Validation of an Arthroscopic Training Device

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Purpose: To investigate the usefulness and conduct validation of a simulated arthroscopy training device to train basic arthroscopy skills. **Methods:** Forty-six participants including 12 novices, 12 intermediates, and 22 experts completed a questionnaire regarding demographics, previous arthroscopic experience, training potential, and statements about the device. Furthermore, participants performed a single task on the arthroscopic training device using the 0° camera and a probe. The task consisted of an attempt to carry a rubber ring across a helix inside a box as fast as possible. Construct validity was evaluated by comparing total task time and portal replacements of the camera and probe between all groups (median values [interquartile range]; Kruskal-Wallis test). **Results:** The median age was 35 (29-44) years. There were 4 female and 42 male participants. A total of 89% of the participants graded the overall training capacity $\geq$5 (35% graded it as 5, 39% as 6, and 15% as 7), and 83% believed that it is useful to improve any kind of arthroscopy. Ninety-three percent of the participants would recommend the arthroscopic training device to their colleagues. Sixty-one percent of the participants stated that there are certain disadvantages. The median time to complete the task was 108 (58-236) seconds. Novices (259 [123-435] seconds) performed tasks significantly slower than intermediates (169 [67-257] seconds) and experts (75 [49-132] seconds) ($P = .005$). Furthermore, portal changes were significantly more common in novices and intermediates than experts ($P = .019$). **Conclusions:** High scores in training potential were achieved with this arthroscopy simulator box, and most study participants believed that practice with the arthroscopic training device is useful for any kind of arthroscopy. Construct validity was established since novices, intermediates, and experts in real arthroscopy were discriminated with the arthroscopic training device in terms of time to successful completion of a task. However, 61% of the participants stated that there were certain disadvantages. **Clinical Relevance:** In every training tool using simulation, it is crucial to pass the first steps in the validation cascade. This study provides this step for further evaluation of this arthroscopic training device.

The learning of surgical procedures mainly has consisted of supervised training on patients in the operating room. Decreasing resident work hours, increasing costs of operating room time, and ethical concerns have made this type of practical learning difficult for surgical trainees.[1]

Arthroscopic surgery demands visuospatial skills and cannot be acquired by observation and assistance alone.[1-3] One study found a high number of senior residents who did not feel confident in performing arthroscopic procedures.[4] Because arthroscopic procedures are of increasing importance in orthopaedic and trauma surgery, simulator training is of increasing interest.[5-10] It has been shown that virtual-reality based training has at least equal value as animal and cadaver models as well as videotape learning tools.[11,12] The integration of a standardized and virtual reality-based simulator training is lacking in orthopaedic graduate programs in most countries despite the increasing number of virtual reality-based arthroscopy simulators on the market.[13-19]

The desire to practice arthroscopic skills outside of the operating room in an efficient and affordable way remains a fundamental wish of most residents who are willing to improve their skills in arthroscopic techniques. This fact was the reason for the design of a simple arthroscopic training device that was introduced into the market recently. Furthermore, this device might be helpful in other specialities like general surgery, learning endoscopy, or in any kind of surgery in

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which a 3-dimensional problem is managed through tools that are transferred to a 2-dimensional screen by a camera.

The studied arthroscopic training device has not been validated as a tool in enhancing surgeons' arthroscopic skills. The main questions were whether the study participants believe that the tested arthroscopic training device is a useful training tool and whether they would recommend it to residents and colleagues. Furthermore, the assessment of construct validity was evaluated by comparing the performances on a standardized task for overall time and portal changes between surgeons with varying arthroscopy experience.[20,21] Therefore, the purpose of this study was to investigate the usefulness and conduct validation of a simulated arthroscopy training device to train basic arthroscopy skills. We hypothesized that the arthroscopic training device would be a useful training tool that participants would recommend to residents and colleagues. We further hypothesized that the device would have high construct validity.

Methods

The recruitment of the participants was during the 3 days of the Swiss national orthopaedic society meeting from June 24 to 26, 2015. Conference attendees were asked to participate in this validation study. Before participation (arthroscopic training device task and questionnaire), all volunteers signed a written informed consent that their anonymized information could be used for research. The local institutional review board waived the need for ethical approval (BASEC-Nr. Req-2016-115 00083). We excluded participants who were not medical doctors or medical students in their last year.

The so-called ArthroBox (Arthrex, Naples, FL; referred to as arthroscopic training device) is a relatively small arthroscopic training device that consists of a cube in the size of a bigger joint like the knee or shoulder with a solid base and 4 identical sidewalls consisting of equally sized 4 holes (portals) each as well as a top-piece with another 4 portals. The whole system can be put together in a press-fit manner. The box is set up in only a few seconds. So-called "skill plugs" are interchangeable task modules in the center of the box. A small metallic helix with a rubber ring attached was used for the present study. These skill plugs can be switched for other training modules (Fig 1). There are various options to train, as described in the original training tool guide. Furthermore, there is a pen-like camera with an unchangeable zero-degree view. The camera has a Universal Serial Bus plug for the use at any computer, which visualizes a live image from the box (Fig 2). Moreover, there is a thin endoscopic probe with a hook at the tip to practice triangulation and hand-eye coordination, as well as to perform the various tasks.

Fig 1. The arthroscopic training device is depicted and shown with the top-piece moved aside to have a good view in the inside showing the skill plug with the metallic helix and rubber ring.

The camera and hook can be inserted through all portals available, as preferred by the surgeon.

Protocol

Arthroscopic Training Device Task. Every participant underwent standardized introduction by a supervisor. The box and tasks were explained and a short video of the task was shown followed by 2 minutes of hands-on time to get familiar with the device. The task included only one skill plug, where the goal was to bring the rubber band from one side of the helix to the other side as fast as possible using the camera and the probe. There were no restrictions with respect to portal placements, neither for the camera nor for the probe. It was not allowed to move the arthroscopic training device itself. The exercise started when the camera entered through any of the portals and ended when the rubber band dropped on the opposite side after passing the complete helix. As outcome variables, the time (seconds) was taken and the number of portal changes of the probe and the camera were counted. The construct validity was assessed by comparing the time to completion of the