Personalized Medicine with Patient Specific Implants

D.C. (David) Koper, MD, DMD
Resident Oral & Maxillofacial Surgery
Customised Implants in 48h.

SME Supply Chain Integration for Enhanced Fully Customisable Medical Implants, using New Biomaterials and Rapid Manufacturing Technologies, to Enhance the Quality of Life of EU citizens.

3D Bioprinting Conference - 19th June 2014
<table>
<thead>
<tr>
<th>Goal</th>
<th>Anatomical model</th>
<th>Implantable product</th>
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<tbody>
<tr>
<td>Data acquisition</td>
<td>CT scan ✓</td>
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<tr>
<td>Data processing</td>
<td>Software ✓</td>
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<td>Design</td>
<td>Software ✓</td>
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<td>Production</td>
<td>Printer ✓</td>
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<td></td>
<td>Material ✓</td>
<td>Material ±</td>
</tr>
<tr>
<td>End use</td>
<td>Model surgery</td>
<td>Implant surgery</td>
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</table>
Cranioplasty
Cranioplasty

Cranio-facial surgery

Trauma

Cancer
Cranioplasty - trauma

Skull involvement in craniofacial injuries: 30 - 70%

Skull fractures in cranio-cerebral injuries: 11 - 20%

Reconstructive skull surgery needed: 1.5%

Cranioplasty - primary reconstruction
Cranioplasty - secondary reconstruction
Cranioplasty - secondary reconstruction
Cranioplasty - a little history

Fallopious (±1550):

First cranioplasty; gold

Job Janszoon van Meekerent (1668):

First bone graft; dog skull

Cranioplasty - today

Material

Titanium alloys

PEEK
Implant

Surgical model
The perfect biomaterial
The perfect biomaterial

1. Strong
2. Lightweight
3. 3D printable
4. Nonconductive
5. Bioactive
6. Radiolucent
7. Nonmagnetic
8. Sterilizable
9. Easy to use
10. Aesthetically pleasing
11. Readily available
12. Affordable

1. Strong

Mechanical stress model:

PEEK and Titanium alloys stronger than human bone

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# The perfect biomaterial

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5. Bioactive

Inert

PEEK

Osteoinductive

Titanium alloys

Ideal response

Gradual resorption and replacement by own bone
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Material

Ease of handling in 3D printing

End product

Perfect fit and easy fixation

Less OR time

Predictable outcome
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Current research
Current research

Hybrid concept

PEEK mesh filled w/ resorbable polymer

Pilot animal study: Göttingen minipigs
Future research

Optimizing

Design, surface texture, coating, ...

Biologizing

Resorbable scaffold material, seeding w/ stem cells, ...
Goal

3D printed implants used to activate and guide bone regeneration, not used as permanent end products
Offer

End user

Offering translational research in CMF surgery

Looking for partners from fundamental research
David Koper

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