which tools have been validated, and how has validation been described?

Articles on live animal training and cadaver training were excluded as not fitting our research question.

An electronic survey using Google Docs was sent to all members of the European Wrist Arthroscopy Society (EWAS). This cohort was chosen being a representative group of hand surgeons familiar with wrist arthroscopies from around the world. The survey consisted of both multiple-choice questions and open-ended questions on demographics and expertise of the hand surgeon, specifically in the field of wrist arthroscopy. Also, questions on current wrist arthroscopy training in the respondents' institutions and expressed opinion on the usefulness of e-learning and simulators as educational tools in teaching wrist arthroscopy were posed. Two reminders were sent.

Results

Figure 1 summarizes the result of our literature search. Few papers were identified related to arthroscopy simulation and/or e-learning. Fifty-three papers were used for our study.

Which tools have been developed for training in endoscopic skills?

E-learning

E-learning is an educational tool to impart basic and advanced knowledge via interactive learning. E-learning is presented in a computer-based format or through Internet [44].

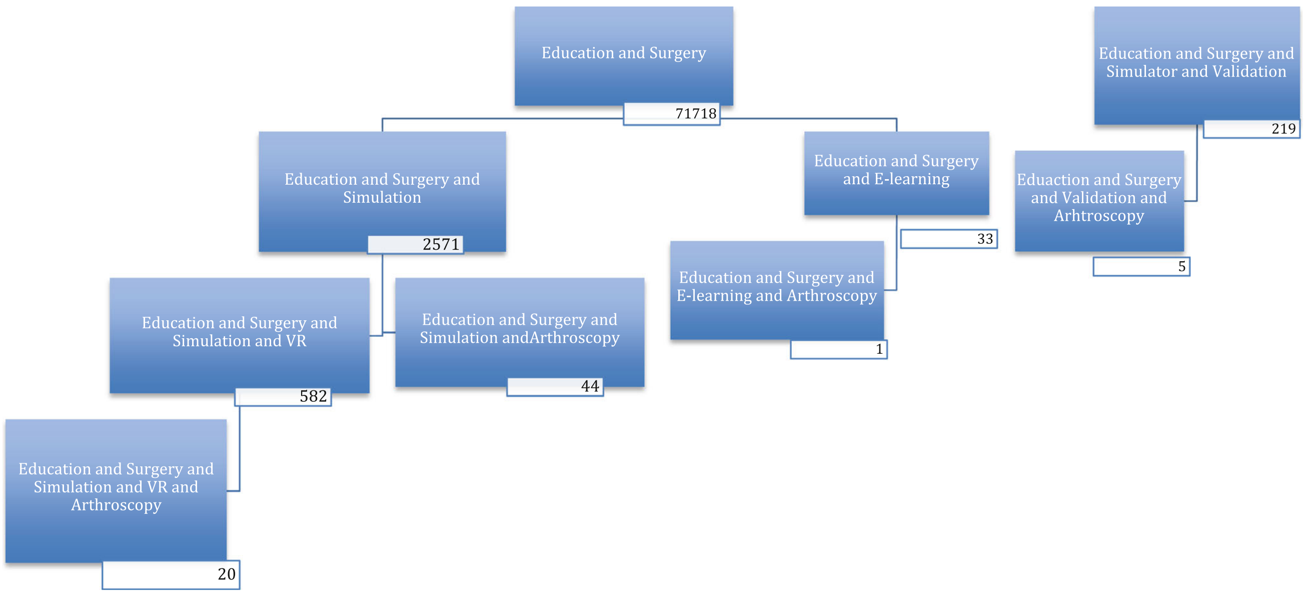

Fig. 1 Literature search in PubMed. Numbers indicate the number of papers found in PubMed with these search terms

As Ruiz states [41]: "E-learning refers to the use of Internet technologies to deliver a broad array of solutions that enhance knowledge and performance". Multiple papers describe the use of e-learning in medical education [2, 39, 41, 44]. Only one article related to arthroscopy was identified, reflecting on a web-based virtual arthroscopy trainer [25]. On the Internet, an e-learning module for wrist arthroscopy can be found on the site of Websurg [56]. Furthermore, references on the development of e-learning solutions in the field of arthroscopy are present, but to date, no applications on the Internet could be found available for use by the public [25, 56].

