

Apply It.

The math behind...

Facial Reconstructive Surgery



Some Technical terms used:

Partial differential equations, elastomechanics, fluid dynamics, virtual patient, virtual lab.

Uses and applications:

Facial reconstructive surgery is used for correction of bony structures of the skull with the aim of both functional and aesthetic reconstruction.

How it works:

Mathematics plays a crucial role in planning of facial reconstructive surgeries. Its most important tools are the software environments within which patient specific geometric models are integrated with partial differential equations for elastomechanics (pertaining to the mechanical properties of elastic materials), fluid dynamics, or diffusion as well as with fast algorithms for their numerical solution and visualization.

The process involves the following three steps: (a) Generation of a “virtual patient” from data of a real patient, (b) mathematical therapy and operation planning in a “virtual lab”, (c) transfer of the results back to the situation of the real patient. The first step requires the construction of a sufficiently accurate 3D computer model of the patient from medical imaging data. The second step contains the fast numerical solution of partial differential equations over realistic body geometry of the individual patient. The third step comprises techniques for an exact implementation of the planning. All the steps have the importance of an efficient 3D visualization in common.

Apart from improved operation preparation, this kind of computer assisted operation planning leads to improved patient information and thus leads to a higher patient motivation.

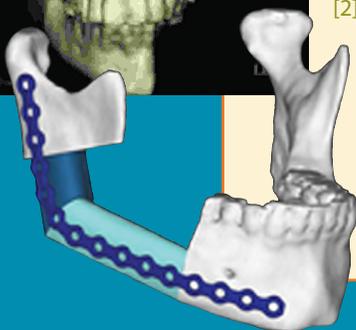
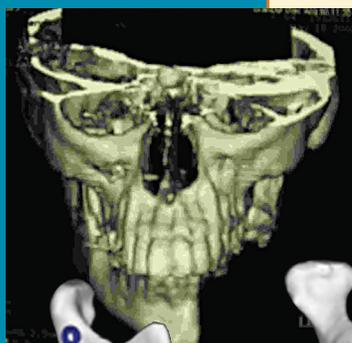
Interesting facts:

Nadia Ilse, a 14-year-old girl from Georgia, USA underwent radical facial surgery in the summer of 2012, after years of relentless teasing about her looks. She was born with bilateral lop-eared deformities on both ears, a condition where the person is missing the folds within the ear and the bowl of the ear sticks out. On her first day of ninth grade, Nadia was all smiles as she wore her hair up, showing her ears for the first time in years.

References:

[1] P. Deuffhard, M. Weiser, and S. Zachow. “Mathematics in Facial Surgery.” *Notices of the AMS* 53, no. 9 (2006): 1012–1016.

[2] Golodryga and M. Frost. “Bullied Teen Who Got Facial Plastic Surgery Ready to Forgive Tormentors, But Won't Forget”, <http://abcnews.go.co>



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