pharmacokinetics, and resumed on POD3 after unremarkable postoperative imaging. Primary outcomes are the incidence of hemorrhagic and thromboembolic complications in the first 3 months after surgery.

Results: Outcomes of 153 patients were analyzed (45.8% in the AT-Group and 54.2% in the Control-Group). 41.8% of the patients had a craniotomy for tumour surgery (53.1% intra- and 46.9% extra-axial), 17.0% for transsphenoidal pituitary surgery, 9.8% for cranioplasty, 7.2% for vascular surgery, 5.9% for shunt surgery and 18.3% for various other surgeries. In the AT-Group, 48.6% of the patients were treated with ASA, 35.7% with non-vitamin K oral anticoagulants (NOAC), 4.3% with vitamin K antagonists, 5.7% with a combination of AT and 5.7% with various other AT. The haemorrhagic complication rate was 4.5% (95% CI [0.5-9.1]) in the AT-Group and 6.0% (95% CI [1.6-12.8]) in the Control-Group (p=0.9). The rate of thromboembolic events in the AT-Group was 2.9% (95% CI [0.9-6.7]) in comparison to 6.0% (95% CI [0.9-11.1]) in the Control-Group (p=0.3).

Conclusions: The presented perioperative management protocol of continuation or ultra-early resumption of AT in elective cranial procedures appears to be safe. Moreover, it seems to protect patients from thromboembolic complications.

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THE USE OF AUGMENTED REALITY AS AN EDUCATIONAL TOOL IN MINIMALLY INVASIVE TRANSFORAMINAL LUMBAR INTERBODY FUSION

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The Ethics of Waiting lists and Rationing access to care (Ethics Parallel Session), September 26, 2023, 4:50 PM - 6:20 PM

Background: One of the major challenges in training neurosurgical and orthopedic residents the technique for minimally invasive transforaminal lumbar interbody fusion is the lack of visualization of surgical landmarks (pedicle, pars, lamina). This is due to the limited access to the bony spine through a tubular retractor, in addition to a smaller working corridor or patient-specific factors such as bony overgrowth, disc space collapse, and listhesis). These factors increase the possibility for surgical error and prolonged surgery time. Augmented Reality (AR) is an emerging technology, which superimposes digital images onto the real-world environment. It is being used clinically for placement of pedicle screws with the surgeon wearing a headset, but its use for the remainder of the procedure including the facetectomy, decompression and discectomy part has not been reported. With AR, relevant surgical anatomy can be projected directly into the user's field of view through the microscope. The purpose of this study is to assess the utility, accuracy, efficiency, and precision of AR-guided MIS-TLIF and to determine its impact in spine surgery training.

Methods: At two centers, twelve neurosurgical residents performed a one-level MIS-TLIF on a high-fidelity lumbar spine simulation model with and without AR projection into the microscope. Screw placement which is being done routinely with navigation or AR was omitted and the study focused on the facetectomy, decompression, discectomy and cage placement. For the MIS-TLIF procedures with AR, surgical landmarks were highlighted in different colors on preoperative image data. These landmarks were visualized in the spinal navigation application on the navigation monitor and in the microscope in order to confirm the relevant anatomy. All procedures were recorded for evaluation and time measurements. Post-procedural surveys (NASA task load index) were given to the residents. Descriptive statistics, correlations, and ANOVA were performed to compare resident performance with and without AR and AR-specific factors on overall workload and by subscales.

Results: 12 neurosurgical residents were included in this prospective, multicenter, randomized-controlled trial. AR-guided procedures had a consistent impact on resident anatomical orientation and workload experience. Procedures performed without AR had a significantly higher mental demand (p=0.003) than with AR. Residents reported to a significantly higher rate that it was harder work for them to accomplish their level of performance without AR (p=0.019).

Conclusions: AR can bring a meaningful value in MIS teaching and training in order to confirm relevant anatomy in situations where the surgeon will have less direct visual access. AR employed in surgical simulation can also speed the learning curve.