Simulators

Surgical simulators can be subdivided into box trainers (also called video-trainers), virtual reality trainers and augmented reality trainers [19, 43]. Box trainers are devices where trainees have to perform tasks using real instruments in a box while watching their movements on a video screen. The box can be a simple square box or a physical model resembling part of the human body. Virtual reality (VR) trainers are computer-based applications that allow for movement in free space whilst performing tasks in a virtual operative environment on the computer screen. VR can be combined with a physical model as an 'overlay', hence often referred to as augmented reality trainers. These types of simulators offer the advantage of both systems, namely haptic feedback, use of real-life surgical material, physical contact with the model while also offering the possibility of a realistic internal view and training of different scenarios. For laparoscopic skills, several types of simulators are on the market (Table 1). For training arthroscopic skills, knee and shoulder arthroscopy simulators are of interest (Table 2). The first mention on the Internet of a wrist arthroscopy simulator is from Yaacoub in 2008 [57]. No proof of concept was found, nor signs of further development were found. More recently, a new wrist arthroscopy simulator was identified, marketed by CLA [www.gtsimulators.com]. No papers on the validation of this device could be retrieved.

Why are these methods being developed?

E-learning

In papers on e-learning, the e-learning seems to follow from computer technology developments instead of being developed to fill in a void. As Cook describes it: "Shortly after the advent of the computer, educators began using this

Table 1 Laparoscopy simulators

Name of the simulator	Company	Type of simulator
Lap mentor	Simbionix	VR simulator
SEP	Sim surgery	VR simulator
D-Box	Sim surgery	Box trainer
Lapstar	Camtronics	Box trainer
Laptrainer	Simulab	Box trainer
MISTELS	Mc Gill	Box trainer
i-Sim	ISurgicals	Box trainer
Real Sim	Real Sim systems	Box trainer
SIMENDO laparoscopy	Simendo	Box trainer

Table 2 Arthroscopic simulators

Simulator	Company	Joint	Box/VR
ArthroSim	Toltech	Knee Shoulder	VR simulator
Saw Bones		Knee	Box
Passport	TU Delft	Knee	Box
ArthroS	VirtaMed	Knee	VR
Arthro VR	Insight	Knee Shoulder	VR
CLA knee	Global Tech	Knee	Box

powerful tool to facilitate learning" [7]. Of course, arguments were sought and found to support the development of e-learning facilities. Arguments frequently cited are flexibility in terms of access to the learning material, and the possibility to allow for regular testing or assessment [5, 36].

Simulators

The apprentice training method is challenged in view of the increasing numbers of surgical trainees with less surgical training time due to the working-hour regulation [42]. Furthermore, significantly higher costs are implied due to prolonged operating time as the result of training on the patient [4, 12]. This result led Mabrey et al. [32] to conclude that any time saved by training on simulators is money saved by the hospital.

Another reason for developing simulators is that to improve their skills, surgeons have to learn from their mistakes, and this learning curve should preferably be outside of operations on patients [53]. This is elegantly supported by the following quote by Samuel Beckett: "Ever tried? Ever failed? No matter. Try again. Fail again. Fail better". Virtual reality provides a comfortable environment for the trainees to make their mistakes without the serious consequences that mark real-life surgery [28]. Harden states that the quality of education will improve, because of effective skill training and competency assessment [21]. The reason is that in simulation, learning is facilitated through the provision of effective feedback, repetitive practice, a range of difficulties, multiple learning strategies, clinical variation, a controlled learning environment and individualized learning [21]. Gallagher defines the attentional capacity threshold (ACT) as the amount of information we can attend to at a specific time point [15]. When skills have become automatic, the surgeon/resident has a surplus of attentional capacity because they use less of their attentional resources in monitoring the position of their hands or the movements of their tools [15]. This automatization of the basic skills can only be acquired by repetitive training. Simulator training allows for this repetition.

