

Success Story / [Virtual implant design with simulation](#)

Transforming Maxillofacial Implant Design with Simq's Advanced Simulation

Craniotech, a specialized biomedical company, leveraged Simq's advanced simulation software to optimize the design and testing of custom maxillofacial implants. Facing challenges in ensuring mechanical strength without excessive bulk, Craniotech integrated Simq into its workflow to simulate intricate forces and refine implant designs. The collaboration resulted in streamlined implants, enhanced patient outcomes, and minimized postoperative aesthetic concerns. Simq VIT's user-friendly interface and robust performance provided comprehensive insights, significantly improving efficiency and reducing development costs. This partnership underscores the transformative impact of simulation technology in advancing patient-specific medical solutions.

The task

CranioTech's project centered on a complex maxilla reconstruction utilizing a fibular free flap, with one of their custom medical devices crucial for stabilizing the reconstruction. They integrated Simq VIT, a specialized simulation software, into their workflow to aid in the design and testing phases. Simq VIT has different workflows for the CMF area. A workflow for maxillary implants proved invaluable for simulating the complex forces that occur in the upper jaw, including bite and chewing forces. By leveraging these simulations, CranioTech aimed to refine its implant design, ultimately reducing its size while maintaining mechanical strength.

Before using Simq VIT, CranioTech faced challenges in bulking up implants for adequate strength, leading to potential post-surgery soft tissue implications. However, with Simq VIT's capabilities, they wanted to optimize designs to eliminate unnecessary bulk, thus minimizing postoperative aesthetic concerns while ensuring implant strength. The expected benefits included more streamlined implant designs, enhanced patient outcomes and reduced soft tissue implications. Through Simq's assistance, CranioTech wanted to achieve optimal implant functionality, underscoring its commitment to innovation and patient-centric care.



Fig. 1: A 3D-printed anatomical model of a maxilla showcasing a custom-designed metal implant for maxilla reconstruction. The implant, precisely fitted to the anatomical structure, demonstrates the advanced design capabilities facilitated by Simq's simulation software.



"Simq VIT is a must. It has completely changed the validation of the design of custom-made devices."

Sven Delpert
Chief Operating Officer

The solution

CranioTech chose to incorporate Simq VIT for their project due to its specialized focus on custom implants and its user-friendly interface, which allowed them to upload anatomical STL files directly. Unlike other solutions, Simq VIT was optimized specifically for simulating forces relevant to their maxillofacial implant application, making it the ideal choice for their needs.

To set up the project, CranioTech first uploaded anatomical models together with implants and screws into the Simq VIT software. The project workflow revolved around simulating bite forces to test implant strength. They utilized Simq's algorithm to run simulations, specifically focusing on the maxilla implant project case provided by the software. Despite the challenge of minimal maxilla teeth available for force simulation, the Simq team's support proved invaluable. They worked closely with CranioTech to model the case accurately, overcoming this hurdle through their expertise and responsiveness.

Their dedication ensured the success of the simulation, highlighting the importance of effective collaboration in addressing project challenges. Ultimately, Simq's software and team support enabled CranioTech to navigate complexities efficiently, advancing toward its goal of optimizing implant solutions for patient care.

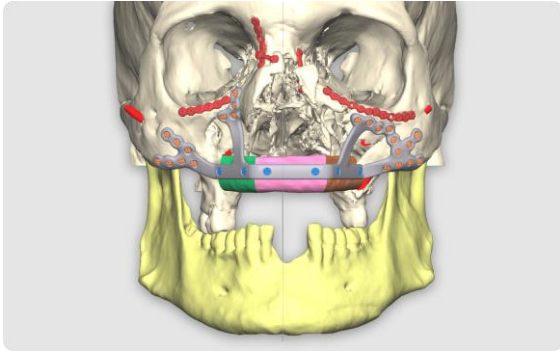


Fig. 2: A detailed CAD rendering of a maxilla reconstruction featuring a custom-designed implant. This visualization shows the implant's precise fit and secure attachment to the patient's unique anatomy, including the use of screws and the integration with the jawbone. The color-coded sections indicate various components and their assembly within the structure. This image highlights the advanced design and simulation capabilities used to ensure the implant's optimal performance and durability, crucial for achieving successful surgical outcomes and enhancing patient care.