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SURVEY ON TRAINING SATISFACTION AMONG GERMAN NEUROSURGICAL TRAINEES

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The Ethics of Waiting lists and Rationing access to care (Ethics Parallel Session), September 26, 2023, 4:50 PM - 6:20 PM

Background: There has been a fivefold increase of neurosurgeons over the last three decades in Germany, despite a lesser increase in operations. Currently, there are approximately 1000 neurosurgical residents employed at training hospitals. Little is known about the overall training experience and career opportunities for these trainees.

Methods: In our role as resident representatives, we implemented a mailing list for interested German neurosurgical trainees. Thereafter, we created a survey including 25 items to assess the trainees' satisfaction with their training and their perceived career prospects, which we then distributed through the mailing list. The survey was open from 1st April until 31st May 2021.

Results: 90 trainees were enrolled in the mailing list and we received 81 completed responses to our survey. Overall, 47% of trainees were very dissatisfied or dissatisfied with their training. 62% of trainees reported a lack of surgical training. 58% of trainees found it difficult to attend courses or classes and only 16% had consistent mentoring. There was an expressed desire for a more structured training programme and mentoring projects. In addition, 88% of trainees were willing to relocate for fellowships outside their current hospitals.

Conclusions: Half of the responders were dissatisfied with their neurosurgical training. There are various aspects that require improvement, such as the training curriculum, the lack of structured mentoring and the amount of administrative work. We propose the implementation of a modernized structured curriculum, which addresses the mentioned aspects, in order to improve neurosurgical training and, consecutively, patient care.

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FOETAL NEUROSURGERY AND NEURAL TUBE DEFECTS: A CRITICAL REVIEW OF THE ETHICAL CONSIDERATIONS

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The Ethics of Waiting lists and Rationing access to care (Ethics Parallel Session), September 26, 2023, 4:50 PM - 6:20 PM

Background: A congenital neurological anomaly connected to the growing central nervous system is myelomeningocoeles. The Management of Myelomeningocoele (MOMS) study (2011) demonstrated that prenatal surgery improved motor results, albeit at the expense of maternal-foetal hazards, when compared to the postnatal surgical protocol. It is paramount to continue the conversation on the ethical implications of the MOMS trial notwithstanding its comprehensive bioethical requirements to ensure that participants could make an informed decision.

Methods: According to PRISMA criteria, a critical review was conducted on the ethical issues concerning prenatal neurosurgery for myelomeningocoeles. Additional research publications assessing the outcomes of the MOMS were included in the review. Between 2011 and 2023, the terms "myelomeningocoele," "surgery," and "ethics" were utilised in the PubMed search. This yielded 9 results when combined with the previously specified inclusion criteria.

Results: All the examined literature (n=9) highlighted the significance of thorough patient counselling in discussions of the ethical consequences on the mother and foetus in prenatal surgery. While most clinicians (65%) agreed that denying mothers prenatal surgery would be unfair to the unborn child, a study indicated that the clinicians' individual values may affect their recommendations to mothers. This emphasises the necessity of offering all eligible surgical candidates an ethics-focused interview (included in the MOMS research protocol) to

minimise the ethical difficulties that may arise. Other potential ethical concerns include the balance between the mother's autonomy and the child's survival in life-threatening conditions and the extent to which therapeutic proportionality should be considered when deciding whether to perform surgery.

Conclusions: It is crucial that all expectant mothers and families receive counselling about the risks of surgery, and their choice not be contested on legal and moral grounds. This emphasises the importance of patient counselling and ethic-focused interviews. All facilities that provide prenatal neurosurgery for the management of myelomeningocoele ought to provide this.

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INFLUENCE OF HAND POSITION AND SURGEON POSTURE ON SPATIAL ACCURACY IN NEUROSURGERY