Recognizing the importance of simulator-based learning, the American Board of Orthopaedic Surgeons (ABOS) in 1997 and later the American Academy of Orthopaedic Surgeons (AAOS) in 1998 each designed task forces to evaluate the available technology in this field [16]. Besides the need for training facilities outside the operating theatre, a need exists for objective assessment of skill performance. Performing standardized tasks in a skills laboratory environment allows unbiased and objective measurement of the performance [17].

What are the strength and weaknesses of each tool?

E-learning

Larvin explains the key concept behind e-learning [28]. He quotes Einstein who prophesized: "Computers are incredibly fast, accurate and stupid. Human beings are incredibly slow, inaccurate and brilliant. Together they are powerful beyond imagination". Compared to conventional learning, e-learning has the advantage that participants can choose the place and time of education themselves [24]. In this era, in which most operating theatres are equipped with computers, and many residents carry portable computer devices, its availability is secured. It also offers the possibility of short to ultra-short educational moments. Another advantage of e-learning is that different scenarios can be trained, and adding a quiz at the end can assess the skills and progress of skills of the trainee.

A disadvantage of e-learning is that it does not provide contact between teacher and students and it should never completely replace face-to-face education [35]. The construction of an e-learning module may also influence the results. Levinson et al. [30] showed that, for example, a multiple view presentation for teaching 3D brain anatomy could be disadvantageous for those learners with relatively low spatial ability. Also, interactive control of the e-learning content can have disadvantages as Mayer described that behavioural activity such as clicking between e-learning screens of images is not the same as cognitive activity, which may be preferentially stimulated by the more passive, program-controlled presentation of materials. As Cook et al. [7] stated: "E-learning is only a tool- a powerful tool indeed, but not an end in itself".

Simulators

Simulators come in different shapes and possibilities. Simulator training enables residents to practise independently of other clinical factors such as the number of procedures performed in the hospital, the number of residents and operations at which residents can assist.

The advantages of the more simple box trainers are that they are relatively cheap compared to more advanced simulator models and that the same instruments can be used as in the operating environment. Their disadvantages are that they lack realistic features and their tasks do not sufficiently resemble the real-life tasks. Furthermore, box trainers do not allow for objective assessment of skills, because in most box trainers there is no system to subjectively record the performance of the task [53].

Physical models that mimic a body part or organ add realism to the simulator. Anatomical landmarks can be recognized, and palpation and orientation play a more important role than in box trainers. The disadvantages are that such models do not offer realistic sensing and they are not easily fit to train for multiple scenarios. However, in the PASSPORT model for training of knee arthroscopy, bleeding can be simulated [53].

A virtual reality trainer makes it possible to train for unexpected complications [32]. Using a combination of visual and haptic interfaces, the purported aim of VR surgical simulators is to help train surgical students and residents in complex surgical procedures [20]. Virtual reality systems have the advantage over box trainers that performance can be monitored and objectively assessed. Disadvantage of VR simulators is that they are in general expensive, which means that they probably cannot be made available in every teaching hospital.

Which methods have been validated?

E-learning

Bhatti et al. [3] reviewed the validation of e-learning by comparing normal lectures and e-learning. The e-learning group demonstrated significantly more knowledge than the lecture group. However, there are also multiple studies showing that the improvement in knowledge did not differ significantly between the e-learning group and a group with conventional learning (lectures or books) [10, 24, 30, 40]. The study of Bhatti also looked at satisfaction rates amongst the students between the two educational modalities and found no significant differences [3].

