Realists Framework White Paper Series
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Realists

Simulation in Surgical Education

An insight into the RealSpine Training System

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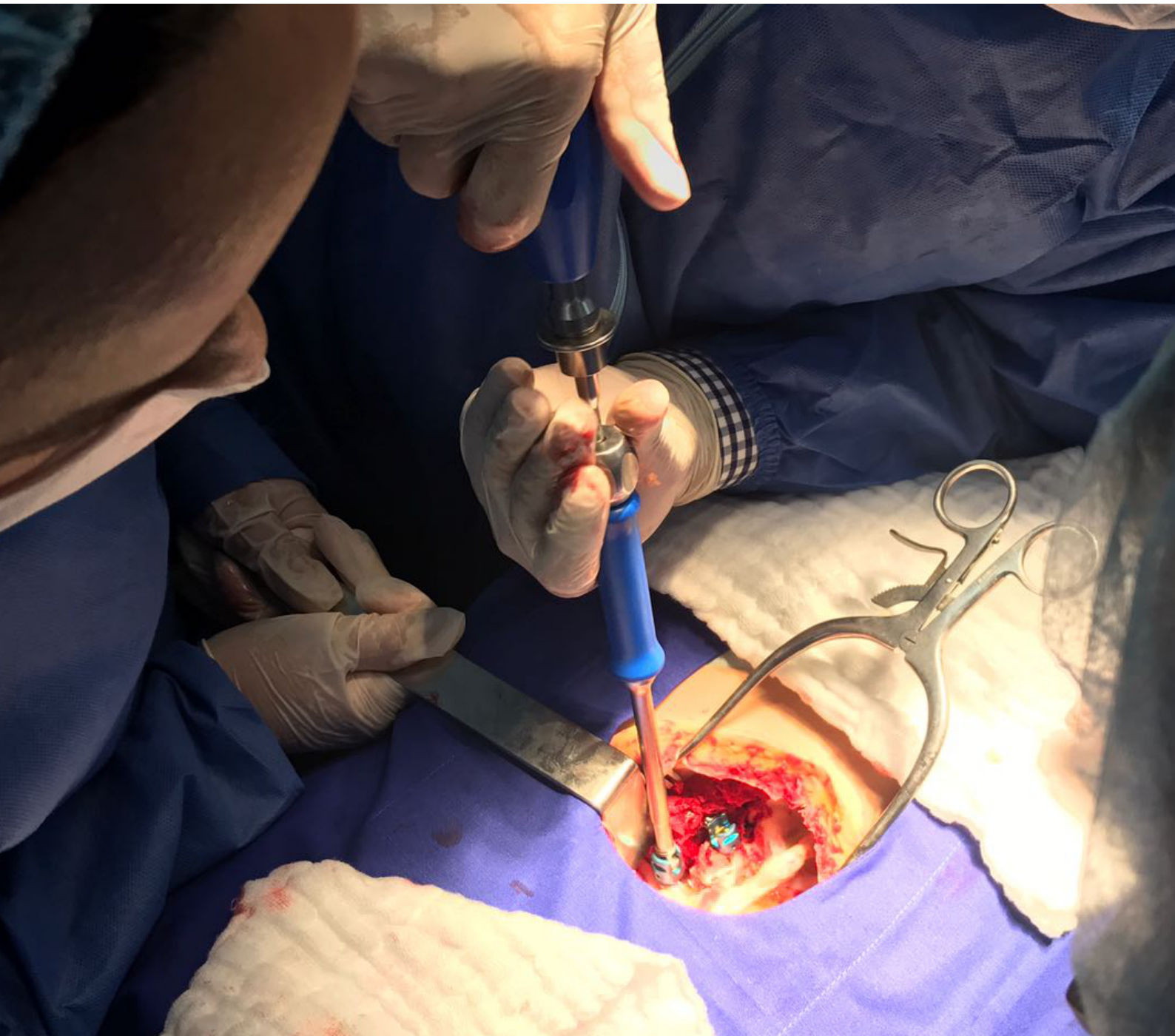


RealSpine Hands-on training in Strasbourg (France), 2017

Simulation is a powerful tool in medical education and learning. The paradigm shift away from the traditional teaching-learning methods and the recognition that learning surgical skills and abilities by mere observation is not sufficiently promising, led to competency-based education and training in the first place.[1] New technologies and challenging surgical procedures require a new approach to medical education and training. The use of simulation in medical education and training offers the possibility of competency-based training with the focus on learning surgical skills, attitude and knowledge at different levels of difficulty.

Especially in the last 20 years the awareness for simulation-based education (SBME) has increased significantly.[2] This is also due to the fact that technical development in the field of simulation is now well advanced. The call for alternative training methods without direct intervention in patient safety has also become louder. Haptic surgical simulation systems not only mimic individual organs and are limited to training basic skills such as suturing or knotting, but, thanks to their precise anatomy and haptics, enable surgical interventions and the training of complex procedures.

