

Rapid prototyped individual orbital wall implant**Process description of individual orbital wall reconstruction using 3-D CAD – Rapid prototyping (RP) techniques****Kontio R / Westermarck A / Suomalainen A****Helsinki University Hospital (Finland)****Project #: C-10-1K**

Individual or customized orbital wall/ floor implants are required to repair severe orbital wall fractures or to correct traumatic orbital deformities i.e. secondary reconstruction. The purpose of the project is to develop the medico - industrial process to manufacture such individual orbital wall/ floor implants. Because orbital wall fracture is a defect fracture, the fractured wall should be reconstructed using implant. Numerous implants are available with different shapes and with different materials. However, several problems exist. The exact positioning of the implant is difficult. It is also difficult to estimate the shape and thickness of the implant in order to restore the original volume of orbital cavity.

One of the promising methods to solve this dilemma is to apply 3-D CAD (computed assisted design) technique integrated to RP (rapid prototyping). The technique allows the user to design and manufacture an implant with accurate shape and dimensions. The 3-D CAD RP process can be divided into four stages:

- 1) Image of the orbit is created using either spiral or cone beam CT
- 2) CT data is then converted into 3-D CAD software to develop a 3-D digital model.
- 3) 3D digital implant is designed onto digital model of patient's orbit
- 4) Precise and equivalent solid implant out of the -3D digital implant is manufactured using RP technique.

The shape, dimensions, volume of the implant and especially model – implant contact surfaces can be determined accurately at 3-D CAD stage using volumetric design and space orientated calculation. RPI (rapid prototyped implant) based on the 3-D digital model fits accurately onto the orbital walls and allows accurate reconstruction.

Up to now three patients have undergone orbital wall defect repair using 3-D CAD designed RPI. A clinical project will be launched in order to develop and document medico - industrial process for manufacturing individual RPI to repair bony orbital injury or deformity. Ten patients with traumatic orbital wall fracture or traumatic orbital deformity will be operated on using 3-D CAD RPI technique. The study will be a joint venture between Helsinki University Hospital and Karolinska University Hospital. For future inclusion of tissue engineering and bioactive substances in this field, we include researches from Regaea Institute for Regenerative Medicine at Tampere University in this project. The testing of industrial part of medico-industrial process will be carried out by one engineer at Planmeca Oy, Helsinki.