Simulators

Virtual reality Validity of simulators can be subdivided into face validity, content validity, construct validity, concurrent validity and transfer validity (or predictive validity). Multiple studies demonstrate that training with virtual reality simulators decreases the time and the number of errors in the performance of a given surgical task [17, 23, 46, 48, 49, 54, 55]. Construct validity has been shown as simulators can clearly differentiate between the less experienced and the more experienced trainees [20, 45, 47]. Seymour [48] and Seymour et al. [49] investigated the predictive validity of the MIST-VR. Residents who trained on MIST-VR made fewer errors, were less likely to injure the gallbladder and burn non-target tissue and were more likely to make steady progress throughout the procedure. The randomized clinical trial of Grantcharov et al. [17] also proves the predictive validity by providing objective evidence that training with a simulator improves the operative skills needed for the performance of laparoscopic cholecystectomy. Also, Howells et al. [23] showed that orthopaedic surgical trainees who have undergone a period of laboratory-based arthroscopic simulator training continue to demonstrate improved technical performance in the operating theatre compared to an untrained group.

An overview of the available arthroscopy simulators and their validity can be found in Table 3. None of the currently available arthroscopic simulators have been tested for all aspects of validity.

Wrist arthroscopy curriculum

For the second part of the study, we surveyed a panel of expert wrist arthroscopists on their views on education in wrist arthroscopy. The response rate after two reminders was 64 respondents out of 185 members of the EWAS. The professions were equally dispersed between orthopaedic surgery and plastic surgery (Table 4). The majority of respondents (53 out of 64) had more than 5 years of experience in hand surgery, and 32 out of 64 had more than 10 years of experience in this area. Hand surgeons consider wrist arthroscopy to show a gradual learning curve showing considerable actions to be taken before the asymptote of

Table 3 Validity for each arthroscopic simulator

Simulator	Validity				
	Content	Face	Construct	Concurrent	Predictive
ArthroSim [1]	+	+	+/−	−	−
Saw Bones [23]	−	−	+	−	+
Passport [52]	−	+	+	−	−
ArthroS[b]	−	−	−	−	−
Arthro VR[*,a] [34, 53]	+	+	+		
CLA knee[b]	−	−	−	−	−

*Insight Arthro VR is now called Arthro Mentor

[a] Abstracts mentioned on the website but not published in PubMed journals: (1) “A new assessment methodology for virtual reality surgical simulators”, Bayona and Bayona et al. (2009). (2) “Preliminary report of shoulder arthroscopic VR training system”, Noguchi and Naoyuki et al. (2009). (3) “Assessment study of insight ArthroVR…”,. Bayona et al. (2008). (4) “Validation of a VR arthroscopic…”,. Funk and Awan et al. (2007)

[b] No information found on validity studies on Internet or PubMed

the curve is overcome and plateau is reached. Over 50 % of respondents (48 out of 64) indicated that a surgeon should perform more than 20 wrist arthroscopies per year in order to be qualified as an expert in this field (Table 4).

All hand surgeons developed their own skills from the ‘see one–do one–teach one’ Halstedian method of training. Of them, 34 % (22 out of 62) indicate a cadaveric arthroscopy course to be compulsory for their residents (Table 4). Forty-nine out of the 64 respondents had immersed in a wrist arthroscopy training course.

Fifty-five out of the 64 hand surgeons felt that a wrist arthroscopy e-learning would be an asset to the wrist arthroscopy curriculum, and 60 out of the 64 indicated that a wrist arthroscopy simulator would be an asset. The results of the questions regarding the aspects that can be learned in a computer simulation program and the aspects that can be learned in a wrist arthroscopy simulator are summarized in Table 4.

The reservation towards e-learning was attributed to a presumed lack of 3D reality and the opinion that portal placement cannot be learned using a computer program.

