Multimodal virtual model for computer-assisted complex reconstruction of the midfacial deformities

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Severe aacquired and congenital midfacial deformities often result in disfiguration and present, even nowadays, a great challenge in CMF surgery. The technique of computer-assisted surgery advances the difficult surgical field of midfacial reconstruction with or without involvement of the orbit, particularly through a greater exploitation of radiologic information without additional radiation to the patient.
Common interest of patient and surgeon is a treatment plan [1] which allows for initial patient's education and pre-operative planning, just as well for intra-operative check-up and post-operative quality control.
Aim of the application is to optimize an ad hoc workflow, even for the use in urgent trauma, using multimodal imaging and 3D shape analysis tools to improve surgical outcome and patient satisfaction. Part of the existing workflow is the acquisition and combination of 3D data (CT, MRI, CBCT scan) and their use for pre-operative planning and intra-operative control.
Improvement of computer-assisted techniques has led to the standard use of 3D-modells of virtual templates for several years [2-9]. It has been shown that the clinical outcome in midfacial deformities especially of orbital corrections could be improved by using Computer-assisted surgery in both primary and secondary reconstructions [10]. One way to create a virtual model is the mirroring techniques [3] in unilateral defects.
There is an urgent need for an advanced virtual model for planning and for the intra-operative use which provides support in patients with fractures or deformities exceeding the midline. This is why in principle two innovative approaches are pursued: building a deformable virtual model by using a "normalized midface" either based on cephalometric data or based on a statistically averaged midface (individual cephalometry assisted deformable model**)** and reassembling of fragments by the "3D-puzzle method". For post-operative quality control the volume data set is combined with a superimposed soft tissue and surface model [11-16].
The initial phase is to gather suitable 3D data sets for the normalized midface model and to develop a valid autofusion to merge different 3D data such as CT, CBCT scan together with surface information (3D stereophotogrammetry). After set up of the "*statistical midface model*" and "*3D-Puzzle-model*", both methods are validated using existing virtual models in unilateral deformities. Then, the created multimodal virtual model is implemented into the clinical workflow.

The aim of this grant application is to build up a 3D multimodal virtual model, which is based on the the currently best bony information and combined with the currently best surface view including colour and texture for pre-operative planning, intra- and post-operative quality control as well as for education and training.