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The Ethics of Waiting lists and Rationing access to care (Ethics Parallel Session), September 26, 2023, 4:50 PM - 6:20 PM
**Background:** The aim of this study was to evaluate the effect of hand position and surgeon posture on the spatial accuracy of neurosurgical manipulations.
Methods: A testing device developed by the authors was used to evaluate and simulate neurosurgical manipulations. Experimental results were compared using non-parametric analysis (Wilcoxon test) and multivariate analysis using mixed models. Results were considered statistically significant at $p < 0.05$.
Results: The study included 14 first-year neurosurgery residents who met the inclusion criteria. Hand support in the sitting position (Wilcoxon test p value = 0.004), had statistically significant influences on the spatial accuracy of surgical manipulations (univariate analysis). The spatial accuracy did not significantly depend on the type of standing position (Wilcoxon test p value = 0.34), whether the surgeon was standing/sitting (p = 0.213). When conducting the multivariate analysis, the spatial accuracy significantly depended on the test subject (p < 0.0001).
Conclusions: The surgeon's posture does not influence spatial accuracy. To improve spatial accuracy during microsurgical manipulations, hand support should be used.
Optional Image
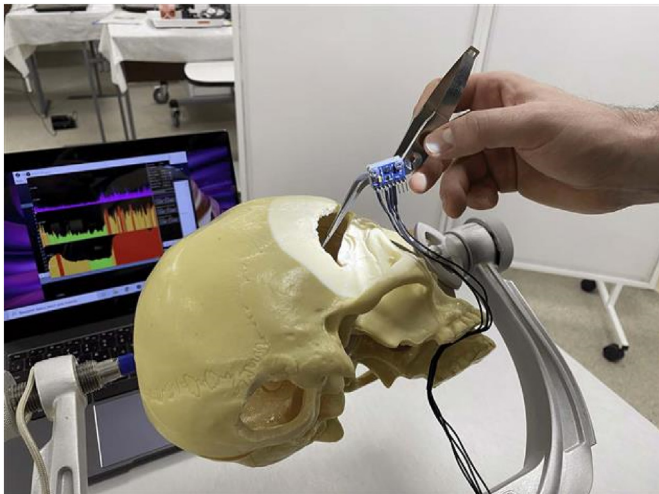
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COMPARISON BETWEEN AUGMENTED REALITY-BASED AND EX-CATHEDRA LECTURES: CAN WE IMPROVE THE EDUCATION OF NEUROANATOMY WITH THE USE OF NOVEL TECHNOLOGIES?

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The Ethics of Waiting lists and Rationing access to care (Ethics Parallel Session), September 26, 2023, 4:50 PM - 6:20 PM
Background: Neuroanatomy comprehension is a keystone for anyone aiming to understand intracranial procedures. Traditionally taught to medical students during ex-cathedra courses, neuroanatomy is reported as complex. The development of augmented reality (AR) opened new perspectives in the learning process. This study aims to compare AR-based training with traditional ex-cathedra lectures for neuroanatomy education.
Methods: Two lectures on the anatomy of the "anterior circulation arteries (VS)" and "white matter fiber tracts (WB)" were designed for the purpose of this study and declined in an ex-cathedra and AR-based (MagicLeap®, Elements Brainlab®) forms. The ex-cathedra and AR-based lectures had the same duration. 65 medical students were randomly assigned to either: group-1 attended the ex-cathedra lecture on WB and the AR lecture on VS; group-2 attended AR lecture on WB and ex-cathedra lecture on VS. Prior to each lecture, the students took a pre-test with 10 MCQs. After the lecture, the students took a post-test with 20 MCQs (70% neuroanatomy, 30% clinical correlation).
Results: The intergroup analysis showed no significant difference between the groups regarding the pre-test scores. Concerning the VS lecture, the post-test score showed 17.7% increase with the use of AR compared to the ex-cathedra form (respectively, mean 13.2 (sd= 2.4); mean 11.2 (sd= 2.8) (p= 0.003)). No significant difference was observed for the WB lecture (AR mean 17.4 (sd= 1.8); ex-cathedra mean 17.2 (sd= 1.4) (p= 0.3).
A posteriori, 98.5% of the students showed a high motivation to learn neuroanatomy with the use of AR against 33.8% during ex-cathedra lectures (p<0.001).
Conclusions: This study showed an increased performance regarding the learning of anterior circulation arteries anatomy with the use of AR. AR added no benefit in the learning process of white fiber tracts anatomy. New development of AR-goggles is needed to improve the neuroanatomy education. This is an ongoing study.
Optional Image

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REVISITING NEUROSURGICAL PRACTICE UNDER EARTHQUAKE-LIKE NATURAL DISASTERS

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