The result

Simq VIT performed exceptionally well, providing comprehensive results essential for Craniotech's implant assessment. They only needed to run one simulation, which lasted approximately 3 hours, delivering all the necessary data for their evaluation. Simq's efficiency significantly streamlined their workflow, eliminating the need for multiple simulations and intricate constraint specifications. The software's optimization for anatomical applications facilitated a seamless process, allowing them to focus solely on analyzing the results. The results included material limits, deformations during force loading, stresses, and strains throughout the implant and bone, presented in maximum principal stresses and equivalent Von Mises stresses. This thorough insight enabled Craniotech to assess the patient's suitability of the implant accurately. Their overall impression of working with Simq was highly positive; its user-friendly interface and robust performance exceeded their expectations. While it's challenging to attribute a specific ROI, the time and resource savings, coupled with the precision of results, undoubtedly contributed to their projects' overall efficiency and success, emphasizing the value of Simq in their endeavors.

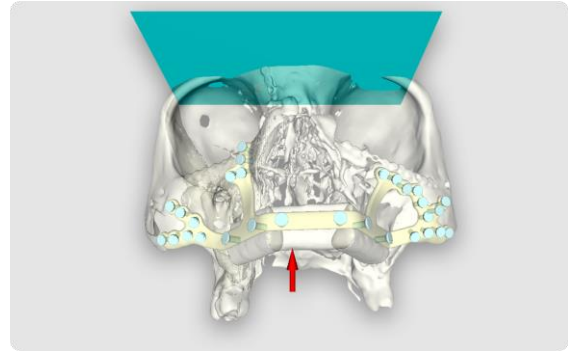


Fig. 3: A digital simulation of a maxilla showcasing a custom implant design within Simq's software. The simulation illustrates the implant's positioning and attachment points, as well as the forces acting on it, indicated by the red arrow. This visualization highlights the detailed biomechanical analysis and optimization capabilities provided by Simq for patient-specific implant designs.

Next Steps

Since adopting Simq VIT, Craniotech has witnessed significant benefits and positive changes within their company. Firstly, it serves as a critical quality assurance step, instilling confidence in both their team and the surgeons they collaborate with regarding the capabilities of their implants. This assurance translates into shortened development times, decreased costs, and improved efficiency, as they can confidently proceed with designs backed by robust simulation data. Moreover, Simq VIT has enabled them to reduce the number of physical prototypes required, saving time and resources while enhancing the overall development process. Moving forward, Craniotech plans to continue incorporating Simq VIT into its development workflow in the same manner as before, leveraging its applicability to every unique case they encounter. This steadfast integration ensures consistent quality assurance and confidence in their implant designs. As for the next steps in product/system development, they aim to refine further and optimize their implants, utilizing Simq VIT's capabilities to iteratively improve designs and meet the evolving needs of surgeons and patients. Additionally, they will continue exploring advancements in simulation technology to enhance their development process and maintain their position at the forefront of biomedical innovation.

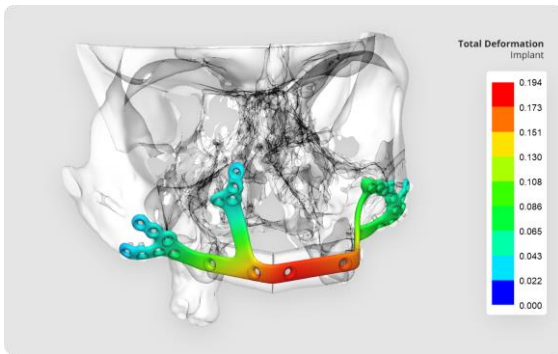


Fig. 4: A biomechanical simulation displaying the total deformation distribution on a custom maxilla implant. The color-coded scale indicates deformation levels, with red representing the highest deformation and blue the lowest. This detailed analysis, conducted using Simq's advanced simulation software, provides essential insights into the implant's deformation under load, enabling optimization of its design for durability and effectiveness, thereby ensuring the best possible outcomes for patient-specific applications.

Your contact



Dipl.-Ing. Alexander Volf
CTO

+49 8092 7005 16
avolf@simq.de

About Craniotech

Craniotech is a specialized biomedical company dedicated to crafting custom medical devices tailored to the unique needs of patients. With a team of 5 to 10 dedicated professionals, they operate at the intersection of innovation and precision in the biomedical industry. Their primary focus lies in serving neuro, maxillofacial, and orthopedic surgeons, providing meticulously designed implants that enhance patient outcomes and improve quality of life. From addressing complex bone fractures to reconstructing facial structures, their bespoke solutions cater to the diverse needs of their discerning clientele, ensuring optimal functionality and patient satisfaction.

About Simq

The company was founded in 2014 and is part of the CADFEM Group. Simq's products and services enable medical device manufacturers, clinicians and medical staff to practically apply numerical simulation and use it for more effective and safer patient care.

Simq is committed to the standardization and broader application of in silico medicine as part of the Avicenna Alliance, thereby ensuring safe, affordable and cost-effective healthcare.



Simq is a certified simulation service provider and software manufacturer in the field of medicine and medical technology and is one of the pioneers of in silico medicine.