1. Park Y.S., Hodges B.D., Tekian A. (2016) Evaluating the Paradigm Shift from Time-Based Toward Competency-Based Medical Education: Implications for Curriculum and Assessment. In: Wimmers P., Mentkowski M. (eds) Assessing Competence in Professional Performance across Disciplines and Professions. Innovation and Change in Professional Education, vol 13. Springer, Cham. https://doi.org/10.1007/978-3-319-30064-1_19

2. Okuda Y, Bryson EO, DeMaria S Jr., Jacobson L, Quinones J, Shen B, et al. The utility of simulation in medical education: What is the evidence? Mt Sinai J Med 2009;76:330-43.

The advantages of simulation-based training are obvious. Simulation serves to create a real-world situation without actually experiencing this real situation. It is a replica of reality in which elements are taken from the real world to train important sequences and events that are necessary for professional practice.[3] Simulation is therefore seen as an effective supplement to training in the direct clinical environment, especially in surgery, as it enables the surgeon to manage risk situations such as intraoperative complications, but also to learn soft skills such as dealing with patients or relatives or working with team members in the operating room. In contrast to reality, simulation provides a safe environment for the learner in which mistakes can be made and difficult action schemes can be repeated as often as desired without harming the patient or affecting the professional's reputation. The content and timing of a simulation training can be specifically controlled, skills can be learned in a targeted manner, as the simulated learning environment can always adapt to the respective learning objective. Pre-questionnaires help to uncover weaknesses of the participants and to transform them into strengths through training. The prerequisite for this is a didactic concept that focuses on the direct involvement of the learners in the training process and includes both the use of feedback and the application of validated assessment methods.[4]

Case Study RealSpine

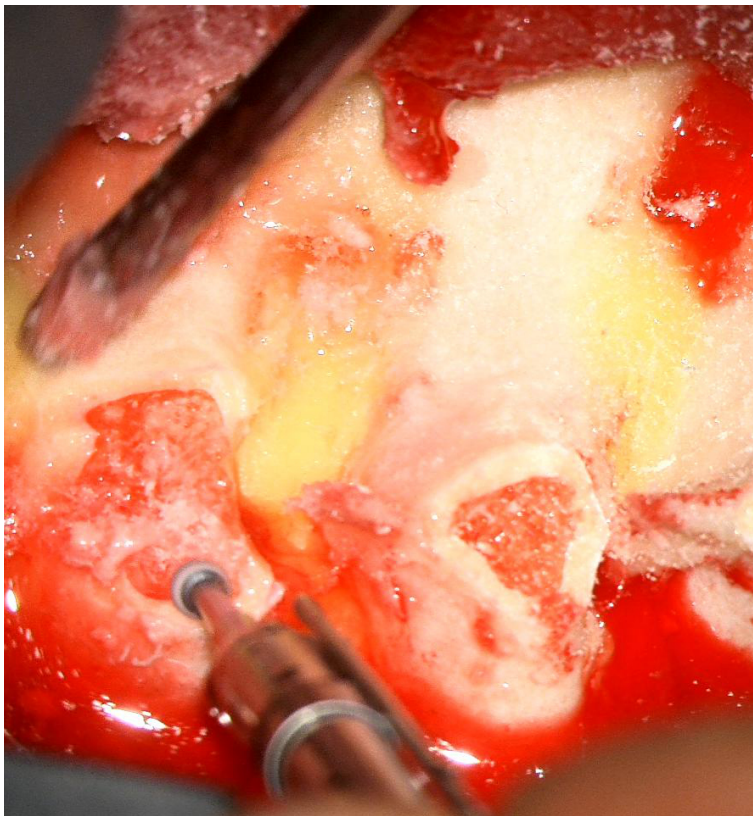
The RealSpine Training System: a combination of sophisticated technology and realistic anatomy

A simulation system that combines sophisticated technology and highly realistic anatomy with a didactically sound training concept is the RealSpine Training System. This training system was developed especially for operations on the lumbar and cervical spine. All structures and tissue parts are based on real patient data and were reproduced in detail. It was repeatedly validated by neurosurgeons, orthopedic and trauma surgeons regarding the systems haptic and optic characteristics.[5] The goal of the scientists was to provide surgeons with a haptic training device that enables them to solve real problems, whose action schemata can be transferred to real situations and tasks in their work as surgeons. RealSpine bleeds with individually adjustable intensity and dura injuries and the associated leakage of dura

3. Al-Elq, Abdulmohsen H. "Simulation-based medical teaching and learning." Journal of family & community medicine vol. 17,1 (2010): 35-40. doi:10.4103/1319-1683.68787