Table 4 Results of the survey

Background	Orthopaedic surgeon	30
	Plastic surgeon	24
	Hand surgeon	9
	Other	1
Experience in hand surgery	<5 years	11
	5–10 years	21
	>10 years	32
Experience in wrist arthroscopy	<5 years	28
	5–10 years	20
	>10 years	16
Have you done a course?	Yes	49
	No	15
How are your residents trained? (8 have no residents)	See one–do one–teach one	30
	Compulsory course	22
	No training	5
No of wrist arthroscopies/year (2 no answer)	<20	13
	20–40	31
	>40	17
No of wrist arthroscopies to become an expert (4 no answer)	<50	14
	50	19
	100	18
	>100	9
Would you consider an e-learning to be an asset?	Yes	55
	No	9
Would you consider a simulator to be an asset?	Yes	60
	No	4

One respondent stated that the basics and theory might as well be learned from books or from a teacher. However, 55 out of the 64 surgeons were of the opinion that a computer program would be very useful for learning the theoretical basis. Furthermore, normal and pathological findings can be taught in an e-learning program provided that it is interactive and has good visuals of normal anatomy.

Concerning the value of the use of simulators, respondents indicated that it would be advantageous if pathologies could be included. Also, the possibility to perform certain therapeutic interventions, such as shaving, synovectomy and TFCC reinsertion, is mentioned. Opponents of wrist arthroscopy simulator training indicate that it is difficult to mimic the manual skills necessary for wrist arthroscopy in a computer-aided device and that the limitation of the device would be that it is only useful at the beginning of a training. The respondents expressed a warning that the real-life aspects such as stress, time management and defective instruments may not be simulated and that residents should be aware that there is a difference between training on a simulator and performing surgery on a live patient.

Discussion

This study shows that the current way of teaching wrist arthroscopy skills can be validly supported using new educational media, such as e-learning and simulator training.

Over the past decade, training of arthroscopic surgical skills in skills laboratories has gained popularity. There are many training tools available, from the classic literacy ones towards more ICT empowered ones such as e-learning and simulators (box trainers, VR simulators and augmented reality solutions). And both e-learning and simulators have been studied for various aspects of validity of teaching knowledge and skills in surgical specialties.

E-learning is especially useful in teaching the theoretical knowledge. A survey conducted by Stevens [50] indicated that 90 % of residents and consultants in plastic surgery would like to have access to e-learning in the curriculum. The answer was independent of the participants’ age [51]. These results have prompted the British Association of Plastic Reconstructive and Aesthetic Surgeons (BAPRAS) to continue to develop the Electronic Learning for Plastic Reconstructive and Aesthetic Surgery (e-LPRAS). Citak et al. [6] developed an Internet-based textbook for trauma surgery and determined that 79 % of the students found this tool very helpful. In their review of e-learning practices for undergraduate medical education, Lau et al. [29] concluded that while most reviewed articles reported favourable results with e-learning, it is difficult to generalize these findings to other settings.

However, the question remains: When does e-learning become more than just a book behind glass? If we put the content of books or presentations in an electronic format, the advantage of availability and standardized content will be present, but it will not add extra strength from an educational point of view. In this survey participants were asked whether they felt e-learning would be an asset, but they were not asked about their criteria for a useful e-learning. As Stephanie Marshall states: "Adding wings to caterpillars does not create butterflies" [33]. Cook [8] summarized the criteria for instructional design as follows: interactivity, practice exercises, repetition and feedback will improve learning outcome, whereas interactivity and online discussion improve satisfaction rates.

Thus, in order to lift an e-learning above the level of a 'book behind glass', it should have the following features:

- Interactive elements
- Instructional movies, particularly useful to illustrate 3D elements
- Assessment of knowledge by adding quiz elements
- Possibility to train different scenarios and learning strategies

Although closely related, education and training are not the same. Education usually refers to the communication or acquisition of knowledge or information, while training refers to the acquisition of skills (cognitive or psychomotor). Whereas e-learning can be used for education (teaching theoretical knowledge), training will mostly be done on simulator models [15].

