

# Successful implant surgery through virtual planning

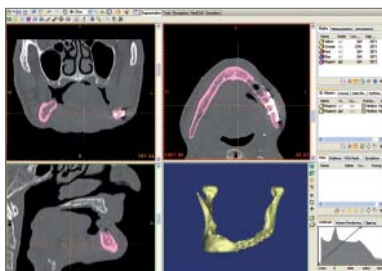
Materialise enables optimal jaw surgery preparation and implant design

By Ing. M.M.A. Beerens<sup>1</sup>, Ing. P. Laeven<sup>1</sup>, Drs. J. Poukens<sup>2</sup>



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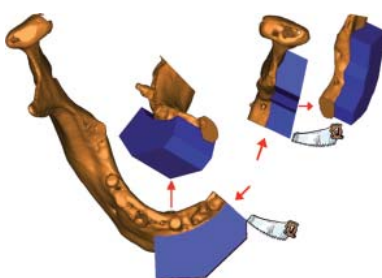
A man who suffered from an infection of his conventional jaw implant is smiling again. He received a new, custom-fit implant that could be designed by using Mimics and 3-matic software. Within the framework of a European Integrated Project called Custom-Fit<sup>3</sup>, Dr. Jules Poukens performed the case study at the University Hospital of Maastricht, the Netherlands, with the assistance of IDEE<sup>4</sup> (University of Maastricht). This case clearly illustrates that it is possible to use additive manufacturing technology for the design and insertion of implants. Additive manufacturing technology enables faster, more accurate, better planned implant surgeries than is possible with conventional techniques.



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## Making a detailed diagnosis

The patient's conventional jaw implant had become infected. Starting with CT-images of his mandibula, Materialise's 3D image processing software Mimics extracted a surface model of the bone defect, which clearly displayed the extent of the infection.



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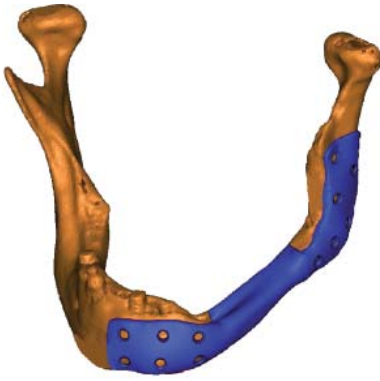
## Planning, simulating and optimizing surgical procedures

The combination of the CT-images and surface model of the defect can be used for other purposes besides diagnosis. Because these images give a clear picture of the complete patient anatomy, they can help the surgeon predict challenges he will meet during surgery. The insights and knowledge he gains enable him to forecast an optimal procedure for cutting the mandibula. Another solution lies in patient-specific, intra-operative guidance systems, developed and patented by Materialise, that accurately transfer the treatment plan to the patient at the time of surgery. In this case, the surface model was used to design two cutting guides that fit the mandibula exactly.

## Designing a custom-fit implant

Conventional implants are made of relatively flexible material, which means that they can be shaped and reshaped to fit during surgery. This shaping process can take a lot of time in the operating room. Thanks to Mimics and 3-matic software, a custom implant can be designed in advance, thus reducing the length of the surgery. The design of a custom implant involves the incorporation of scanned data. Since anatomical data are extremely complex and organic in shape, it is very difficult to develop a model from them with conventional CAD-systems. With Mimics, on the other hand, it takes only minutes to transform scanned data into a complete 3D computer model.

- 1 The infected patient
- 2 CT scan of the mandibula and generated 3D model (using Mimics)
- 3 Cutting guides design based on virtual planning (using 3-matic)



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Conventional CAD systems usually can import files that result from scanning. In order to perform operations on such data, the user must first put them through the lengthy, difficult process of reverse engineering. 3-matic software completely eliminates the reverse engineering step, allowing the user to work directly on the scanned data. Tests showed that **designing a jaw implant with a conventional CAD system took three times longer than designing it in 3-matic.**

In this case, IDEE used 3-matic software to design the jaw implant. Because of the considerable time span between the moment when the patient was scanned and his actual surgery, the odds were that the infection in the bone would have spread. To compensate, the designer added extra large flanges for any additional bone that might need to be removed.

A further advantage of working with 3-matic is the **ability to combine organic, scanned shapes together with engineering components** (such as fixtures). For example, when designing this jaw implant, the designer could quickly create the holes to fix the implant onto the existing bone with conventional titanium screws.

## Planning translated into precision surgery

Next, the implant design was produced through conventional milling, while the cutting guides and a 3D model of the jaw were made in ABS by fused deposition modeling. The team used this model to practice the surgery.

During surgery, the surgeon used the different cutting guides to cut the patient's jaw easily. **He was thus able to translate the treatment plan to the operating theatre with maximal accuracy.** Next, the implant was screwed onto the existing bone using conventional titanium screws. The custom-designed implant turned out to be an absolutely perfect fit.

The combination of virtual planning, the patient model and the cutting guides substantially enhanced the surgical intervention's precision, efficiency and simplicity. Thanks to the skill of the surgeon (Drs. Jules Poukens), this patient has a life again.

1 Custom Made Implant Designer IDEE 2 Cranio Maxillo Facial Surgeon University Hospital of Maastricht 3 A knowledge-based manufacturing system, established by integrating Rapid Manufacturing, IST and Material Science to improve the Quality of Life of European Citizens through Custom-Fit Products. [www.custom-fit.org](http://www.custom-fit.org) 4 IDEE (Instrument Development Engineering & Evaluation) is the engineering department of the University of Maastricht (UM). It provides services to the Faculty of Health, Medicine & Life Sciences (FHML) as well as the University Hospital of Maastricht (azM). IDEE develops innovative and unique medical and research devices that are not available commercially. [www.id.unimaas.nl](http://www.id.unimaas.nl)

- 4 The designed implant (using 3-matic)
- 5 The milled jaw implant on the ABS jaw model
- 6 The implant surgery



## Why choose Materialise software for implant design and surgical planning?

Using Mimics and 3-matic software enables you to:

- Save time by working directly on the scanned data
- Ensure a perfect fit by incorporating the anatomical geometry in the design
- Facilitate medical diagnostics
- Virtually simulate surgeries on patient data with the highest possible accuracy
- Optimize surgical procedures and manufacture custom implants before entering the operating room
- Improve the surgical outcome
- Reduce surgery time
- Increase patient comfort

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[medical@materialise.com](mailto:medical@materialise.com) or [www.materialise.com/BiomedicalResearch](http://www.materialise.com/BiomedicalResearch)

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