



Facts

Challenge

Design and construct a precision-fitting, lightweight, yet stable hip implant in a short period of time.

Solution

Manufacture of a lightweight titanium implant made with the EOSINT M 280 and integrated into the cavity.

Results

- Fast: Short planning and production times for an imminent operation
- Light: Minimum weight for minimal patient limitations
- Precise: Exact fit for the best possible alignment to the skeleton



The titanium implant has a large number of cavities. These weight-reducing recesses in otherwise solid parts can only be achieved through Additive Manufacturing (courtesy of EOS GmbH).

Help Is Fast at Hand Thanks to Additive Manufacturing: Alphaform Produces a Hip Replacement Designed by Instrumentaria



e-Manufacturing Solutions

15-Year-Old Cancer Patient Receives the Perfect Implant and Renewed Hope for the Future

Short Profile

Alphaform AG is a professional and innovative development and production partner for 3D printing technology, in particular for the manufacture of small production runs and niche products, but also covering small series using rapid prototyping or injection moulding technologies.

Instrumentaria Co., J.S.C. is a Croatian manufacturer of medical instruments. The company is over 115 years old and has 50 employees. Instrumentaria exports its products to Southeastern Europe and, besides manufacturing also offers both development and process services.

Further Information

www.alphaform.de

www.instrumentaria.hr

For anyone affected by it, a cancer diagnosis always comes as a shock: In the case of a boy from Croatia this was particularly true as an aggressive form of bone cancer had destroyed the teenager's hip. The only option for the doctors treating him was a complete reconstruction of the hip bone. Once again, the 3D printing experts at Alphaform, a company with extensive experience in the medical sector, placed its trust in EOS' technology to successfully produce the implant.

Challenge

A primary bone tumor (meaning one not formed by metastasis) is a cancer lying directly on the bone – a serious illness. The malignancies generally grow destructively, meaning that the original tissue must be removed. This was the case with a 15-year-old patient from Croatia. A complete arthroplasty of the hip was the fundamental prerequisite for ensuring the cancer cells did not continue to spread in the boy's body. An intervention of this type limits the mobility of the joint,



This artificial hip together with the integrated joint replaces all of the bone affected by cancer. The illness of the 15-year-old boy spread quickly, so the implant had to be available as fast as possible (courtesy of Instrumentaria).

and thus the mobility of the patient. Particularly in young people it is important to find solutions that limit, or even prevent, any negative consequences further down the line.

With a precision implant, a patient's motor skills can largely remain unaffected in the future. In the hip area, the precise shaping of the replacement bone is particularly important. The femoral neck functions as the central joint for the leg and is thereby fundamental to walking and running. It requires a perfect connection to the body in order to function correctly. What is important is not so much the fit of the hip bone in the joint. Rather, the complete artificial hip should correspond as precisely as possible to the original so that the entire positioning and all of the angles match one another again.

The manufacture of such an implant is of course no simple undertaking. However, the cancer in the body of the boy was a

powerful adversary. In addition to its pure destructive force, the illness was also causing the doctors concern because of the speed with which it was spreading – time was of the essence.

Furthermore, the new implant had to meet the doctors' weight specifications. Lightweight, precision, fast – these were the three requirements the Croatian surgical team brought to Alphaform with their request for a corresponding metal bone part.

Solution

The German Additive Manufacturing expert has made a name for itself in the production of implants. It utilises a process whereby a powdered material is hardened with a laser, layer by layer, to create artificial bone parts. Having studied the available information it was quickly established that the boy could be helped. According to Christoph Erhardt, Director of Additive Manufacturing at Alphaform AG, "The design process was a real challenge. We received the complete 3D data including the cavities from Instrumentaria. Based

on this we were able to start with the precise manufacture of the implant."

This is where the advantages of EOS' innovative production processes came into full effect. In order to keep the weight of the artificial hip to a minimum, Instrumentaria built in a large number of cavities. Such recesses in otherwise solid parts can only be achieved through Additive Manufacturing. Precision casting or conventional milling cannot achieve such a complex shape. The challenge with the integration of the empty spaces was to find the correct mix of stability and weight reduction because the implant also needed to withstand a high degree of physical stress.

Within one week the component was produced with the EOSINT M 280 using a stable yet light titanium alloy. The process, from the initial computer sketches to the final implant, took only six weeks. This period included the sophisticated finishing of the artificial bone. "We were making something that would be placed inside a human body. Even the slightest contamination, residues, or unevenness could have catastrophic consequences", explains Erhardt. The

high level of experience of the 3D service provider also had a positive effect here. The cleaned implant fulfilled the highest medical requirements and arrived in Croatia within an impressively short time.

Results

To the delight of everyone involved, the subsequent operation in May 2014 was a great success. First the team of doctors completely removed all of the parts affected by the cancer and then, the new artificial hip was inserted, complete with the integrated joint. What's more, a part of the young patient's thigh was replaced so that both joint parts fit within one another perfectly. The precision, light-weight implant fulfilled all of the medical requirements and the foundation was laid for the patient's successful recovery.

Besides the short duration of the planning and construction, the finishing process, which was developed by Alphaform and has subsequently proven its value on many occasions, was a further component of the overall success. Amongst other factors, the multi-step cleaning process facilitates the utilisation of the part for medical applications. It also guarantees over the long term

that the body and the implant harmonise with one another. In addition, depending on the growth rate of the young patient, it will also be possible to replace, the hip with a larger one in a relatively simple procedure.

Atif Cakor is R&D Design Manager for Custom Implants at Instrumentaria and had a leading role in the joint project. He underlines the importance of Additive Manufacturing in the medical sector: "The team that carried out the operation with Prof. Dr. Robert Kolundžić and Dr. sc. Srećko Sabalić did a fantastic job. Together with the knowledge of the doctors it was the high quality of the implant that served as a guarantee for the enduring success of the procedure. The fact that these advantages do not come at an exorbitant cost is better still. The signs are that this technology will go on to help many more patients in the future."

"We have not only contributed to saving the life of a 15-year-old boy, but also to making his life significantly more pleasant – what more could you hope to say about the advantages of an innovative solution? Both the Additive Manufacturing and the finishing have proven to be a great success. We are all very happy that the operation went well. It is a prime example of the way in which EOS technology can help people."

Christoph Erhardt, Director, Additive Manufacturing at Alphaform AG

"In recent years we have been able to gain a great deal of knowledge and experience in the area of custom implants. Each new patient benefits from this expertise. The technical foundation is provided by Additive Manufacturing. It has been important that technology pioneers such as EOS were able to establish metal-based processes in this field. The result of their innovation is that we are able to offer people consistently better implants."

Atif Cakor, R&D Design Manager for Custom Implants at Instrumentaria Co., J.S.C.

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