4. Dale E. Audiovisiual Methods in Teaching. New York: Holt, Reinhart & Winston; 1946

fluid can be treated with conventional methods. The use of real surgical instruments and surgical equipment such as endoscopes and implants or screws extend the range of applications of this training device. RealSpine thus offers the best conditions for scenario-based learning. Thanks to its versatility and high degree of realism, not only different types of spine surgery can be trained but also nearly every high-risk situation that can occur during spinal surgery, not only for the surgeon but also involving the entire surgical team. The associated Realists Training Concept is designed and standardized in that way that it can be used for any surgical training that follows the scenario-based and competency-based approach. Based on the Cognitive Load Theory, it is recommended to divide the learning of skills into smaller units. This is the only way to ensure that the acquired knowledge can be fully absorbed by the learner and stored in the brain. For this reason, the Realists Training Concept divides each operation performed on RealSpine into smaller steps - Standard Operation Procedure (SOP). Each of these steps will then be taught and trained until competency is reached. This way a high learning curve is achieved, and learners can improve their skills with only one training.[6] This allows both novice and experienced surgeons to use RealSpine. A specially developed pre-test questionnaire is used to assess the learners' previous knowledge and skills. Accordingly, the learning goals and the competencies and skills to be acquired are determined for each training. The subsequent practical training thus adapts optimally to the needs of the learners. Formative and summative feedback and assessment as well as a post-test



Microscopic image of laminoplasty procedure on RealSpine

questionnaire to measure the achievement of the learning objective round off the training and measure effectiveness and success of learning activities (learning outcomes). Hence, we believe that surgical simulation training with a sophisticated didactic concept can provide the space and opportunity to practice procedures and high-risk situations as long as necessary to gain competency and confidence in one's own abilities. Simulation provides the security of being able to make mistakes and correct them without consequences for the surgeon's future career and no risk for patient safety.

6. Realitätsnahe chirurgische Trainingsumgebungen für die Wirbelsäulenchirurgie // Realistic surgical training environment for spinal surgery. Fenyöházi E, Jarvers JS, Torres OA Adermann J, Voigtländer M, Selig C Schrempf A, Härtl R, Josten C, Bernal Vera LE, Korb W. In: Journal für Neurologie Neurochirurgie und Psychiatrie 2018; 19 (3), 96-102

Visions for the future

Renowned experts agree: the future of spinal surgery lies in the digital domain.[7] Up to now, their use has been limited to a few areas, but a real boom is expected in the future.[8] Online platforms that encourage exchange (case discussions via MRI images and X-Ray pictures) are increasingly used by medical professionals around the world. Enormous technical advances such as robotics for screw placement or computer-assisted navigation have already found their way into the operating room.[9] In the future, it is not a question of replacing surgeons with machines. On the contrary, digital technology will act as an additional aid, as a third eye to point out mistakes or correct errors before they are made. A combination of augmented reality with navigation and robotics is also conceivable. Individual surgical steps, which are supported by augmented reality, are monitored and guarantee a more efficient intervention. Injuries and bleeding can be minimized and structures such as soft tissue or bone can be removed sparingly.[10] The goal will be to make surgery safer.

7. The future of IT in spine — Machine learning, virtual reality & more. Alan Condon. In: Becker's Spine Review. Wednesday, September 16th, 2020

8. What 5 spine surgeons are thinking about augmented reality. Alan Condon. In: Becker's Spine Review. Friday, June 19th, 2020

9. Kazemi N, Crew LK, Tredway TL. The future of spine surgery: New horizons in the treatment of spinal disorders. Surg Neurol Int 2013;4:S15-21. Available FREE in open access from: http://www.surgicalneurologyint.com/text.asp?2013/4/2/15/109186

10. https://spinalnewsinternational.com/how-will-technology-shape-spinal-surgery-during-the-next-decade/

Due to the complexity of the described procedures and the high technical development, training is essential. With RealSpine Imaging, the RealSpine Training System already offers X-Ray simulation and thus intraoperative guidance which enables the placement of cages and screws. In combination with the Realists Training Concept, simulation training provides the appropriate framework to teach surgeons the correct handling and provides the necessary safety.

A combination of RealSpine with virtual elements and force sensors is also conceivable for the future, which measure the pressure and tension on the structures along the spine and make them visible to the learner. Both guarantee an even more intensive learning experience.

The possible applications of the RealSpine Training System are diverse and range from training of individual surgical steps to performing a complete spine operation to training of complex and risky patient cases and situations that can occur at any time during an operation. This is possible because of the extraordinary design and the fact that the RealSpine Training System can be combined with modern surgical equipment and is constantly being developed to adapt it to the latest technological standards. The associated Realists training concept rounds off the surgical training. Why the RealSpine Training System can be considered a unique tool for surgical simulation training on the spine will be the subject of the upcoming white paper.