Training on simulators is not new. The first surgical simulators were leaf and clay models used in ancient India in 600 BC for training of forehead flaps [42]. The current surgical simulators have their roots in flight simulators, which have been used for more than 50 years [42]. Although the use of simulator training in aviation is already well established, in surgical training it is still under development. The first developments of simulators were in the field of laparoscopy. In the last 10 years, simulators for arthroscopic skills have been developed (Table 2). Many specific arthroscopic skills such as triangulation skills (working with two hands while watching the movements on a screen) and hand–eye coordination can be integrated in a simulation model. Unlike other orthopaedic procedures, such as tendon repair and basic fracture fixation, there is little, if any, crossover in the technique from other procedures [31]. This implies that the arthroscopic skills should be acquired in a specifically designed set-up. Mabrey [31] stated that with its restricted field of view and limited physical interaction between physician and patient, arthroscopic surgery lends itself to VR simulation more so than most other orthopaedic procedures. Although this may be true for knee and shoulder arthroscopy, for wrist arthroscopy, a certain degree of interaction with a physical model is necessary to appreciate the manoeuvres of portal placement and manipulation of the wrist while examining the wrist from the radial to the ulnar side.

Where physical models lack the realistic representation of the surgical environment, VR training environments lack the physical contact with the model. Ultimately, combining physical models with virtual reality images inside (so-called augmented reality) will combine the best of both, thus allowing for interaction with the model as well as practising different clinical scenarios.

The importance of skills laboratory training is illustrated by the fact that in our institute surgical residents are not allowed to perform laparoscopic procedures if they have not fulfilled the requirements for the SIMENDO certificate, a psychomotor endoscopic skills trainer. To improve their skills, surgeons have to learn from their mistakes, and this learning curve should preferably be outside of operations on patients [53]. This literature study has shown that although the financial cost of simulator training may be substantial, the savings in operative time, the potential for improved safety and, accordingly, reduced morbidity can justify the expense [11]. Finally, as simulator training has shown to improve surgical operating performance, integration of VR into the orthopaedic curriculum will save time in the operating theatre, reduce operative errors and improve the resident's overall educational experience [32].

Simulators are used not only for training, but also in assessing trainee performance. Assessing technical skills is vital to ensure that residents are adequately trained before they operate unsupervised [52].

Finally, there is a medico-legal aspect: CRICO, the US malpractice insurance company, began offering insurance premium incentives for anaesthetists who participated in simulation-based crisis resource management. Upon analysis of the results, they found a significant decrease in the number of malpractice claims [27].

In this study validation of the currently available simulators was searched. Only a few studies known to date address the full spectrum of validation issues of these devices. As Gaba [13] states, we have to realize that: "No industry in which human lives depend on skilled performance has waited for unequivocal proof of the benefit of simulation before embracing it".

This survey amongst hand surgeons in Europe has shown that there is a perceived need for e-learning and/or simulation modalities. Despite a few reservations, the responses to the proposed introduction of an e-learning module and a wrist arthroscopy simulator are positive and encouraging in a quest for better training in the area of wrist arthroscopy. Authors stress the need for a uniform and clear definition of both context and criteria in the development of new learning modalities.

As Grechenig et al. [18] state in their paper: “It may be said that nowadays nobody should do arthroscopic operations without having a complete command of handling and techniques, including new arthroscopic techniques, learned by dry runs”. A future role for trainees would be to start the initial steep part of the learning curve of a procedure in a simulated environment, demonstrate a certain level of simulator competence and then progress to the operating theatre [23].

Limitations of this study include the fact that the respondents were not asked to specify why and which modalities they would appreciate. Also, the response rate is only 35 %.

Just as airline pilots are not allowed to fly if they have not spent a minimum number of hours in a flight simulator, hand surgeons should not be allowed to enter a wrist arthroscopically without having acquired the appropriate skills in a skills laboratory. As Curry stated: “See one, practice one on a simulator, do one: The mantra of the modern surgeon” [9].

Improving the teaching curriculum for wrist arthroscopy is expected to improve the proficiency level of wrist arthroscopy in clinical practice and allows further development of this technique.

Conclusion

Both the results of the survey and of the literature search indicate that there is a need to develop new teaching modalities for arthroscopic skills and that these teaching modalities have already proven their worth in other field of surgical education.

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