Scalable and objective tool for benchmarking and education of robotic procedures in cardiovascular surgery.

Intro: The Medical Robotic System market was valued at USD 8.307 billion in 2020 and is expected to reach USD 28.34 billion by 2026. Despite the advantages of surgical robotics in several areas and immerse growth, the vascular and microvascular field is a bit underrepresented. Microvascular sutures are highly sensitive with extraordinary dimensions of haptic, visual information. Novel trends and development have appeared with promising results for vascular surgical procedures, but the spreading of these applications is hindered by two different reasons: 1) robotic procedures of vascular anastomoses, sutures need clear and objective benchmarking (potentially with a demonstration of clinical relevance); 2) The education for operating of devices needs to rely on standards ensuring reliable and effective surgical progress.
Youranastomosis project is for providing effective training in cardiovascular surgery. With data-driven, deconstructed educational methods a cost and time-effective way of cardiovascular surgical training is ensured. Youranastomosis provides replication of physically created anastomoses, sutures and highlights how clinically relevant alterations, pitfalls can be improved. Here a scalable solution is applied for achieving continuous functional (computational simulation of blood flow) and morphological evaluation of vascular anastomoses. Based on an immense amount of data benchmarking of procedures, devices can be performed.

Scope: Youranastomosis method of morphological and functional assessment for vascular structures is intended for applied in the education of robotic procedures.

Results and potential advantages: In a previous study the Youranastomosis method (n=20) was investigated. Participants had the opportunity to use our high-resolution 3D virtual model with *in- silico* computational analysis of blood-flow parameters of anastomoses. It was compared to the control group received a similar course (n=20) without access to the results of morphological and functional analysis provided by our model. Formative assessment of morphological assessments and *in silico* simulations were performed. The study group showed significantly improved results of anastomosis quality to the control group.
The method could add impressive and effective results to the education of robotic procedures, serving the more stable spreading of microvascular robotic-assisted interventions. From the database of results, summative results can be also evaluated which can control the quality of one surgeon's skills and expertise in robotically assisted procedures. Moreover, it can benchmark the robotically performed anastomosis and sutures in comparison to conventional procedures.

Relation to UN SDGs: Educational method directly reflects the clinical prediction of vascular sutures. Therefore, it results in a better quality of anastomoses/sutures with better surgical outcomes as a consequence. This goal is perfectly associated with good health (SDG 3) where spreading of robotic procedures and educational / assessment tool together forms surgical procedures of more reliable and better outcomes. Quality of education (SDG 4) is also served with the highest and most up-to-date direction of education 4.0 in surgical skill training. As a long-term goal, the industrial revolution (SDG 9) is also highlighted developing autonomous algorithms for robotic procedures, where data about surgically created anastomoses is applied, and best practice scenarios are determined.